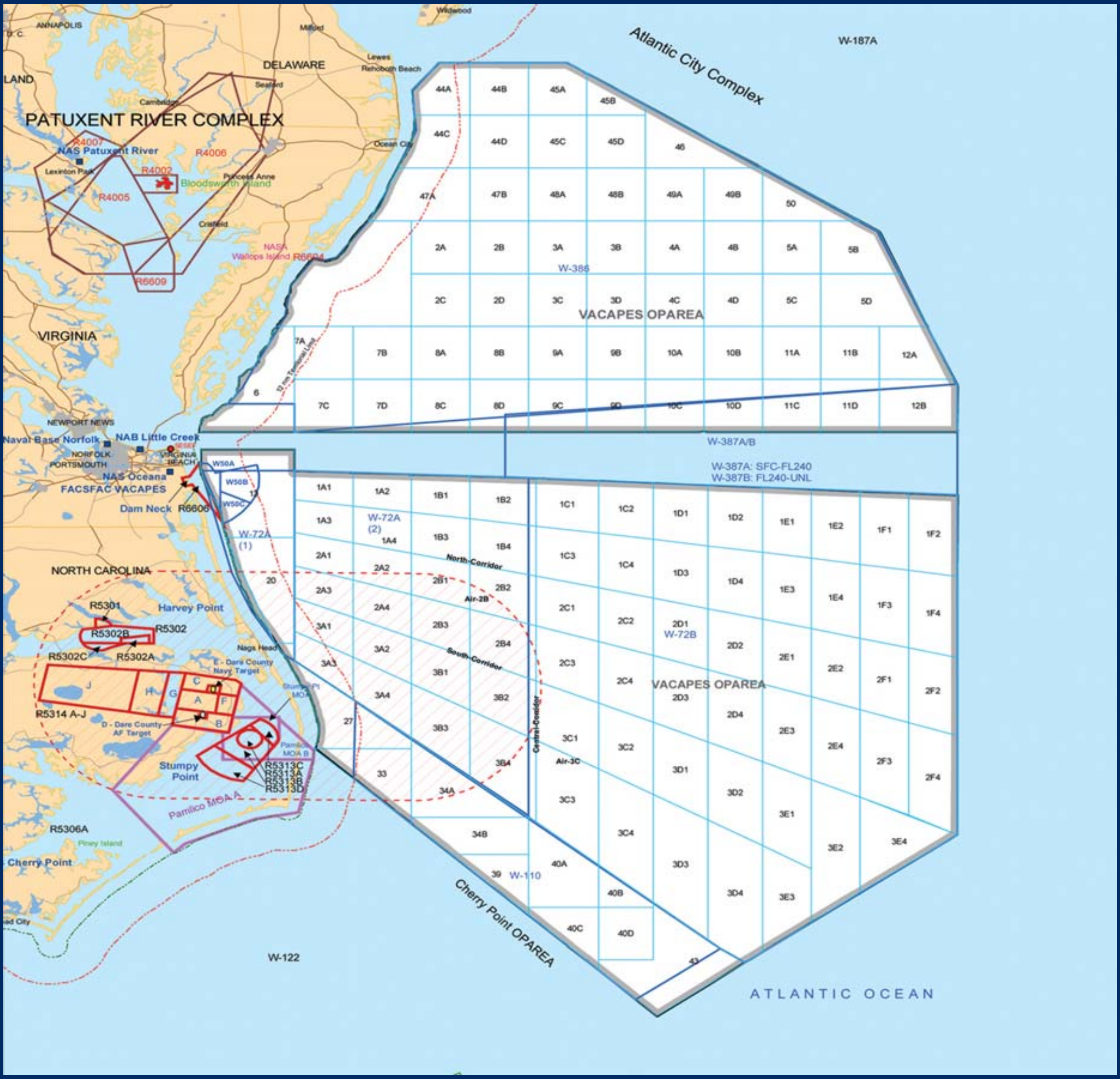
Virginia Capes Range Complex Final Environmental Impact Statement/ Overseas Environmental Impact Statement (EIS/OEIS) Volume 1



Prepared by:

United States Fleet Forces

March 2009

VACAPES RANGE COMPLEX
FINAL ENVIRONMENTAL IMPACT STATEMENT/ OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

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Abstract:

The Department of the Navy has prepared this Final Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) to assess the potential environmental impacts over a 10-year planning horizon associated with Navy Atlantic Fleet training, research, development, testing, and evaluation activities, and associated range capabilities enhancements (including infrastructure improvements) in the Virginia Capes (VACAPES) Range Complex. The EIS/OEIS Study Area includes the VACAPES Operating Area and Warning Areas as well as portions of the lower Chesapeake Bay. The potential effects to physical, biological, and man-made environments from the testing and training alternatives were studied to determine how the proposed action could affect these resources. The National Marine Fisheries Service is a Cooperating Agency for this EIS/OEIS.

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LIST OF ACRONYMS AND ABBREVIATIONS

A-A	Air-to-Air
AAMEX	Air-to-Air Missile Exercise
AAW	Anti-Air Warfare
ACM	Air Combat Maneuver
ADC	Acoustic Device Countermeasure
AIC	Air Intercept Control
ACHP	Advisory Council on Historic Preservation
ACM	Air Combat Maneuvering
AFAST	Atlantic Fleet Active Sonar Training
AFECC	Atlantic Fleet Exercise Coordination Center
AGL	Above Ground Level
AIC	Air Intercept Control
ALMDS	Airborne Laser Mine Detection System
Al_2O_3	Aluminum Oxide
AMCM	Airborne Mine Countermeasure
AMNS	Airborne Mine Neutralization System
AMRAAM	Advanced Medium-Range Air- to-Air Missile
AMW	Amphibious Warfare
APNEP	Albemarle-Pamlico National Estuary Program
APPS	Act to Prevent Pollution from Ships
AQCR	Air Quality Control Region
AQM	Air-Launched Drone Missile Target
APE	Area of Potential Effect
AR	Atlantic Route
ARPA	Archaeological Resources Protection Act
ARTCC	Air Route Traffic Control Center
A-SEL	A-weighted SEL
ASMFC	Atlantic States Marine Fisheries Commission
ASROC	Rocket-Assisted Anti-Submarine Torpedo
ASTAC	Anti-Submarine Tactical Air Controller
ASTM	American Society for Testing and Materials
ASUW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
ATC	Air Traffic Control
AUE	Association of Underwater Explorers
AW	Air Warfare
BA	Biological Assessment
BAMS	Broad Area Maritime Surveillance
BDA	Battle Damage Assessment
BDU	Bomb Dummy Unit
BE	Biological Evaluation
BFM	Basic Fighter Maneuvers
BMP	Best Management Practice
BO	Biological Opinion
BOMBEX	Bombing Exercise
BQM	Air- or Surface-Launched Drone Missile Target
BRAC	Base Realignment and Closure
BUD	Basic Underwater Demolition
C2W	Command and Control Warfare
CAA	Clean Air Act
CAMA	Coastal Area Management Act
CAS	Commercial Air Services OR Chemical Abstract System
CATEX	Categorical Exclusion
CBFEAP	Chesapeake Bay Fisheries Ecosystem Advisory Panel
CBP	Chesapeake Bay Program
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFFC	Commander, United States Navy Fleet Forces Command
CFR	*Code of Federal Regulations*
CG	Cruiser
CH_4	Methane
CHAFFEX	Chaff Exercise
CFMETR	Canadian Forces Maritime Experimental and Test Ranges
CHRIMP	Consolidated Hazardous Materials Reutilization and Inventory Management Program
CINCLANTFLT	Commander, in Chief, U.S. Atlantic Fleet
CIWS	Close-In Weapon System
CNA	Center for Naval Analysis
CNIC	Commander Naval Installations Command
CNO	Chief of Naval Operations
CO	Commanding Officer or Carbon Monoxide
CO_2	Carbon Dioxide
COMAR	Code of Maryland Regulations
COMNAVREG SE	Commander, Navy Region Southeast
COMPTUEX	Composite Training Unit Exercise
CAN	Center for Naval Analysis
CNO	Chief of Naval Operations
CRC	Coastal Resources Commission
CSAR	Combat Search and Rescue
CSG	Carrier Strike Group
CTR	Chesapeake Test Range
CVN	Nuclear Aircraft Carrier
CVW	Carrier Airwing
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DAWM	Division of Air and Waste Management
dBA	Decibel(s) (A-weighted)
dd	Distance Doubled
DDG	Guided Missile Destroyer
DE	Delaware
DENR	Department of Environment and Natural Resources (NC)
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DIN	Dissolved Inorganic Nitrogen
DIP	Dissolved Inorganic Phosphorus

DLQ	Deck Landing Qualifications
DNB	Dinitrotoluene
DNL	Day-Night Average Sound Level
DNREC	Delaware Department of Natural Resources and Environmental Control
DNT	Dinitrobenzene
DO	Dissolved Oxygen
DoD	Department of Defense
DoN	Department of the Navy
DTE	Detect-to-Engage
DVD	Digital Versatile Disk
DWQ	Division of Water Quality (North Carolina)
EA	Environmental Assessment
EC	Electronic Combat
EEZ	Exclusive Economic Zone
EFD	Energy Flux Density
EFH	Essential Fish Habitat
EFHA	Essential Fish Habitat Assessment
EGMTTA	Eastern Gulf of Mexico Testing and Training Areas
EIS	Environmental Impact Statement
EMATT	Expendable Mobile ASW Training Target
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
ESG	Expeditionary Strike Group
ESGEX	Expeditionary Strike Group Exercise
ESM	Electronic Support Measure
EW	Electronic Warfare
EXTORP	Exercise Torpedo
FAA	Federal Aviation Administration
FACSFAC	Fleet Area Control and Surveillance Facility
FCLP	Field Carrier Landing Practice
FCTC	Fleet Combat Training Center
FERC	Federal Energy Regulatory Commission
FFG	Guided Missile Frigate
FIP	Federal Implementation Plan
FIREX	Firing Exercise
FL	Flight Level
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
Fps	Foot (Feet) per Second
FRP	Fleet Response Plan
FRS	Fleet Replacement Squadron
FRTP	Fleet Readiness Training Plan
F-SEL	Flat-Weighted Sound Exposure Level
Ft	Foot (Feet)
FWPCA	Federal Water Pollution Control Act
FWS	Future Water Supply
FY	Fiscal Year
GMFMC	Gulf of Mexico Fishery Management Council
GPS	Global Positioning System
GUNEX	Gun Exercise
H_2	Hydrogen
H_2O	Water
HAB	Harmful Algal Bloom
HAPC	Habitat Areas of Particular Concern
HARM	High-Speed Anti-Radiation Missile
HARMEX	High-Speed Anti-Radiation Missile Exercise
HAZMINCEN	Hazardous Material Minimization Center
HCN	Hydrogen Cyanide
HE	High Explosive
HFAS	High Frequency Active Sonar
HITS	Historical Temporal Shipping
HMX	High-Melting Explosive or Octogen
HQW	High-Quality Waters
HSO_3	Hydrogen Sulfite (Bisulfite)
Hz	Hertz
IBA	Important Bird Area
ICAO	International Civil Aviation Authority
IEER	Improved Extended Echo Ranging
IEF	In Ex Fish
IFH	Improved Flex Hose
IFHA	Essential Fish Habitat Assessment
IFR	Instrument Flight Rules
IMPASS	Integrated Maritime Portable Acoustic Scoring and Simulator System
IOC	Initial Operational Capability
IRIS	Integrated Risk Information System
ISE	Independent Steaming Exercise
ISR	Intelligence, Surveillance, and Reconnaissance
ISTT	Improved Surface Tow Target
ITA	Incidental Take Authorization
ITS	Incidental Take Statement
IUSS	Integrated Undersea Surveillance System
IWC	International Whaling Commission
JFCOM	Joint Forces Command
JNTC	Joint National Training Capability
JSF	Joint Strike Fighter
JTFEX	Joint Task Force Exercise
kg	Kilogram(s)
kHz	KiloHertz
LATR	Large Area Tracking Range
lb. and lbs.	pound and pounds
LCAC	Landing Craft Air Cushion
LCM	Landing Craft Mechanized
LCS	Littoral Combat Ship
L_{dn}	Day-Night Average Sound Level (formula version)
L_{dnmr}	Onset-Rate Adjusted Monthly Day-Night Average Sound Level
L_{eq}	1-Second Averaged Equivalent Sound Level
LiBr	Lithium Bromide
LIDAR	Light Detection and Ranging
$LiSO_2$	Lithium Sulfur Dioxide
LMRS	Long-Term Mine Reconnaissance System
LNG	Liquid Natural Gas
LOA	Letter of Authorization

m^3	Cubic Meter(s)
M&S	Modeling and Simulation
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council
MAGTF	Marine Air Ground Task Force
MARPOL	International Convention for the Prevention of Pollution from Ships
MATS	Mid-Atlantic Tursiops Surveys
MBTA	Migratory Bird Treaty Act
MCM	Mine Countermeasures
MD	Maryland
MDE	Maryland Department of the Environment
MEM	Military Expended Material
MEMC	Military Expended Material Constituent
MEU	Marine Expeditionary Unit
MFAS	Multi-Function Active Sensor
µg/L	Microgram(s) per Liter
$\mu g/m^3$	Micrograms per Cubic Meter
µPa	MicroPascal(s)
mg	Milligram
mg/kg	Milligram(s) per Kilogram
mg/L	Milligram(s) per Liter
MINEX	Mining Exercise
MIO	Maritime Intercept Operation
MISSILEX	Missile Exercise
MIW	Mine Warfare
mm	Millimeter(s)
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MOA	Military Operating Area
MOUT	Military Operations on Urban Terrain
MPCD	Marine Pollution Control Device
mph	Mile(s) per Hour
MRA	Marine Resource Assessment
MS	Maritime Security Surge
MSAT	Marine Species Awareness Training
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MSR	Mobile Sea Range
MTE	Major Training Exercise
MU	Management Unit
N_2	Nitrogen
NAAQS	National Ambient Air Quality Standards
NAB	Naval Amphibious Base
NALF	Naval Auxiliary Landing Field
NAMS	National Air Monitoring Site
NARWC	North Atlantic Right Whale Consortium
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NASOCEANAINST	NAS Oceana Instruction
NAVFAC	Naval Facilities Engineering Command
Navy	U.S. Departmentof the Navy
NAWCAD	Naval Air Warfare Center, Aircraft Division
NAWQC	National Ambient Water Quality Criteria
NC	North Carolina
NCA	National Coastal Assessment
NCAC	North Carolina Administrative Code
NCBC	Naval Construction Battalion Center
NC DENR	North Carolina Department of Environment and Natural Resources
NCGS	North Carolina General Statute
NDAA	National Defense Authorization Act
NDCBR	Navy Dare County Bombing Range
NDZ	No Discharge Zone
NECC	Navy Expeditionary Combat Command
NEFMC	New England Fishery Management Council
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NEPM	Non-explosive Practice Munitions
NERR	National Estuarine Research Reserve
NEW	Net Explosive Weight
NGFS	Naval Gun Fire Support
NH_3	Ammonia
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
nm	Nautical Mile(s)
nm^2	Square Nautical Mile(s)
NMFS	National Marine Fisheries Service
NMMA	National Marine Manufacturers Association
NO_X	Nitrogen Oxides
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Agency
NODE	Navy Operating Area Density Estimate
NOI	Notice of Intent
NOTAM	Notice-to-Airmen
NOTMAR	Notice-to-Mariners
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	National Research Council
NRHP	National Register of Historic Places
NS	Naval Station
NSFS	Naval Surface Fire Support
NSW	Naval Special Warfare OR Nutrient Sensitive Waters
NSWC	Naval Surface Warfare Center
NTTL	Navy Tactical Task List
NWS	Naval Weapons Station
O_3	Ozone
OASIS	Organic and Surface Influence Sweep
OB/OD	Open Burn/Open Detonation
OCE	Officer Conducting the Exercise
OCM	Oil Content Monitor
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement

OLF	Outlying Landing Field
OMCM	Organic Mine Countermeasures
OOD	Officer of the Deck
OPA	Oil and Pollution Act
OPAREA	Operating Area
OPFOR	Opposition Force
OPNAVINST	Chief of Naval Operations Instruction
ORW	Outstanding Resource Waters
OTC	Officer in Tactical Command
P2	Pollution Prevention
Pa	Pascal(s)
PACFIRE	Pre-Action Calibration Firing
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
$PbCl_2$	Lead Chloride
$PbCO_3$	Lead Carbonate
PBI	Primary Blast Injury
$PbOH_2$	Lead Hydroxide
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit
PERSTEMPO	Personnel Tempo of Operations
PL	Public Law
pm	Particulate Matter
$PM_{2.5}$	Particulate Matter, Diameter of 2.5 Microns or Less
PM_{10}	Particulate Matter, Diameter of 10 Microns or Less
PMAR	Primary Mission Area
pna	Primary Nursery Area
POC	Point of Contact
POL	Petroleum, Oils, and Lubricants
ppb	Part(s) per Billion
ppm	Part(s) per Million
ppt	Part(s) per Thousand
PRMARs	Navy Primary Mission Areas
psf	Pound(s) per Square Foot
psi	Pound(s) per Square Inch
psu	Practical Salinity Units
PVC	Polyvinyl Chloride
PWC	Personal Watercraft
R&D	Research and Development
RAMICS	Rapid Airborne Mine Clearance System
RCD	Required Capabilities Document
RCMP	Range Complex Management Plan
RCRA	Resource Conservation and Recovery Act
RDT&E	Research, Development, Test, and Evaluation
R	Restricted
RDX	Rapid-Detonating Explosive or Cyclonite
REC	Regional Environmental Coordinator
REXTORP	Recoverable Exercise Torpedo
RF	Radio Frequency
RFF	Request for Forces
RHIB	Rigid Hull Inflatable Boat
rms	Root Mean Squared
RMS	Remote Mine-hunting System
ROD	Record of Decision
RONA	Record of Non-Applicability
RSG	Range Sustainability Group
S-A	Surface-to-Air
SAB	South Atlantic Bight
SAFMC	South Atlantic Fishery Management Council
SAR	Search and Rescue OR Stock Assessment Report
SARA	Superfund Amendments and Reauthorization Act
SAV	Submerged Aquatic Vegetation
SCP	Spill Contingency Plan
SDWA	Safe Drinking Water Act
SDZ	Surface Danger Zone
SEAC	Submarine Exercise Area Coordinator
SEAD	Suppression of Enemy Air Defenses
SEAL	Sea, Air, Land
SEL	Sound Exposure Level
SEPTAR	Seaborne Powered Target
SESEF	Shipboard Electronic Systems Evaluation Facility
SFH	Strong Flex Hose
SHPO	State Historic Preservation Office
SiO_2	Silicon Dioxide
SIP	State Implementation Plan
SINKEX	Sinking Exercise
SLA	Submerged Lands Act
SLAMS	State and Local Air Monitoring Site
SMCA	Sunken Military Craft Act
SME	Subject Matter Expert
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedure
S-S	Surface-to-Surface
SSG	Surface Strike Group
SSN	Nuclear Submarine
SST	Sea Surface Temperature
STW	Strike Warfare
SUA	Special Use Airspace
SUBOA	Submarine Operating Area
SUBOPAUTH	Submarine Operating Authority
SUW	Surface Warfare
SW	Swamp Waters
SWAP	Severe Weather Avoidance Plan
T&E	Testing and Evaluation
T&R	Training and Readiness
TACAN	Tactical Air Navigation
TACTS	Tactical Air Combat Training System
TALD	Tactical Air-Launched Decoy
TAMU	Texas A&M University
TAP	Tactical Training Theater Assessment and Planning
TBD	To Be Determined
TCTS	Tactical Combat Training System
TDS	Total Dissolved Solids
Tetryl	trinitrophenylnitramine

TL	Transmission Loss
TMDL	Total Maximum Daily Load
TNB	Trinitrobenzene
TNT	Trinitrotoluene
tpy	Ton(s) per Year
TR	Trout Waters
TRACKEX	Tracking Exercise
TSP	Total Suspended Particulates
TSPI	Time, Space, and Position Information
TTS	Temporary Threshold Shift
TWA	Time-weighted Average
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Air Vehicle
UJTL	Universal Joint Task List
ULT	Unit-Level Training
UNDET	Underwater Detonation
UNDS	Uniform National Discharge Standards
U.S.	United States
USAF	United States Air Force
USACOE	United States Army Corps of Engineers
U.S.C.	*United States Code*
USCG	United States Coast Guard
USCOP	U.S. Commission on Ocean Policy
USE	Uncommon Stranding Event
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VACAPES	Virginia Capes
VDH	Virginia Department of Health
VEM	Versatile Exercise Mine
WRSEPA	Water Range Sustainability Environmental Program Assessment

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EXECUTIVE SUMMARY

The United States (U.S.) Department of the Navy (DoN or Navy) has prepared this final Environmental Impact Statement (EIS) / Overseas Environmental Impact Statement (OEIS) to assess potential environmental impacts in the Virginia Capes (VACAPES) Range Complex over a 10-year planning horizon. The proposed actions that are evaluated in this EIS/OEIS are associated with Navy Atlantic Fleet training; research, development, testing, and evaluation (RDT&E) activities; and associated range capabilities enhancements, including infrastructure improvements. The components of the VACAPES Range Complex include 28,672 square nautical miles (nm^2) of special use area (SUA) warning area; 27,661 nm^2 of offshore surface and subsurface operating area (OPAREA); and 18,092 nm^2 of deep ocean area greater than 100 fathoms (600 feet). The geographic scope of this EIS/OEIS includes the airspace, seaspace, and undersea space of the VACAPES Range Complex. This area is referred to as the VACAPES Study Area. The VACAPES Study Area does not include any dry land. However, it does include the area from the mean high tide line east (seaward) to the 3-nautical-mile (nm) boundary of the states of Delaware, Maryland, Virginia, and North Carolina. This 3-nm boundary also serves as the western boundary of the VACAPES OPAREA, which is illustrated in Figure ES-1. The VACAPES Study Area also includes 420 nm^2 of the lower Chesapeake Bay, where proposed Mine Warfare (MIW) training would occur.

This FEIS/OEIS has been prepared by the Navy in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code [U.S.C.] § 4321); the Council of Environmental Quality (CEQ) Regulations for implementing the procedural provisions of NEPA (Title 40 Code of Federal Regulations [CFR] Parts 1500-1508); Department of the Navy Procedures for Implementing NEPA (32 CFR 775); Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*; and Department of Defense (DoD) regulations implementing EO 12114 (32 CFR Part 187). The proposed action requires analysis of potential impacts within and outside U.S. territory; therefore, this document was written to satisfy the requirements of both NEPA and EO 12114. The Navy has made changes to this FEIS/OEIS based on comments received during the public comment period. These changes included factual corrections, additions to existing information, and improvements or modifications to the analyses presented in the Draft EIS/OEIS. None of the changes between the Draft and Final EIS/OEIS resulted in substantive changes to the proposed action, alternatives, or the significance of the environmental consequences of the proposed action. There were additional revisions, which are reflected in this Final EIS/OEIS, that were made to amplify information previously provided. These changes included a more detailed description of Maritime Security Operations and more detailed Weapon System data sheets located in Appendix E.

In accordance with 50 CFR §401.12 the Navy has prepared a separate Biological Evaluation to assess the potential effects from the proposed action on marine resources and anadromous fish protected by the National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA). In accordance with the Marine Mammal Protection Act (MMPA) (16 U.S.C. §1371[a][5]), the Navy has submitted a request for Letter of Authorization to the NMFS for the incidental taking of marine mammals by the proposed action. The Navy has prepared a separate Consultation Package in accordance with legal requirements set forth under regulations implementing Section 7 of the ESA (50 CFR 402; 16 U.S.C 1536 (c)) for listed species under jurisdiction of the U.S. Fish and Wildlife Service (USFWS). The Record of Decision for this FEIS/OEIS will address any additional mitigation measures which may result from these ongoing regulatory processes.

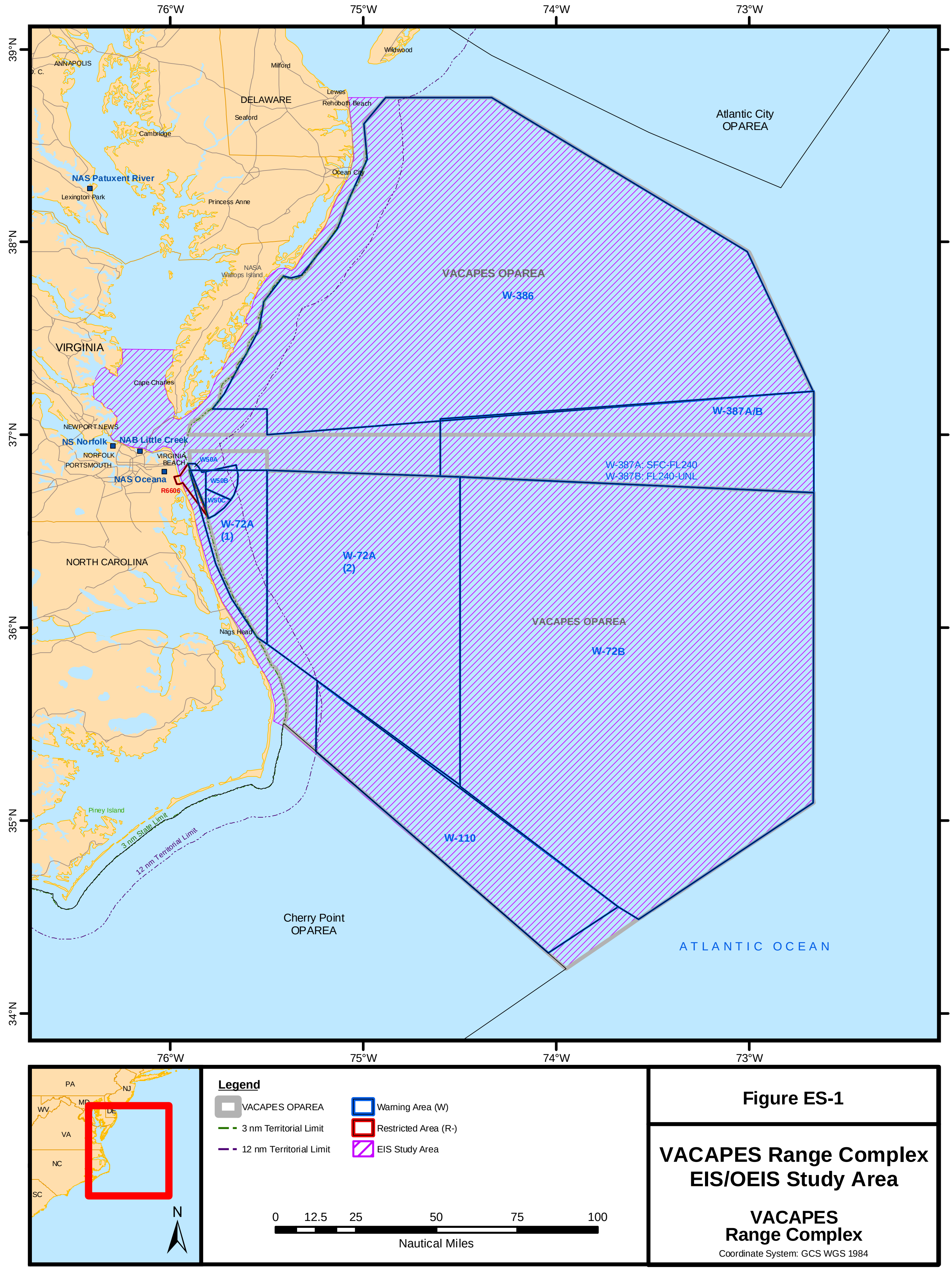

Figure ES-1

VACAPES Range Complex EIS/OEIS Study Area

VACAPES Range Complex

Coordinate System: GCS WGS 1984

ES 1.0 PURPOSE AND NEED

The purpose of the proposed action is to:

- Achieve and maintain Fleet readiness using the VACAPES Range Complex to support and conduct current, emerging, and future training operations and RDT&E operations;
- Expand warfare missions supported by the VACAPES Range Complex; and
- Upgrade and modernize existing range capabilities to enhance and sustain Navy training and RDT&E.

The need for the proposed action is to provide range capabilities for training and equipping combat-capable naval forces ready to deploy worldwide. In this regard, the VACAPES Range Complex furthers the Navy's execution of its Congressionally mandated roles and responsibilities under Title 10 U.S.C. Section 5062. For further information on the purpose and need for the proposed action refer to Chapter 1 of the FEIS/OEIS.

ES 2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

The Navy has identified the need to support and conduct current and emerging training and RDT&E operations in the VACAPES Range Complex. The proposed action would not result in major changes to VACAPES Range Complex facilities, operations, training, or RDT&E capacities over the 10-year planning period. Rather, the proposed action would produce relatively small-scale but critical enhancements to the VACAPES Range Complex that are necessary if the Navy is to maintain a state of military readiness commensurate with its national defense mission.

ES 2.1 Proposed Action

The proposed action is to support and conduct current and emerging training and RDT&E operations in the VACAPES Range Complex. To achieve this, the Navy proposes to:

- Maintain training and RDT&E operations at current levels if the No Action Alternative is selected.

If either Alternative 1 or Alternative 2 is selected, then:

- Increase or modify training and RDT&E operations from current levels in support of the FRTP.
- Accommodate mission requirements associated with force structure changes, including those resulting from the introduction of new platforms (aircraft and weapons systems).
- Implement enhanced range complex capabilities.

The decision to be made by the decision-maker is to determine which alternative analyzed in this EIS/OEIS satisfies the level and mix of training to be conducted, and the range capabilities enhancements to be made within the VACAPES Range Complex, to best meet the needs of the Navy, based on consideration of all of the reasonably foreseeable environmental impacts.

ES 2.2 Alternatives

Alternatives in this FEIS/OEIS were evaluated to ensure they met the purpose and need, giving due consideration to range complex attributes such as: the capability to support current and emerging Fleet tactical training and RDT&E requirements; the capability to support realistic, essential training at the level and frequency sufficient to support the FRTP; and the capability to support training requirements while following Navy Personnel Tempo of Operations guidelines. Three alternatives are analyzed in this FEIS/OEIS:

1. The No Action Alternative – Under the No Action Alternative, training operations and major range events would continue at current levels. Evaluation of the No-Action Alternative provides a

credible baseline for assessing environmental impacts of Alternative 1 and Alternative 2 (Preferred Alternative).

2. Alternative 1 would include all of the features of the No Action Alternative, and would implement enhancements to the minimal extent possible to meet the components of the FRTP to implement the FRP. Alternative 1 would increase operational training, expand warfare missions, and accommodate force structure changes, which would include changing weapon systems and platforms, and homebasing new aircraft and ships. Modifications to current training or introduction of new training would include:

   a) Using more commercial aircraft to serve as opposition forces rather than using Navy aircraft for air-to-air missile exercise, surface-to-air gunnery exercises, air intercept control exercises, and detect-to-engage exercises.
   b) Incorporating maritime security training into existing training events.
   c) Adjusting training levels to ensure that deployment can be stepped up quickly and at multiple locations in response to world events.
   d) Conducting new or modified training associated with the introduction of new rotary-wing aircraft, and new organic mine countermeasure (OMCM) systems. ("Organic" refers to embedding mine warfare capability into the strike group rather than providing it as an external capability of specialized ships and aircraft that are brought in on an as-needed basis.)
   e) Establishing a mine neutralization training area for realistic MIW training.

3. Alternative 2 (Preferred Alternative) would include all of the enhancements of Alternative 1, plus it would include reducing high explosive BOMBEXs by 96 percent, additional mine warfare training capabilities, the establishment of MIW training areas with small fields of non-explosive mine shapes, and implementation of additional enhancements to enable the range complex to meet future requirements.

For detailed information on each alternative refer to Chapter 2 of the FEIS/OEIS.

ES 2.3 Alternatives Considered but Eliminated from Further Analysis

Other approaches that were considered but eliminated because they did not meet the purpose and need included:

- No Training Alternative;
- Using alternative range complex locations;
- Conducting simulated training only; and
- Only using non-explosive practice munitions within the VACAPES Range Complex.

These were eliminated from further analysis, because none would be effective in putting into practice the FRTP. Specifically:

- If the Navy did not conduct training exercises along the East Coast, they would not be able to meet its obligations, as identified in Title 10 United States Code, Section 5062.
- The VACAPES Range Complex is an important component in the available suite of Navy training and testing capabilities. The proximity of the VACAPES Range Complex to existing naval installations produces important advantages relating to features such as travel times, costs of operations, and personnel tempo of operations that could not be achieved at any other range complex.
- Although simulated training and non-explosive practice munitions are widely used, including in many VACAPES operations, they are no substitute for realistic field conditions. The value of live

training provided by actually operating a combat system or handling explosive ammunition cannot be substituted through simulation, particularly as it relates to the physical reaction invoked by the danger, noise, and visual effects associated with these systems. Similarly, individuals and groups must be able to practice and hone their skills in communication, maneuvering, operating systems, repairing equipment, and firing weapons in an environment that is realistic and that replicates the high energy and stress of what they would encounter in an actual combat situation.

ES 3.0 Public Involvement

NEPA requires federal agencies to prepare an EIS for proposed actions that may significantly affect the quality of the human and natural environments. The EIS must disclose significant environmental impacts and inform decision-makers and the public of the reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment. The Navy is the lead agency for the proposed action. The NMFS is a cooperating agency for this EIS/OEIS.

A notice of intent (NOI) to develop the draft EIS/OEIS was published in the *Federal Register* on December 8, 2006, and in four local newspapers in Maryland, Virginia, and North Carolina. The newspaper notices were run five times in each newspaper. Four scoping meetings were held, in Salisbury, Maryland; Chincoteague Island, Virginia; Virginia Beach, Virginia; and Nags Head, North Carolina. During these meetings, the public had the opportunity to help define and prioritize issues and convey these issues to the agencies through oral and written comments.

A revised NOI was issued in the *Federal Register* on September 5, 2007, when potential non-explosive mine warfare training areas in the southern Chesapeake Bay were identified for analysis. Additional agency and public comments were solicited, and the action was advertised in several local newspapers.

During the scoping process, 26 comments were received. Seventeen were from government agencies at various levels, and nine were from individuals. Commenters raised concerns about impacts on fish and fishing; harm to cultural resources, marine protected areas, oyster reefs, and endangered species; and potential conflicts between boating or shipping and Navy activities. This EIS/OEIS addresses all of the issues that were identified during scoping.

The draft EIS/OEIS was provided to the U.S. Environmental Protection Agency (USEPA) for review and comment in accordance with its responsibilities and notice of availability of USEPA comments was published in the *Federal Register* (Vol 73, No. 164, August 22, 2008). The Navy also placed notices in local newspapers announcing the availability of the draft EIS/OEIS and public hearings. The draft EIS/OEIS was circulated for internal/agency review and made available for general review in public libraries. Public hearings were held in Ocean City, MD, Chincteague, VA, Virginia Beach, VA, and Kitty Hawk, NC 14-17 July 2008. Public and agency comments were received via the VACAPES web site, facsimile, and regular mail. The public comment period for the draft EIS/OEIS ended on 11 August 2008. One hundred nineteen public comments were received. This Final EIS/OEIS incorporates, and formally responds to, all public comments received on the draft EIS/OEIS. Responses took the form of corrections of data inaccuracies, clarifications of and modifications to analytical approaches, inclusion of additional data or analyses, and modification of the proposed action or alternatives. Public and agency comments are located in Appendix F.

ES 4.0 Comparison of Alternatives and Effects

The comparison of alternatives presented in Table ES-1 is based on the information and analyses presented in Chapter 3 (Affected Environment and Environmental Consequences). The environmental stressors associated with each warfare area and operation were evaluated for each resource or issue in assessing potential environmental impacts under each alternative. There were no recordable differences in potential impacts between the alternatives for the following resources and issues:

TABLE ES-1
COMPARISON OF ALTERNATIVES

Resource or Issue	Alternatives		
	No Action Alternative	Alternative 1	Preferred Alternative
Bathymetry and Sediments	Short tem, minor impacts from deployment and recovery of MIW mine shapes (Section 3.1.3.1)	Short tem, minor impacts from deployment and recovery of MIW mine shapes (Section 3.1.3.2)	An increase in short tem, minor impacts from deployment and recovery of MIW mine shapes compared to No Action Alternative and Alternative 1 (Section 3.1.3.3)
Marine Communities	Long-term minor impacts to benthic habitats from accumulation of NEPM (Section 3.6.3.1)	Slight increase in potential impacts to benthic habitats from accumulation of NEPM and short tem minor impacts from deployment and recovery of MIW mine shapes considering mitigation measures in place (Section 3.6.3.2)	An increase in potential impacts to benthic habitat from accumulation of NEPM and an increase in short tem minor impacts from deployment and recovery of MIW mine shapes (Section 3.6.3.3)
Marine Mammals	Under MMPA, 7 mortality potential exposures, 63,664 non-injurious potential exposures, and 728 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.7.3.3).	Under MMPA, 7 mortality potential exposures, 63,686 non-injurious potential exposures, and 729 injurious potential exposures. Under ESA, proposed activities may affect listed species. (Section 3.7.3.4)	Under MMPA, 1 mortality potential exposure, 2,472 non-injurious potential exposures, and 25 injurious potential exposures. Under ESA, proposed activities may affect listed species. (Section 3.7.3.5)
Sea Turtles	Two mortality potential exposures, 11,340 non-injurious exposures, and 97 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.8.3.2).	Two mortality potential exposures, 11,348 non-injurious exposures, and 98 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.8.3.3).	No mortality potential exposures, 1,513 non-injurious exposures, and 15 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.8.3.4).
Fish and Essential Fish Habitat (EFH)	Under MSFCMA, no significant population-level impacts to managed species would occur; impacts would be temporary, minimal, and would not reduce the quality and/or quantity of EFH. Under ESA, there would be no effect on listed species. (Section 3.9.3.1)	Under MSFCMA, no significant population-level impacts to managed species would occur; impacts would be temporary, minimal, and would not reduce the quality and/or quantity of EFH. Under ESA, there would be no effect on listed species. (Section 3.9.3.2)	Under MSFCMA, no significant population-level impacts to managed species would occur; impacts would be temporary, minimal, and would not reduce the quality and/or quantity of EFH. Under ESA, deployment and recovery of non-explosive mine shapes may affect one listed species. (Section 3.9.3.3)
Seabirds and Migratory Birds	Under ESA and MBTA, no effect would occur to listed species and no long-term population-level effect would occur to migratory bird populations. (Section 3.10.3.1)	Under ESA and MBTA, no effect would occur to listed species and no long-term population-level effect would occur to migratory bird populations. (Section 3.10.3.2)	Under ESA and MBTA, no effect would occur to listed species and no long-term population-level effect would occur to migratory bird populations. (Section 3.10.3.3)
Atlantic Fleet Active Sonar Training (AFAST)	Potential impacts to resources or issues from AFAST and the Proposed Action combined are less than significant. (Section 3.19)	Potential impacts to resources or issues from AFAST and the Proposed Action combined are less than significant. (Section 3.19)	Potential impacts to resources or issues from AFAST and the Proposed Action combined are less than significant. (Section 3.19)

- Bathymetry, Sediment, and Soils
- Hazardous Materials and Hazardous Waste
- Water Resources
- Air Quality
- Airborne Noise
- Land Use
- Cultural Resources
- Transportation
- Demographics
- Regional Economy
- Recreation
- Environmental Justice
- Public Health and Safety

The potential impacts would generally be temporary, short-term, minor, and/or localized changes to these resources or issues. As defined under NEPA, no significant impacts in U.S. Territory and no significant harm in Non-Territorial Waters to resources or issues were identified considering implementation of mitigation measures described in Chapter 5. In addition, resources were evaluated in accordance with Marine Mammal Protection Act (MMPA). Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Act (Eagle Act), Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), and National Historic Preservation Act (NHPA). The potential impacts presented below provide the basis for providing choices to the decision maker.

The Atlantic Fleet Active Sonar Training (AFAST) FEIS/OEIS is incorporated by reference in this FEIS/OEIS for active sonar and Anti-Submarine Warfare associated activities as they pertain to the VACAPES Range Complex. The reader should refer to the AFAST EIS/OEIS (available at http://afasteis.gcsaic.com) for the full description and analysis of active sonar activities along the East Coast and within the Gulf of Mexico. A summary of the environmental consequences due to sonar activities in the VACAPES Range Complex is provided by resource area in Section 3.19.

ES 5.0 Mitigation and Monitoring

The Navy recognizes that the proposed action has the potential to impact marine and other resources in the vicinity of training. Chapter 5 describes the Navy's overall mitigation and monitoring approach as well as specific mitigation measures that would be implemented to protect marine mammals, sea turtles, and other resources during training activities. Some of these measures are generally applicable and others are designed to apply to certain geographic areas and/or for specific types of Navy training. Due to the long-term nature of the proposed action, mitigation measures for many elements of the action have been established through previous environmental analyses, consultations, and/or permitting processes.

The Navy believes that a comprehensive approach to mitigation for the VACAPES Range Complex requires focus on: (1) mitigation by avoidance, in which adverse impacts are avoided altogether by altering the location, design, or other aspect of an activity, and (2) minimization of impacts when avoidance is not feasible. An important complement to the avoidance and minimization of impacts is monitoring to track compliance with take authorizations, impacts on protected resources, and effectiveness of mitigation measures. Taken together, these three elements – avoidance, minimization, and monitoring comprise the Navy's integrated approach to addressing potential environmental impacts.

The Navy is committed to demonstrating environmental stewardship while executing its National Defense Mission and is responsible for compliance with a suite of Federal environmental and natural resources laws and regulations that apply to a wide variety of environments. Consistent with the cooperating agency agreement with the NMFS, mitigation and monitoring measures presented in this FEIS/OEIS focus on the requirements for protection and management of marine resources.

The Navy has provided over $94 million to universities, research institutions, federal laboratories, private companies, and independent researchers around the world. The Navy will continue to fund a significant amount of marine research directly applicable to U.S. Fleet Forces Command training activities.

ES 6.0 Cumulative Impacts

The proposed action will not make radical changes to the VACAPES Range Complex facilities, operations, training, or RDT&E capacities. Rather, the actions proposed in Alternatives 1 and 2 are incremental increases over the No Action Alternative that would result in relatively small-scale, but critical, enhancements that are necessary if the Navy is to maintain a state of military readiness commensurate with its national defense mission.

Various types of past and present actions not related to the proposed action have the potential to impact the resources evaluated in this FEIS/OEIS. Twenty projects including, but not limited to, military activities in other OPAREAs on the Atlantic coast, offshore oil and gas activities along the Atlantic seaboard, maritime traffic, scientific research, and marine ecotourism were analyzed for direct, indirect, and cumulative effects. The environmental consequences conclusions and incremental contribution and cumulative effects from past, present, and reasonably foreseeable future projects and activities for each resource evaluated in this FEIS/OEIS were used in Chapter 6 for summarizing cumulative effects. Most of the summary conclusions on past, present, and reasonably foreseeable future actions for the resources evaluated were no adverse impacts and potential for minor, but recoverable, adverse impacts. There were fewer summary conclusions categorized as potential for moderate, but recoverable, adverse impacts. No summary conclusions were characterized as potential for major, non-recoverable, adverse impacts.

CHAPTER 1 : PURPOSE AND NEED FOR PROPOSED ACTION

1.1 INTRODUCTION

The United States (U.S.) Department of the Navy (Navy) has prepared this Environmental Impact Statement (EIS) / Overseas Environmental Impact Statement (OEIS) to assess the potential environmental impacts associated with Navy Atlantic Fleet training and research, development, testing, and evaluation (RDT&E) activities, and associated range capabilities enhancements (including infrastructure improvements) in the Virginia Capes (VACAPES) Range Complex. The Navy's mission is to maintain, train, and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. Title 10 *United States Code* (U.S.C.) Section 5062 directs the Chief of Naval Operations to train all naval forces for combat. The Chief of Naval Operations meets that direction, in part, by conducting at-sea training exercises and ensuring naval forces have access to ranges, operating areas (OPAREA), and airspace where the Navy can develop and maintain skills for wartime missions and conduct RDT&E of naval weapons systems. For purposes of this EIS/OEIS, exercises and training do not include combat operations, operations in direct support of combat, or other activities conducted primarily for purposes other than training.

The proposed action is to support and conduct current and emerging training and RDT&E operations in the VACAPES Range Complex. The decision to be made by the decision-maker is to determine both the level and mix of training to be conducted and the range capabilities enhancements to be made within the VACAPES Range Complex that best meet the needs of the Navy.

The focus of this EIS/OEIS is the VACAPES Range Complex as depicted in Figure 1.1-1. This complex consists of targets and instrumented areas, airspace, seaspace, and undersea space. The activities analyzed in this EIS/OEIS include current and future proposed Navy training and RDT&E operations within Navy-controlled OPAREAs, special use airspace (SUA), and ranges, and Navy-funded range capabilities enhancements (including infrastructure improvements). The actual study area is further defined in Section 1.5.

A separate EIS/OEIS for Atlantic Fleet Active Sonar Training (AFAST) activities along the East Coast and Gulf of Mexico (including the VACAPES Range Complex) that evaluated the potential impacts of active sonar on the marine environment was prepared. Figure 1.1-2 illustrates the AFAST Study Area in relation to the East Coast range complexes. The analysis in this EIS/OEIS for active sonar training, as it pertains to the VACAPES Range Complex, is taken from the EIS/OEIS for AFAST and incorporated into Chapter 3 of this EIS/OEIS to assess the impact of the proposed action and other past, present, and reasonably foreseeable actions.

This EIS/OEIS has been prepared by the Navy in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. § 4321 *et seq.*); the Council of Environmental Quality (CEQ) Regulations for implementing the procedural provisions of NEPA (Title 40 *Code of Federal Regulations* [CFR] Parts 1500-1508); Department of the Navy Procedures for Implementing NEPA (32 CFR 775); Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions; and Department of Defense (DoD) regulations implementing EO 12114 (32 CFR Part 187). The provisions of NEPA apply to major federal actions with effects that occur within U.S. territory, while EO 12114 applies to major federal actions with effects that occur outside U.S. territory, including marine waters seaward of the U.S. territorial seas -- greater than 12 nautical miles (nm) offshore. The proposed action requires analysis of potential impacts both within and outside U.S. territory; therefore, this document has been written to satisfy the requirements of both NEPA and EO 12114.

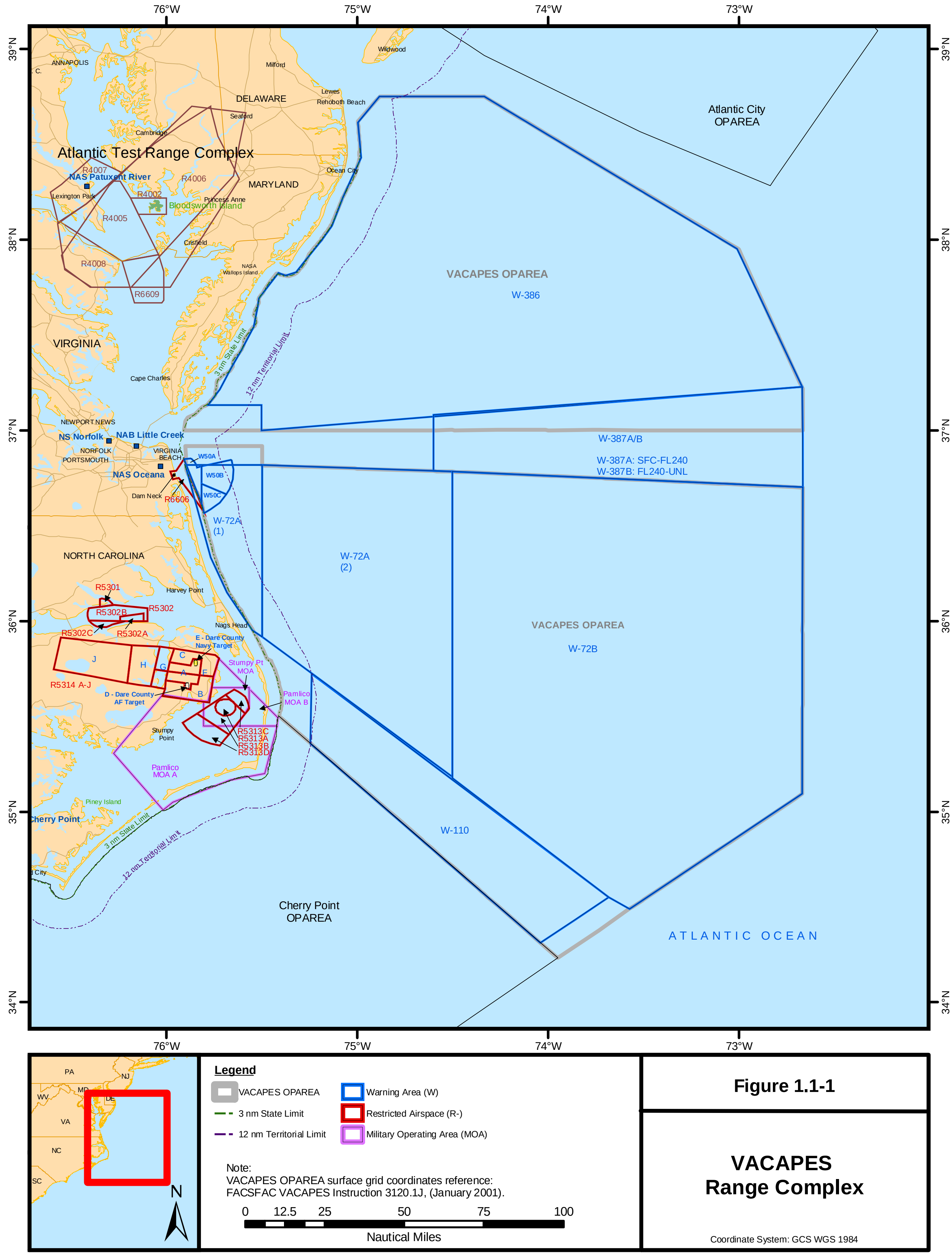

Figure 1.1-1

VACAPES Range Complex

AFAST Study Area
Figure 1.1-2
Legend
Range Complex OPAREAs
Atlantic Fleet Active Sonar Training (AFAST)
VACAPES OPAREA
Cherry Point OPAREA
Charleston OPAREA
Jacksonville OPAREA
New Orleans OPAREA
Pensacola OPAREA
Panama City OPAREA
Corpus Christi OPAREA
90°0'0"W
80°0'0"W
70°0'0"W
60°0'0"W
50°0'0"W
50°0'0"N
40°0'0"N
30°0'0"N
20°0'0"N
N
1:18,580,000
100 50 0 100 200 300
Nautical Miles
150 75 0 150 300 450
Kilometers
Coordinate System: WGS 1984

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1.2 BACKGROUND

The Navy has been training in the area now defined as the VACAPES Range Complex for national defense purposes for more than 60 years. The air, sea space, and undersea space of the VACAPES Range Complex has and continues to provide a safe and realistic training and testing environment to ensure military personnel are ready to carry out assigned missions in furtherance of its Congressionally mandated duty. The VACAPES Range Complex provides the infrastructure and proximity that supports relevant training for the U.S. Atlantic Fleet forces homeported in the Hampton Roads area.

1.2.1 Navy Training

1.2.1.1 Navy Operations

The United States maintains its military forces to ensure the freedom and safety of all Americans, both at home and abroad. The Preamble of the U.S. Constitution established the principle that the people of the United States will provide for the common defense. Article 1, Section 8 states, "The Congress shall have power to provide for the common defense…provide and maintain a Navy," and "to make rules for the government and regulation of the land and naval forces." To implement these constitutionally mandated duties, Congress provided Title 10 U.S.C., Section 5062, which states: "The Navy shall be organized, trained and equipped primarily for prompt and sustained combat incident to operations at sea."

The Navy and Marine Corps generally organize deployed forces into strike groups. The number and composition of individual units comprising a strike group are tailored to meet specific missions and expected threats. A Carrier Strike Group (CSG), consisting of an aircraft carrier and its embarked airwing, plus several surface combatant ships and submarines, can project power ashore via aircraft or missiles. An Expeditionary Strike Group (ESG), consisting of amphibious ships, surface combatant ships, submarines, and an embarked Marine Expeditionary Unit (MEU)[1], can project power ashore via amphibious landing of men, armor, and materiel. Traditionally, a CSG or ESG operates on a two- to three-year cycle that begins with major maintenance and work-up training before culminating in a six- to eight-month deployment. A Maritime Security (MS) Surface Strike Group (SSG), consisting of one to three surface combatant ships, is specially organized to conduct a typically short-term, limited objective.

The Joint Chiefs of Staff determine deployment of naval forces based on world-wide requirements and commitments. While the Navy always has several strike groups deployed to provide global naval presence and engagement, the 21st century security environment has spawned more frequent requests from combatant commanders for additional Navy forces ranging in size from individual units to strike groups. Emergent missions have included major combat, maritime and theater security, homeland defense, support of civil authorities, anti-terrorism/force protection, and humanitarian assistance/disaster relief operations. This rapid response of forces to supplement naval forces on routine deployment is referred to as "surge."

The Navy developed the Fleet Response Plan (FRP) as a deliberate process to ensure continuous availability of agile, flexible, trained, and ready surge-capable forces. The goal of FRP is a standing ability to deploy six CSGs in a very short time, and one more in stages soon thereafter. FRP addresses all aspects of maintaining these surge-capable Navy forces, such as maintenance, manning, and deployment schedules. The VACAPES Range Complex EIS/OEIS addresses the training side of FRP—the Fleet Readiness Training Plan (FRTP), described in more detail below.

[1] The MEU (Special Operations Capable) is a task organized unit of a type known as a Marine Air Ground Task Force or MAGTF. MAGTFs consist of ground combat, aviation combat, combat logistics, and command and control elements, and vary in size depending on the nature of the intended mission.

1.2.1.2 Why the Navy Trains

Operational requirements for deployment of naval forces world-wide drive and shape training doctrine and procedures. The nature of modern warfare and security operations has become increasingly complex. The threat is global, and the tactics, weapons, and forces arrayed against the U.S. military span the gamut from crude to extremely sophisticated.

To effectively counter the array of threats, naval forces bring together thousands of sailors and marines, their equipment, vehicles, ships, and aircraft, and often other U.S. services or coalition partners, all of which need to work together as a cohesive team to achieve success. Developing the leadership and management skills to choreograph all these disparate elements, as well as coordinated employment of weapons at the tactical level, requires extensive, challenging training. In particular, modern weaponry presents both tremendous opportunity and challenges. Smart weapons, used properly, are very accurate and actually allow naval forces to accomplish their missions with greater precision and far less destruction than in past conflicts. However, they are very complex and skills honed for optimum employment are perishable. Realistic, regular training provides all elements of the Navy-Marine Corps team, from the individual to the strike group, with the initial combat experience crucial to success and survival in this environment.

The Navy mission in a maritime environment presents unique challenges. CSGs, ESGs, and SSGs offer combatant commanders unprecedented flexibility and firepower to defeat or suppress threats world-wide. Naval forces can simultaneously carry out operations on and below the ocean surface, on land, and in the air. To optimize all of this capability, Navy training activities must focus on achieving proficiency in eight functional areas, known as Primary Mission Areas or, more commonly, warfare areas. These include Air Warfare (AW), Amphibious Warfare (AMW), Surface Warfare (SUW), Anti-submarine Warfare (ASW), Mine Warfare (MIW), Strike Warfare (STW), Electronic Combat (EC), and Naval Special Warfare (NSW). Each training event addressed in the EIS/OEIS is categorized under one of the warfare areas. Appendix D describes each of these warfare areas and individual training exercises in greater detail.

1.2.1.3 Fleet Readiness Training Plan

This VACAPES Range Complex EIS/OEIS addresses the training side of the Fleet Response Plan, which is the FRTP. The Navy designed the FRTP to support the training requirements of a surge-capable Fleet that meets FRP goals outlined above. FRTP formalizes the traditional Navy building block approach to training in a way that brings the strike groups to the required level of combat readiness earlier in the training cycle, and sustains that readiness longer. Training proceeds on a continuum, advancing through four phases:

<u>Maintenance Phase</u> is the preferred period during which major shipyard- or depot-level repair and most personnel turnover occur. Ships and squadrons focus on individual and team training. This level of training could involve the aircrew of a single aircraft flying basic instrument or tactics flights, or fire control crews for a ship's anti-aircraft systems employing their weapons in a simulated environment at a weapons school.

<u>Basic Phase</u> continues individual and team training, but the focus shifts to unit-level training (ULT), assessment, and certification requirements during which all members of the ship or squadron employ their ship or aircraft tactically. This phase is characterized by high-volume, short-duration, individual and unit training exercises. Examples of ULT could include a single destroyer conducting damage control, weapons employment, and navigation drills over a two-day underway period, or a two-plane flight of F/A-18s performing defensive maneuvers and weapons delivery training against an opposition force at a nearby bombing range during a two-hour sortie.

Integrated Phase brings all the individual units together as a strike group to synthesize staff actions and coordinate operations in a challenging, multi-warfare environment. Generally, integrated phase training occurs during a limited number of major exercises, each lasting one to four weeks. This phase includes strike-group-level assessment and certification prior to deployment. Major exercises for CSGs would include multi-ship air defense and anti-submarine warfare exercises, and 10-plane bombing strikes at multiple target sites, all occurring simultaneously in a realistic battle scenario.

Sustainment Phase begins upon completion of the Integrated Phase, and lasts through deployment and for several months following return to homeport before the strike group stands down and the individual units begin their maintenance period. Sustainment consists of a variety of training evolutions designed to sustain the combat readiness levels attained in the prior three phases. This phase could include several major training exercises with other U.S. and allied services in a joint/coalition environment, as well as a continuation of individual, unit, and integrated-level training exercises. A major sustainment exercise could include elements of a CSG and an ESG operating together with units from the U.S. Air Force (USAF) and/or allied navies during a 10-day battle problem.

FRTP involves acceleration of the training cycles of multiple strike groups, which could entail near-simultaneous execution of similar training events. Deployment schedules must remain flexible and responsive to the nation's security needs. The Navy must ensure that its training areas can support the entire training continuum as needed.

1.2.1.4 Range Complexes

Training must be as realistic as possible to provide the experiences important to success and survival. The Navy often employs simulators and synthetic training to provide early skill repetition and to enhance teamwork, but live training in a realistic environment is vital to success. A range complex, such as the VACAPES Range Complex, is a set of co-located areas of sea space, undersea space, land ranges, and overlying airspace designated for military training and testing operations. No single range complex on the east coast can accommodate the entire spectrum of Navy and Marine Corps training and testing (see Figure 1.1-2). Individual East Coast range complexes serve as "backyard" ranges, supporting Naval forces home based and home ported in multiple locations. Also, the combined capabilities of the VACAPES, Navy Cherry Point, and Jacksonville range complexes are required to support the multiple aspects of integrated, major training events. The result is a system of range complexes, which provides a robust training and testing capability for all naval warfare missions. Range complexes provide a controlled and safe environment with threat-representative targets where military ships and aircraft can train in realistic, combat-like conditions throughout the graduated buildup needed for combat ready deployment. The integration of undersea ranges and OPAREAS with land training ranges, safety landing fields, and amphibious landing sites are critical to this realism, allowing execution of multi-dimensional exercises in complex scenarios. Also, range instrumentation captures data on the effectiveness of tactics and equipment, providing feedback for constructive criticism. Live-fire training ensures the ability to place ordnance on target with the required level of precision in a stressful environment. Live training, most of it accomplished in the waters off the nation's east and west coasts and the Caribbean Sea, will remain the cornerstone of readiness as the Navy prepares its military forces for a security environment characterized by uncertainty and surprise.

1.2.2 Tactical Training Theater Assessment and Planning (TAP) Program

In 2004, Commander, U.S. Atlantic Fleet and Commander, U.S. Pacific Fleet funded the TAP Program to serve as the overarching Fleet training area sustainment program. The purpose of TAP is to support Navy objectives that: 1) promote use and management of ranges (such as the VACAPES Range Complex) in a manner that supports national security objectives and a high state of combat readiness, and 2) ensure the long-term viability of range assets while protecting human health and the environment. The TAP

Program focuses specifically on the sustainability of ranges, OPAREAs, and airspace that support the FRTP. The TAP Program defined broad geographic areas where the Navy trains, called range complexes. The TAP Program represents the first time the Navy has managed its ranges on a broad, complex-wide basis. One element of the TAP Program is development of the required capabilities document (RCD) (DoN, 2006a), and a companion document, the range complex management plan (RCMP) (DoN, 2006b). Another TAP Program element is environmental planning documentation (e.g., this EIS/OEIS), which will assess the potential for environmental impacts associated with activities/actions conducted within a range complex. These documents are described below.

The purpose of the RCD is to quantitatively define the required capabilities that allow Navy ranges to support mission-essential training in an unconstrained environment over a 10-year planning horizon. In sum, the RCD defines what is needed in an ideal sense. The RCD uses several factors to determine range capability requirements, including: range attributes, range-related systems, training levels, and Navy Primary Mission Areas.

- Range attributes: These include four range operational elements or training media, namely airspace, sea space, undersea space, and land area. The geographic breadth of water and land area, water depth, and air space needed to conduct specific types of training occurring at the range are detailed in the RCD.
- Range-related systems: These include systems and infrastructure for scheduling, communications, meteorological data, targets, training instrumentation, and opposition force simulation.
- Training levels: the three levels are:
    1. Basic, or unit-level training, involves a single ship, aircraft, submarine, or small unit, not integrated with other operations;
    2. Intermediate training involves integrated expeditionary or carrier strike group or air wing operations as part of a major exercise; and
    3. Advanced training involves multiple strike group and/or services in major, fully integrated, comprehensive and/or joint force exercises.
- Primary Mission Areas are: Air Warfare (AW), Amphibious Warfare (AMW), Surface Warfare (SUW), Anti-submarine Warfare (ASW), Mine Warfare (MIW), Strike Warfare (STW), Electronic Combat (EC), and Naval Special Warfare (NSW).

Thus, the RCD defines the nature and size of a training medium (*e.g.,* airspace) and training systems to be employed to conduct a specified level of training for naval forces in a given Primary Mission Area.

The Navy has developed an RCMP for each range complex, including the VACAPES Range Complex (DoN, 2006b). The RCMP is an integrated sustainment planning and management document that:

- Describes baseline condition of range complex capabilities, current training and RDT&E operations, environmental documentation/coverage, and encroachment issues;
- Recommends projects and investments based on rigorous assessment of gaps between current range complex capabilities and those required to support the strategic vision; and
- Develops a range complex management structure, outreach plan, and investment strategy for long-term range sustainment.

RCMPs are developed using the RCD to define requirements needed to support warfare areas of individual range complexes. The Final Draft RCMP for the VACAPES Range Complex was completed in 2006. The RCMP iterates the strategic vision for the complex, which is to provide sustainable and modernized ocean operating areas, airspace, land, ranges, range infrastructure, training facilities, and resources to fully support Navy training requirements in accordance with the complex's roles and missions.

The role and missions for the VACAPES Range Complex include providing training opportunities for eight naval warfare mission areas, specifically AW, AMW, SUW, ASW, MIW, STW, EC, and NSW at varying levels of training complexity. RDT&E is conducted in the VACAPES Range Complex on new aircraft and weapons that are designed to support each of these eight naval warfare missions.

When compared to the complex's required capabilities, the VACAPES RCMP (DoN, 2006b) identifies moderate to severe capabilities shortfalls in several warfare mission areas, especially for intermediate and advanced-level training. In an attempt to remedy the identified shortfalls, the VACAPES RCMP makes recommendations for range enhancements, some of which may have an impact on the environment. Those recommended range enhancements that have the potential to impact the environment, as well as current and future training and testing operations that have the potential to impact the environment, are the primary focus of this EIS/OEIS, and are further described in Chapter 2.

1.3 PURPOSE AND NEED

The purpose for the proposed action is to:

- Achieve and maintain Fleet readiness using the VACAPES Range Complex to support and conduct current, emerging, and future training operations and RDT&E operations;
- Expand warfare missions supported by the VACAPES Range Complex; and
- Upgrade and modernize existing range capabilities to enhance and sustain Navy training and RDT&E.

The need for the proposed action is to provide range capabilities for the training and equipping of combat-capable naval forces ready to deploy worldwide. In this regard, the VACAPES Range Complex furthers the Navy's execution of its Congressionally mandated roles and responsibilities under Title 10 U.S.C. § 5062.

To implement this Congressional mandate, the Navy needs to:

- Maintain current levels of military readiness by training in the VACAPES Range Complex.
- Accommodate future increases in operational training tempo in the VACAPES Range Complex and support the rapid deployment of naval units or strike groups.
- Achieve and sustain readiness of ships and squadrons so the Navy can quickly surge significant combat power in the event of a national crisis or contingency operation;
- Support the acquisition and implementation into the Fleet of advanced military technology. The VACAPES Range Complex must adequately support the testing and training needed for new platforms (vessels, aircraft, and weapons systems).
- Maintain the long-term viability of the VACAPES Range Complex while protecting human health and the environment, and enhancing the quality and communication capability and safety of the range complex.

Support to current, emerging, and future training and RDT&E operations, including implementation of range enhancements, entails the actions that will be evaluated in this EIS/OEIS. The assessed actions include:

- Increase use of contractor-operated aircraft that simulate enemy aircraft during training (commercial air services (CAS) support for fleet opposition forces (OPFOR) and electronic warfare threat training);
- Increase Maritime Security (MS) training (MS surface strike group training);
- Support MH-60R/S helicopter warfare mission areas; and
- Operate instrumented mine warfare training areas.

1.4 OVERVIEW OF THE VACAPES RANGE COMPLEX

1.4.1 Summary Description

The VACAPES Range Complex geographically encompasses offshore, near-shore, and onshore OPAREAS, ranges, and SUA located near the east coast of the United States (Figure 1.1-1). Together, components of the VACAPES Range Complex encompass (DoN, 2006b):

- 27,661 square nautical miles (nm^2) of sea space;
- 16,143 acres of land area (including 13,600 acres of land area for ranges); and
- 28,672 nm^2 of SUA warning areas and 5,158 nm^2 of SUA associated with land ranges.

The specific OPAREAS, airspace, and land ranges included in the VACAPES Range Complex to be addressed in this EIS/OEIS are identified in Table 1.4-1.

1.4.2 Mission of the VACAPES Range Complex

The mission of the VACAPES Range Complex is to provide sustainable and modernized ocean operating areas, airspace, ranges, range infrastructure, training facilities, and resources to fully support Navy training requirements. The VACAPES Range Complex provides critical support for Navy operational readiness training and for RDT&E.

Training at the VACAPES Range Complex historically has been diverse, including ship and aircraft maneuvers, gunnery and bombing exercises, joint training exercises, and RDT&E of new systems or weapons platforms. Naval Station Norfolk, Naval Amphibious Base Little Creek, Naval Air Station Oceana, Naval Weapons Station Yorktown, Dam Neck Annex, and Cheatam Annex consider the VACAPES Range Complex their "backyard" range. Numerous commands and their subordinate units attached to these facilities across multiple naval warfare areas use the range complex. Typical range users include CSGs and ESGs, and the component elements of these formations such as naval aviation squadrons, submarine groups, surface forces, and amphibious groups. The VACAPES Range Complex is also heavily used as the backyard range for RDT&E operations from NAS Patuxent River. National Aeronautics and Space Administration's (NASA's) Wallops Island Flight Test Facility performs RDT&E events at the complex, and other DoD entities like the 1st Fighter Wing, Langley Air Force Base use the complex airspace extensively.

This EIS/OEIS considers impacts from typical users of the range complex, and also considers less frequent user's training operations that are similar to typical training activities conducted by principal range users. In addition to its central role in the pre-deployment training of large naval formations, the VACAPES Range Complex is heavily utilized as a "backyard" range for advanced and pre-deployment workup training of units with home stations in the Hampton Roads area of Virginia.[2]

1.5 SCOPE AND CONTENT OF THE EIS/OEIS

The geographic scope of this EIS/OEIS (referred to from here on as the study area) includes the airspace, seaspace, and undersea space of the OPAREA and Warning Areas of the VACAPES Range Complex, including the area from the mean high tide line, up to and extending seaward of the 3 nm western boundary of the OPAREA. Also included is the lower portion of the Chesapeake Bay, south of the mouth of the Rappahannock River to Hampton Roads, Virginia. Figure 1.5-1 depicts the study area for this

[2] Access to capable range facilities located in the vicinity of homeports and stations is a critical component of naval readiness. The Navy strives, and in many cases is required by law, to track and where possible limit "personnel tempo," meaning the amount of time sailors and marines spend deployed away from home. Personnel tempo is an important factor in morale and retention. The availability of a "backyard" range is critical to Navy efforts in these areas.

TABLE 1.4-1
COMPONENTS OF VACAPES RANGE COMPLEX

Component Area	Description	Addressed in this EIS/OEIS?
OPAREAs – Surface Waters	VACAPES OPAREA: Offshore surface operating area extending southward generally from the Delaware-Maryland border along the coast of Maryland, Virginia, and North Carolina to the latitude of approximately Cape Fear, North Carolina, for an estimated distance of 270 miles and seaward (east) from 3 nm off the coast for a distance of approximately 155 nm.	Yes
OPAREAs – Subsurface Waters	The subsurface operating area coterminous with the surface waters of the VACAPES OPAREA, including two submarine transit lanes (Whiskey and Echo).	Yes
Special Use Airspace (SUA)	SUA: Warning Areas generally overlying the ocean OPAREAS, designated Warning Area (W)–50A/B/C; W-72A/B; W-110; W-386A/B/C/D/E/F/G/H/I/J; and W–387A/B.	Yes
Instrumented Ranges	Oceana Tactical Air Combat Training System Range (TACTS): TACTS supports aircrew training and evaluation using a set of fixed instrumentation sites to form a specialized range known as the Oceana TACTS Range located in the VACAPES OPAREA.	No. TACTS will be covered under separate NEPA action.
Navy- Operated Land and Water-Based Ranges and Associated SUA	The VACAPES Range Complex includes land-side ranges operated by the Navy along with associated SUA in Maryland, Virginia, and North Carolina. Fleet Combat Training Center (FCTC) Dam Neck: FCTC, multi-mission range used to support events occurring in VACAPES OPAREA, especially W-50. Supports surface-to-surface and surface-to-air gunnery, parachute drops, RDT&E, Mine Countermeasures (MCM), Anti-Submarine Tactical Air Controller (ASTAC) and exclusive air operations. FCTC includes the SUA designated as Restricted (R)-6606. Fort Story: Former U.S. Army installation that changed hands to Navy ownership during Base Realignment and Closure (BRAC) 2005. Range training usage includes explosive ordnance disposal (EOD), parachute drops, insertion/extraction, small boat amphibious operations, landing craft air cushion (LCAC), and indoor close quarters combat. Naval Amphibious Base (NAB) Little Creek: Amphibious base used for LCAC training, NSW training, beach assaults, landing craft mechanized (LCM) operations, and Sea, Air, Land (SEAL) Delivery Vehicle Team operations. Palmetto Point Range: Instrumented air-to-ground range previously used for practice, non-explosive munitions only. Includes SUA: R-5301, and R-5302A/B/C. Stumpy Point Range: Instrumented air-to-ground range for practice, non-explosive munitions ordnance only. Includes SUA: R–5313A/B/C/D. Military Operating Areas (MOA): MOAs designated as Stumpy Point, Pamlico A, and Pamlico B generally encompass the Stumpy Point target.	No. Installations are managed by Commander Naval Installations Command (CNIC). CNIC is responsible for preparing NEPA documentation for its installations when necessary. Various NEPA documents have been and are prepared at these installations as projects arise.

TABLE 1.4-1
COMPONENTS OF VACAPES RANGE COMPLEX
(Continued)

Component Area	Description	Addressed in this EIS/OEIS?
Navy- Operated Land and Water-Based Ranges and Associated SUA (*continued*)	NWS Yorktown: Installation includes open burn/open-detonation (OB/OD) site and small-arms range. Navy Auxiliary Landing Field (NALF) Fentress: Installation used primarily for field carrier landing practice (FCLP). Also includes NSW training area. NS Norfolk, Northwest Annex: 3,700-acre site in Chesapeake, Virginia used for NSW training. Navy Dare County Bombing Range (NDCBR): Air-to-ground training range (practice, non-explosive munitions only). NDCBR includes the restricted SUA designated as 5314A/B/C/D/E/F/G/H/I/J.	Specifically for NDCBR, an environmental assessment (EA) was recently prepared for Navy operations. The existing EA is referenced in this VACAPES Range Complex EIS/OEIS.
Other-Service Land Ranges and Associated SUA	Wallops Island, Virginia, is a NASA facility that conducts target and missile launches used in Navy training. The associated SUA is designated as R-6604.	No. NASA has responsibility for environmental planning at this range. An EA was previously prepared by NASA and is referenced in this VACAPES Range Complex EIS/OEIS
	Air Force Dare County Bombing Range is located adjacent to the NDCBR and is occasionally used by the Navy for practice, non-explosive, air-to-ground munitions delivery. The Air Force bombing range in Dare County includes the same SUA used by the Navy, including that designated as R-5314A/B/C/D/E/F/G/H/I/J.	No. The USAF has responsibility for environmental planning at this range. An EA was previously prepared for operations conducted at this range and is referenced in this VACAPES EIS/OEIS.

EIS/OEIS, and Section 2.2 of this EIS/OEIS describes the training and RDT&E events that are addressed within the study area. This EIS/OEIS will provide an evaluation of proposed and current training and testing activities, force structure (to include new aircraft and weapons systems), and associated enhancements as identified in the VACAPES RCMP.

By Presidential Proclamation 5928, issued December 27, 1988, the United States extended its territorial sea, wherein the United States exercises sovereignty and jurisdiction under international law, from 3 nm (5.6 kilometers (km)) to 12 nm (22 km) in conformity with the United Nations Convention on the Law of the Sea. The proclamation expressly provides that it does not extend or otherwise alter existing federal law or any associated jurisdiction, rights, legal interests, or obligations. The proclamation thus did not alter existing legal obligations under the NEPA or other federal environmental statutes. As a matter of policy, however, the Department of the Navy has elected to apply NEPA to the 12-nm limit established by the proclamation. Figure 1.1-1 depicts the 12-nm territorial sea established by Presidential Proclamation 5928 as it relates to the VACAPES offshore areas.Impacts to these areas and those portions of the inner sea range within these boundaries are subjected to analysis under the NEPA. Impacts in the

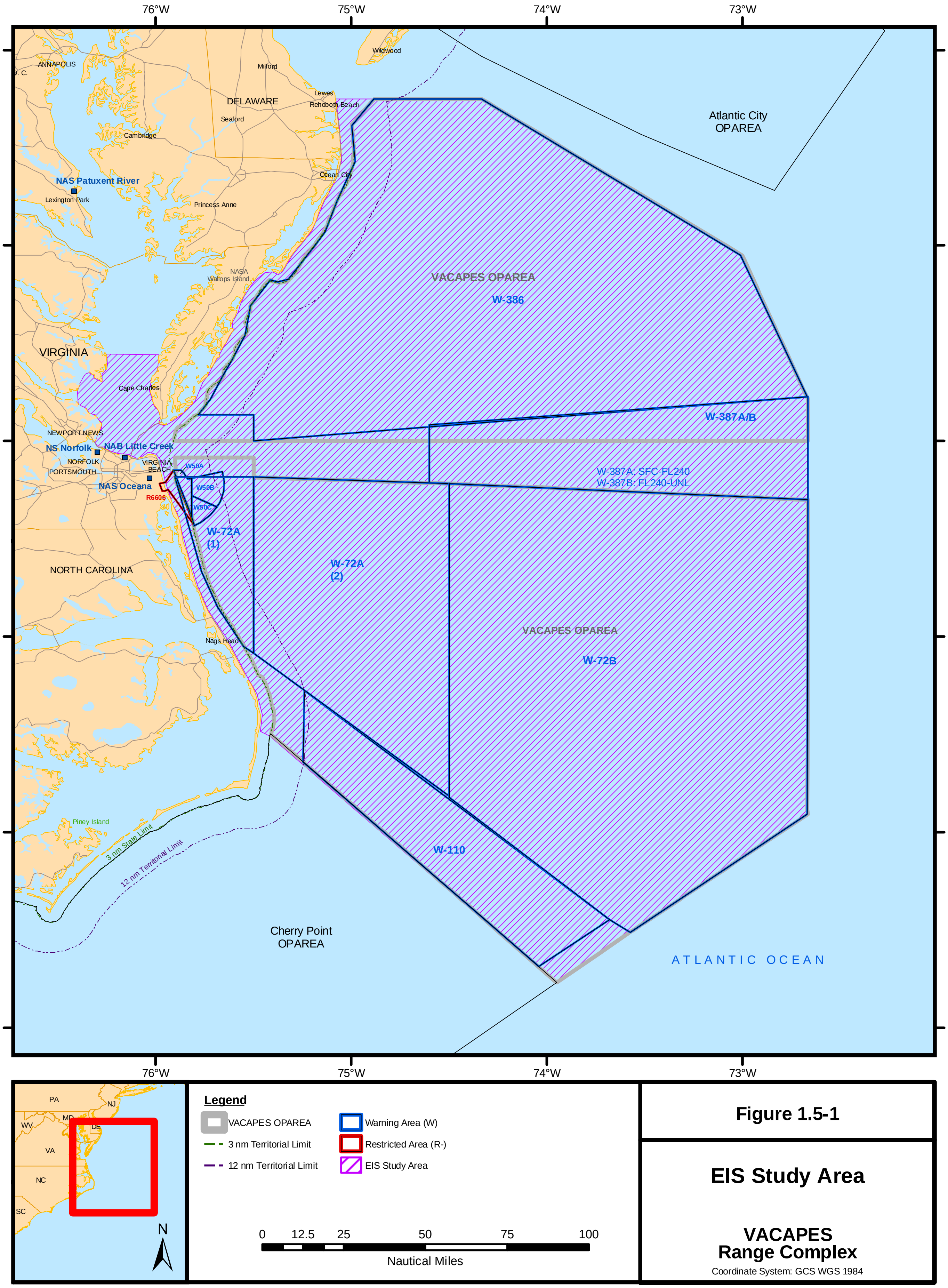


Figure 1.5-1

EIS Study Area

VACAPES Range Complex

Coordinate System: GCS WGS 1984

areas that are outside U.S. territorial waters are analyzed using the procedures set out in EO 12114 and associated implementing regulations.

1.6 THE ENVIRONMENTAL REVIEW PROCESS

1.6.1 National Environmental Policy Act

In 1969 Congress enacted the NEPA, which provides for the consideration of environmental issues in federal agency planning and decision-making. Regulations for federal agency implementation of the NEPA were established by the President's Council on Environmental Quality (CEQ). The NEPA requires an early and open process to determine the scope of issues that should be analyzed in an EIS before an alternative is selected for implementation. The NEPA process is designed to involve and inform the public and local, state, and federal agencies of the potential environmental consequences of a federal agency's proposed action.

The NEPA requires federal agencies to prepare an EIS for proposed actions that may significantly affect the quality of the human and natural environments. The EIS must disclose significant environmental impacts and inform decision-makers and the public of the reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment. The Navy is the lead agency for the proposed action at the VACAPES Range Complex. The National Marine Fisheries Service (NMFS) is a cooperating agency for this EIS/OEIS. A copy of the cooperating agency agreement is provided in Appendix A.

The first step in the NEPA process is preparation of a notice of intent (NOI) to develop a draft EIS (DEIS). A copy of the NOI is provided in Appendix B. The NOI provides an overview of the proposed project and the scope of the EIS/OEIS. The NOI for this project was published in the *Federal Register* on December 8, 2006 (*Federal Register* Volume 71, No. 236, pp 71143-71145) and in four local newspapers. The newspaper notices ran five times in each newspaper. The NOI included Navy point of contact (POC) information, a list of information repositories, the project website address (www.VACAPESRangeComplexEIS.com), a request for public comments, and the dates and locations of the scoping meetings. The following regional newspapers were used to publish the NOI and scoping meeting locations:

- Maryland
  - *The Daily Times*
- Virginia
  - *The Eastern Shore News*
  - *The Virginian-Pilot*
- North Carolina
  - *Outer Banks Sentinel*

Scoping is an early and open process for developing the "scope" of issues to be addressed in an EIS and for identifying significant issues related to a proposed action. The scoping process for this EIS/OEIS was initiated by the publication of the NOI in both the *Federal Register* and local newspapers. During scoping, the public helps define and prioritize issues and conveys these issues to the agency through both oral and written comments.

Scoping meetings were held in the four locations shown in Table 1.6-1.

TABLE 1.6-1
LOCATIONS OF SCOPING MEETINGS FOR VACAPES RANGE COMPLEX EIS/OEIS

Meeting Date	Location
January 8, 2007	Parkside High School, 1015 Beaglin Park Drive, Salisbury, Maryland 21804
January 9, 2007	Chincoteague Community Center, 6155 Community Drive, Chincoteague Island, Virginia 23336
January 10, 2007	Lynnhaven Middle School, 1250 Bayne Drive, Virginia Beach, Virginia 23454
January 11, 2007	Comfort Inn Oceanfront South, 8031 Old Oregon Inlet Road, Nags Head, North Carolina 27959

A revised NOI was issued in the *Federal Register* (Volume 72, No. 171, pp 50940-50941) on September 5, 2007 when potential shallow water non-explosive mine warfare training areas in the southern Chesapeake Bay were identified for analysis. A copy of the revised NOI is in Appendix B. Additional agency and public comments were solicited during the comment period of September 5-30 2007. As with the original NOI, the revised NOI was advertised in the four newspapers listed above, as well as the *Daily Press*, whose circulation focuses on the cities of Newport News and Hampton and other Hampton Roads municipalities.

During the scoping process, 26 comments were received; 17 from government agencies at various levels and nine from individuals. Commenters raised concerns about impacts on fish and fishing; harm to cultural resources, marine protected areas and oyster reefs, and endangered species; and potential conflicts between boating or shipping and Navy activities. Most of these comments were either addressed in Chapter 2 and Appendix D by defining Navy operations that occur in the study area, or in Chapter 3 by assessing the stressors on the various biological resources that occur in the study area. Comments regarding sonar training were not addressed in this EIS/OEIS, but are evaluated in the AFAST EIS/OEIS.

After scoping, a draft EIS/OEIS was prepared to provide an assessment of the potential impacts of the proposed action and alternatives on the environment. It was then provided to the U.S. Environmental Protection Agency (USEPA) for review and comment in accordance with its responsibilities and to have a notice of availability (NOA) published in the *Federal Register* (Appendix B). The Navy also placed notices in the aforementioned newspapers (in addition to *The Daily Press*, *The Beacon*, and the *Gazette Journal*) announcing the availability of the draft EIS/OEIS. The draft EIS/OEIS was circulated for internal review and comment, and notices of availability sent to many federal, state and local officials (distribution list is presented in Chapter 10). The draft EIS/OEIS was made available for general review in public libraries and other publicly accessible locations. The public comment period for the draft EIS/OEIS ended on 11 August 2008. In addition, public meetings were held to accept public comments at the locations shown in Table 1.6-2.

TABLE 1.6-2
LOCATIONS AND DATES OF PUBLIC MEETINGS FOR VACAPES RANGE COMPLEX EIS/OEIS

Meeting Dates	Meeting Locations
July 14, 2008	Princess Royale Oceanfront Hotel, Ocean City, Maryland
July 15, 2008	Community Center, Chincoteague, Virginia
July 16, 2008	Virginia Beach Resort and Conference Center, Virginia Beach, Virginia
July 17, 2008	Hilton Garden Inn, Kitty Hawk, North Carolina

These locations were also identified in the NOA and public hearing notice published in the *Federal Register* (Appendix B). Copies of agency correspondence are provided in Appendix C.

The Final EIS/OEIS incorporates, and formally responds to, all public comments received on the Draft EIS/OEIS (see Appendix F). During the public review process for the Draft EIS/OEIS, 119 comments were received; 30 from government agencies, 66 from state agencies, 9 from organizations and 14 from individuals. Responses took the form of corrections of data inaccuracies, clarifications of and modifications to analytical approaches, inclusion of additional data or analyses, and modification of the proposed action or alternatives. Similar to comments received during the scoping meetings, no comments received on the Draft EIS/OEIS required significant revisions in the Final EIS/OEIS. There were additional revisions, which are reflected in this Final EIS/OEIS, that were made to amplify information previously provided. These changes included a more detailed description of Maritime Security Operations and more detailed Weapon System data sheets located in Appendix E. The Notice of Availability of this Final EIS/OEIS was published in the *Federal Register*, in various newspapers, and on the project website. The Final EIS/OEIS will be made available during a 30-day wait period.

Finally, a Record of Decision (ROD) will be issued, no less than 30 days after the Final EIS/OEIS is made available and published in the *Federal Register* and local newspapers. The ROD will be a concise summary of the decision made by the Navy from the alternatives presented in the Final EIS/OEIS. Specifically, the ROD will state the decision, identify alternatives considered, and discuss other (non-environmental) considerations that influenced the decision identified. The ROD will also describe the implementation of practical measures intended to avoid effects from the chosen alternative and explain any decision not to implement any of these measures. The ROD will also detail any additional mitigation measures which may result from ongoing regulatory processes. Once these regulatory processes are complete, and the ROD is published, the Navy can implement the Proposed Action.

1.6.2 EO 12114

EO 12114, *Environmental Effects Abroad of Major Federal Actions*, directs federal agencies to provide for informed decision making for major federal actions outside the United States., including the global commons, the environment of a non-participating foreign nation, or impacts on protected global resources. An OEIS is required when an action has the potential to significantly harm the environment of the global commons. Global commons are defined as “geographical areas that are outside the jurisdiction of any nation, and include the oceans outside territorial limits and Antarctica. Global commons do not include contiguous zones and fisheries zones of foreign nations” (32 CFR 187.3).

1.7 RELATED ENVIRONMENTAL DOCUMENTS

1.7.1 Documents Incorporated By Reference

In accordance with CEQ regulations for implementing the NEPA, material relevant to an EIS may be incorporated by reference with the intent of reducing the size of the document (40 CFR Section 1502.21). The following paragraphs provide brief descriptions of the documents that are relevant to Navy training and RDT&E in the VACAPES Study Area, and are therefore incorporated by reference into this EIS/OEIS.

EIS: Final Environmental Impact Statement for Increased Flight and Related Operations in the Patuxent River Complex, Patuxent River, Maryland (December 1998, ROD May 1999) (DoN, 1999). The EIS evaluated increased RDT&E flight and related operations in the Patuxent River Complex. The ROD approved Operational Workload III that allows for up to 24,400 flight hours per year, including up to 3,300 annual flight hours of military training support. The operational areas covered in the EIS are under the exclusive control of Naval Air Warfare Center, Aircraft Division (NAWCAD). They include:

- NAS Patuxent River, with all its flight and ground test facilities, runways and associated airspace;
- Outlying Landing Field (OLF) Webster Field with its flight test facilities, runways, and associated airspace; and

- The Chesapeake Test Range (CTR), including its restricted airspace; aerial and surface firing range; and Hooper, Hannibal, and Tangier Island Targets.

No significant impacts were identified in the EIS. The Navy implemented a series of measures in response to public comments about aircraft noise, supersonic events, sufficiency of pilot awareness briefs, unmanned aerial vehicle (UAV) operations in the CTR, and the operation of an open-air aircraft engine test cell. General guidance for meeting the operational and mitigation requirements specified in the ROD can be found in the implementation plan for the final EIS (DoN 1999).

<u>Final EA: Final Environmental Assessment for the Homebasing of the MH-60R/S on the East Coast of the United States (May 2002) (DoN, 2002)</u>. The EA addressed the primary environmental and socioeconomic issues associated with the Navy's proposed action to support the homebasing and operations of new MH-60S and MH-60R (helicopters) on the East Coast of the United States. The MH-60S aircraft type will replace the CH-46D, HH-60H, SH-3H, and HH-1N. The missions assigned to this aircraft will include combat search and rescue (CSAR); surface ship protection; and a new, organic, mine countermeasures role. The MH-60R aircraft type will replace the SH-60B and SH-60F aircraft. The missions assigned to this aircraft include ASW, surface warfare (SUW) and naval gun fire support (NGFS). No significant adverse short-term or long-term impacts were identified as resulting from implementing the Navy's preferred alternative, which was to home-base all or most MH-60S Helicopters at Naval Station (NS) Norfolk, Virginia and all or most MH-60R helicopters at stations in the Jacksonville region.

<u>Endangered Species Act Section 7 Consultation on Mine Warfare Exercises (MINEX) and Explosive Ordnance Disposal (EOD) Unit Level Training at Several Locations Along the East Coast of the United States (October 2002)</u>**.** The National Oceanic and Atmospheric Agency's (NOAA's) National Marine Fisheries Service (NMFS) issued a biological opinion (BO) (NMFS, 2002) for MINEX operations to be conducted indefinitely in three offshore locations, Virginia Beach, Virginia; Onslow Bay, North Carolina; and Charleston, South Carolina. The BO concluded that these underwater detonations are not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, green, hawksbill, or leatherback sea turtles. However, NMFS anticipates incidental takes of these species and issued an incidental take statement (ITS) with mitigation measures to minimize any takes.

<u>Final EIS: Introduction of F/A-18E/F Super Hornets to the East Coast of the US (July 2003)</u>. The final EIS (DoN, 2003) analyzed the impacts of homebasing 10 Super Hornet Squadrons and one Super Hornet Fleet Replacement Squadron at several combinations of east coast Navy and Marine Corps air stations along with the impact to nearby training ranges (BT-9, BT-11, Dare County Range, and Townsend Bombing Range). The final EIS analyzed the amount of ordnance typically used at each range. The final EIS concluded there would not be an increase in the amount of ordnance expended at any of the ranges and that there would not be a significant impact to resources at these ranges. An EIS is currently being developed to evaluate a location for an outlying landing field in Virginia and North Carolina.

<u>EA: Final Site-wide Environmental Assessment Wallops Flight Facility (WFF), Virginia (January 2005) (NASA, 2005)</u>. This NASA EA evaluated the potential impacts associated with a variety of WFF activities that occur in the VACAPES OPAREA, including: rockets, balloons, piloted aircraft, UAVs, autonomous underwater vehicles, payloads, tracking and data systems, scientific research programs and facilities, educational programs, the open burn area, rocket boosted projectile testing, and airfield operations. No significant impacts to the environment were anticipated as a result of the proposed action.

<u>Final OEA: Final Overseas Environmental Assessment (OEA) of Testing the Hellfire Missile System's Integration with the H-60 Helicopter (May 2005) (DoN, 2005)</u>. The OEA addressed developmental and operational testing of Hellfire missile system integration with the H-60 helicopter. Testing involved the firing of non-explosive and high-explosive Hellfire missiles at floating targets located in the VACAPES

OPAREA. After evaluating potential impacts from the proposed action, the determination was that the proposed action would not significantly impact the environment; would have no effect on essential fish habitat (EFH); would not result in reasonably foreseeable "takes" of marine mammals; and would have no effect on threatened and endangered species under the Endangered Species Act (ESA).

Final OEA: Programmatic OEA for Sinking Exercises (SINKEX) in the Western Atlantic Ocean (2006) (DoN, 2006d). The OEA provides environmental impact analysis for SINKEXs conducted in the waters of the western Atlantic Ocean. The purpose of the SINKEX program is to train personnel, test weapons, and study the survivability of ship structures. With the protective measures implemented, the OEA concluded the proposed action would cause no significant or long-term adverse impacts to the marine environment. The Navy determined there would be no reasonably foreseeable takes of marine mammals as defined by the Marine Mammal Protection Act (MMPA). It also concluded the proposed action would not result in impacts to national marine sanctuaries or marine protected areas, and would have no adverse effect to EFH. Impacts to listed species were analyzed in a biological assessment (BA), and a BO was issued by NOAA for this action.

ESA Section 7 Consultation for Sinking Exercises (SINKEX) in the Western Atlantic Ocean (September 2006). NMFS issued a BO (NMFS, 2006) based on the Navy BA (DoN, 2005) that evaluated the potential of the SINKEX to affect the following listed species: north Atlantic right whale, humpback whale, blue whale, fin whale, sei whale, sperm whale, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, and green sea turtle. The BO concluded that proposed SINKEX events are not likely to adversely affect threatened and endangered species or their critical habitat.

EA: Major Atlantic Fleet Training Exercises (February 2006). This EA identified and evaluated the potential environmental effects of conducting major U.S. Atlantic Fleet training exercises within 12 nm of the U.S. east coast and Gulf of Mexico coasts. The Navy may conduct up to six major training exercises annually. The purpose and need for conducting the training exercises are to certify naval forces as combat ready to meet U.S.C. Title 10 requirements. The types of exercises evaluated included: air-to-ground bombing; helicopter events; combat search and rescue; amphibious operations, shore fire control party training; and MIW. No significant impacts to the environment along the U.S. east coast or Gulf of Mexico coasts are anticipated as a result of the proposed action.

Overseas EA: Final Comprehensive Overseas Environmental Assessment for Major Atlantic Fleet Training Exercises (February 2006) (DoN, 2006e). This Overseas EA (OEA) identified and evaluated the potential environmental effects of conducting major U.S. Atlantic Fleet training exercises along the U.S. east coast and Gulf of Mexico. The Navy may conduct up to six major training exercises annually. The purpose and need for conducting the exercises is to certify naval forces as combat ready to meet U.S.C. Title 10 requirements. No significant harm to the environment is anticipated as a result of conducting major Atlantic Fleet training exercises along the east coast and Gulf of Mexico coasts of the United States. The types of exercises evaluated included: bombing; naval gunfire; maritime interdiction operations; torpedo exercises; fast attack craft/fast inshore attack craft; combat search and rescue; air-to-air missile exercises; and mine warfare.

Final Supplement to the Final Comprehensive Overseas Environmental Assessment for Major Atlantic Fleet Training Exercises (DoN, 2006f). The December 2006 Final Supplemental Overseas Environmental Assessment (OEA) documented a quantitative acoustic exposure effects analysis on marine mammals and sea turtles (Naval Surface Fire Support [NSFS] activities only) related to the proposed use of mid-frequency active sonar sources during 2007 Atlantic Fleet major training (Strike Group) exercises and from NSFS Integrated Maritime Portable Acoustic Scoring and Simulator (IMPASS) training that is ancillary to training exercises in accordance with EO 12114. Threshold criteria were used in the quantitative acoustic exposure effects analysis for both mid-frequency active sonar sources and for small ordnance used during NSFS (IMPASS) activities. Level B harassment was analyzed at 173 decibels (dB) after exposures were estimated at the 190 dB level. In addition to sonar, the Navy modeled NSFS explosive 5-inch rounds using the criteria for Level B harassment.

In cooperation with NMFS, a new scientific approach (risk-function) has been under development and is used in the Final AFAST EIS/OEIS to quantify the potential behavioral effects to marine mammals associated with active sonar use in Atlantic Fleet training activities. The current acoustic methodology used to quantitatively assess potential effects at the permanent threshold shift (PTS) and temporary threshold shift (TTS) levels has remained unchanged and is utilized in the Final AFAST EIS/OEIS. (PTS and TTS refer to a shift in the ability to detect sound within certain acoustic ranges due to a marine mammal's exposure to sound).

Final Supplemental Overseas Environmental Assessment (DoN, 2008a). This Final Supplemental OEA analyzed the quantitative acoustic effects for mid-frequency active sonar training events that were scheduled as part of Atlantic Fleet training exercises over the course of one year beginning in Spring of 2008. This document supplements the environmental analysis contained in the Final Comprehensive Overseas Environmental Assessment for Major Atlantic Fleet Training Exercises (DoN, 2006c), focusing on the potential environmental effects from mid-frequency active sonar utilized during Anti-submarine Warfare (ASW) training exercises during the 2008 Atlantic Fleet training exercises beginning in Spring 2008. In its Biological Opinion dated 14 April 2008, NMFS concluded that the anticipated behavioral takes were "not likely to result in jeopardy to the species." In addition, the proposed exercises "are not likely to result in destruction or adverse modification of critical habitat."

NMFS Biological Opinion (BO) in April, 2008, to the *Draft Supplemental to the Final Overseas Environmental Assessment for Major Atlantic Fleet Training Exercises* (October, 2007). NMFS stated that after reviewing the current status of the endangered fin whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, green sea turtle, hawksbill sea turtle, leatherback sea turtle, and loggerhead sea turtle, the environmental baseline for the action area, the effects of the proposed 2008 Atlantic Fleet Training Exercises, and the cumulative effects, it is NMFS' biological opinion that the Navy's proposed 2008 Atlantic Fleet Training Exercises may adversely affect, but is not likely to jeopardize the continued existence of these threatened and endangered species under NMFS' jurisdiction. Because critical habitat that has been designated for endangered or threatened species under NMFS' jurisdiction is not likely to be exposed to the direct or indirect effects of the proposed training exercises, the proposed exercises are not likely to adversely affect designated critical habitat and, as a result, are not likely to destroy or adversely modify that critical habitat.

Final EA: Navy Dare County Bombing Range (January, 2008b). This EA evaluated the potential impacts of air-to-ground bombing using practice, non-explosive munitions, and construction of a military operations on urban terrain (MOUT) target at NDCBR located near Manteo, North Carolina. No significant impacts to the environment are anticipated as a result of the proposed action.

EIS/OEIS: Atlantic Fleet Active Sonar Training (AFAST). The Navy prepared an EIS/OEIS for the use of active sonar and other sources (see Table 3.19-1) of underwater energy during training operations in the East Coast and Gulf OPAREAs of the United States. The types of active sonar analyzed include those using mid- and high- frequencies as well as small explosive charges used in certain ASW devices. AFAST documentation does not include any sources of low frequency sonar. The Navy's ASW and MIW sonars and other acoustic source systems are being studied across a number of environments for myriad Navy training operations in this EIS/OEIS. In addition to incorporating the AFAST EIS/OEIS by reference (see Section 3.19), the VACAPES Range Complex EIS/OEIS includes a summary of effects from active sonar sources utilized in the VACAPES Range Complex based on the analysis of effects from the Final AFAST EIS/OEIS (*Record of Decision* signed 23 January 2009).

1.7.2 Relevant Environmental Documents Being Prepared Concurrently with This EIS/OEIS

The following documents are in progress at this time, and are relevant to Navy training and RDT&E in the VACAPES Study Area, but will not be completed by the time the VACAPES Range Complex EIS/OEIS is finalized.

EIS/OEIS: Undersea Warfare Training Range (USWTR). The Navy is preparing an EIS/OEIS that analyzes the potential impacts of installing and operating a USWTR along the east coast. The proposed action includes training involving the use of mid-frequency active sonar at the USWTR. Several sites along the east coast are under consideration for the USWTR, including a site within the VACAPES Range Complex OPAREA. The analyses in this document, as it pertain specifically to the VACAPES Range Complex, will be included in Chapter 6, Cumulative Impacts of the VACAPES Range Complex EIS/OEIS. (*Record of Decision anticipated Julyr 2009*).

EA: Stand Up of Riverine Squadrons under the Navy Expeditionary Combat Command (NECC). The Navy is conducting an EA (DoN, 2006c) for the permanent homeporting of Riverine Group 1, which is composed of three active riverine squadrons. Each squadron will have 224 personnel and 16 multi-mission riverine crafts. The primary mission of the Navy's riverine force is to conduct maritime security operations, which may include but is not limited to patrol and interdiction, the delivery of land assault forces, resupply and logistics, medical evacuation, security operations, fire support, and civil action support. This EA will analyze the potential environmental effects resulting from the homeporting action and related training requirements of the riverine force. The homeporting action will entail the construction or modification of various administrative, maintenance, storage, and support facilities. Riverine training will include explosive and non-explosive fire combat training and vessel training at inland facilities and in near-shore waters. The homeport sites under evaluation include Naval Weapons Station (NWS) Yorktown, NAB Little Creek, and Naval Construction Battalion Center (NCBC) Gulfport. (*Finding of No Significant Impact anticipated summer 2009).*

CHAPTER 2 : DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The Navy has identified the need to support and conduct current and emerging training and RDT&E operations in the VACAPES Range Complex (see Chapter 1). This chapter provides detailed information on the proposed action and alternatives analyzed in the EIS/OEIS. Over a 10-year planning period, the Navy proposes to implement actions within the VACAPES Range Complex to meet this need by:

- Maintaining baseline training and RDT&E operations at current levels;
- Increasing training and RDT&E operations from current levels as necessary to support the Fleet Readiness Training Plan (FRTP);
- Accommodating mission requirements associated with force structure changes, including those resulting from the introduction of new platforms (vessels, aircraft, and weapons systems); and
- Implementing enhanced range complex capabilities.

Training is governed by the Navy's FRTP. The FRTP sets a deployment cycle for the strike groups that includes three phases: (1) basic, intermediate, and advanced pre-deployment training and certification; (2) deployment; and (3) sustainment training and maintenance. While several strike groups are always deployed to provide a global naval presence, strike groups at homebase must be ready to "surge" on short notice in response to directives from the National Command Authority. Surge refers to the capability to quickly deploy Navy assets, sometimes to multiple locations, in response to world events. For the Navy to be "surge-ready," it must be able to quickly modify its routine training schedule to allow for earlier certification of units before deploying them. One objective of the FRTP is to provide this surge capability. The FRTP calls for the ability to train and deploy six CSGs within 30 days following a deployment order and one additional group within 90 days.

The proposed action does not indicate major changes to VACAPES Range Complex facilities, operations, training, or RDT&E capacities. Rather, the proposed action would result in relatively small-scale, but critical, enhancements to the range complex that are necessary if the Navy is to maintain a state of military readiness commensurate with its national defense mission. The decision-maker will be asked to weigh any potential impacts resulting from this analysis to select the best alternative in order to sustain the Navy's mission.

This chapter is divided into two major subsections: Section 2.1 provides a detailed description of the VACAPES Range Complex. Section 2.2 describes the major elements of the Proposed Action and describes alternatives to the Proposed Action, including the No Action Alternative.

2.1 DESCRIPTION OF THE VACAPES RANGE COMPLEX

The portion of the VACAPES Range Complex evaluated in this EIS/OEIS consists of the following components:

- Offshore OPAREA, which includes surface and subsurface waters. Figure 2.1-1 shows the OPAREA with a surface grid using an alpha-numeric nomenclature
- Airspace, which includes warning areas and restricted areas. Figure 2.1-2 shows these areas with their corresponding grid nomenclature.

Together these components encompass: 27,661 nm^2 of sea space; 28,672 nm^2 of offshore Special Use Airspace (SUA); and 420 nm^2 of the lower Chesapeake Bay.

2.1.1 VACAPES OPAREA

The VACAPES OPAREA is a set of operating and maneuver areas with defined ocean surface and subsurface operating areas that are described in detail in Table 2.1-1.

2.1.2 Special Use Airspace

Restricted Airspace and Warning Areas are components of SUA and are defined by the Federal Aviation Administration (FAA) as follows (FAA Order 7400.8):

Special Use Airspace: Airspace of defined dimensions identified by an area on the surface of the Earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed on aircraft operations that are not part of those activities.

Restricted Airspace: The flight of non-military aircraft, while not wholly prohibited, is subject to restriction. Restricted Airspace denotes the existence of unusual, often invisible hazards to aircraft (e.g., release of ordnance). Restricted Airspace in the VACAPES Range Complex considered in this EIS/OEIS is designated R-6606.

Warning Areas: A warning area is airspace of defined dimensions, extending from 3 nm outward from the U.S. coast, which contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning area is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both. Warning areas in the VACAPES Range Complex considered in this EIS/OEIS are W-50, W-386, W-387, W-72, and W-110.

2.1.3 Surface Danger Zones

Surface Danger Zones (SDZ) are exclusion areas identified to protect the public from weapons firing and detonations during military training. These areas are permitted by the U.S. Army Corps of Engineers (USACOE).

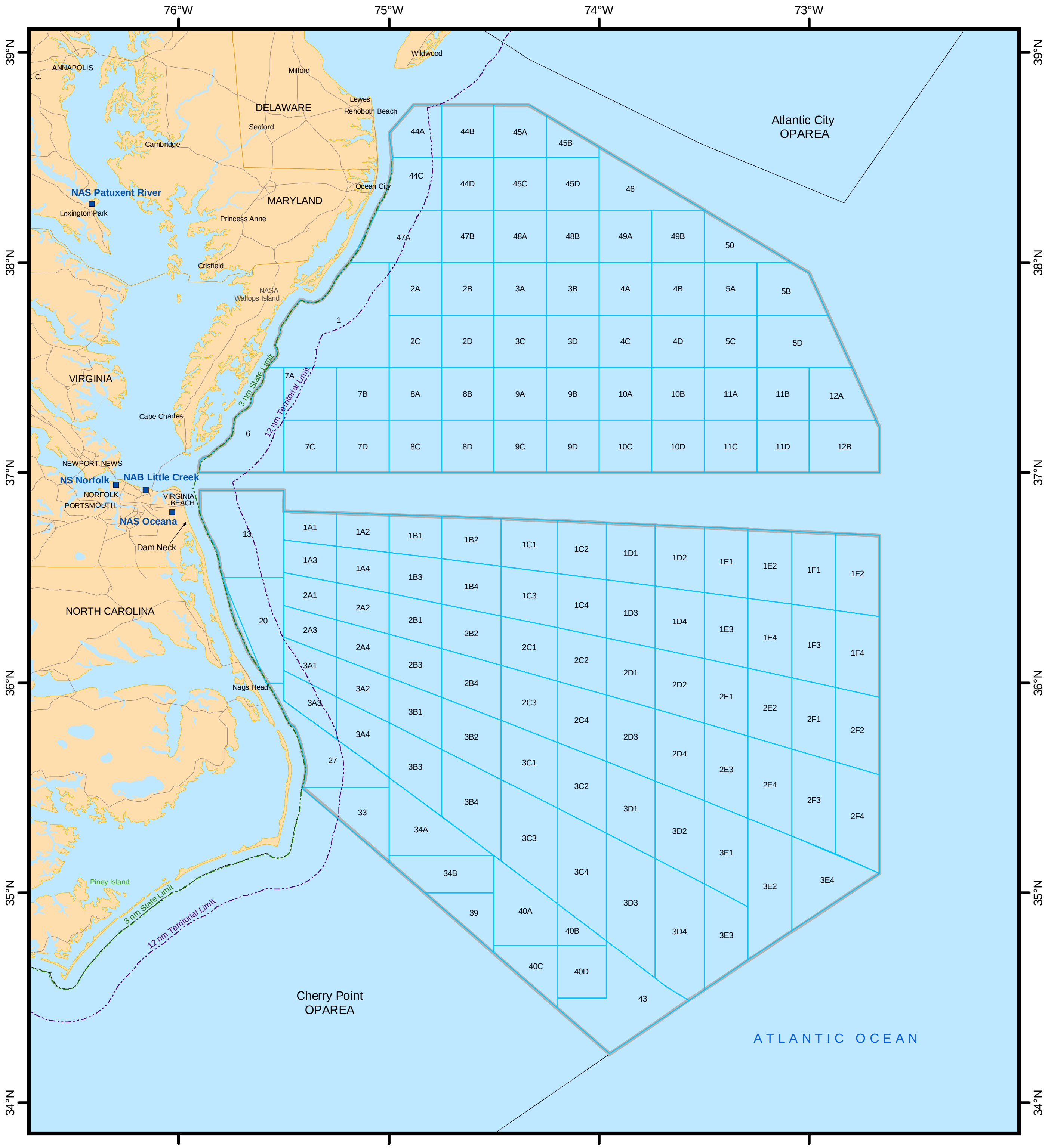
2.2 PROPOSED ACTION AND ALTERNATIVES

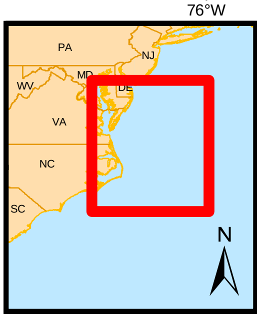
NEPA implementing regulations (40 CFR §1502.14) and Navy procedures (32 CFR Part 775) provide guidance on the consideration of alternatives to a federal proposed action and require rigorous exploration and objective evaluation of all reasonable alternatives. Each alternative must be feasible and reasonable in accordance with CEQ regulations (40 CFR §§ 1500-1508) and Navy guidance (32 CFR Part 775). Reasonable alternatives must meet the stated purpose and need of the proposed action in this case and must be practical or feasible. Alternatives that are outside the scope of what Congress has approved or funded must still be evaluated if they are reasonable because the EIS/OEIS may serve as the basis for modifying the Congressional approval or funding in light of NEPA's goals and policies.

2.2.1 Proposed Action

The proposed action is to support and conduct current and emerging training and RDT&E operations in the VACAPES Range Complex. To achieve this, the Navy proposes to:

- Maintain training and RDT&E operations at current levels if the No Action Alternative is selected.





Legend

- VACAPES OPAREA
- Surface Grid
- 3 nm State Limit
- 12 nm Territorial Limit

Note:
VACAPES OPAREA surface grid coordinates reference:
FACSFAC VACAPES Instruction 3120.1J, (January 2001).

0 12.5 25 50 75 100
Nautical Miles

Figure 2.1-1

OPAREA with Surface Grid

VACAPES Range Complex

Coordinate System: GCS WGS 1984

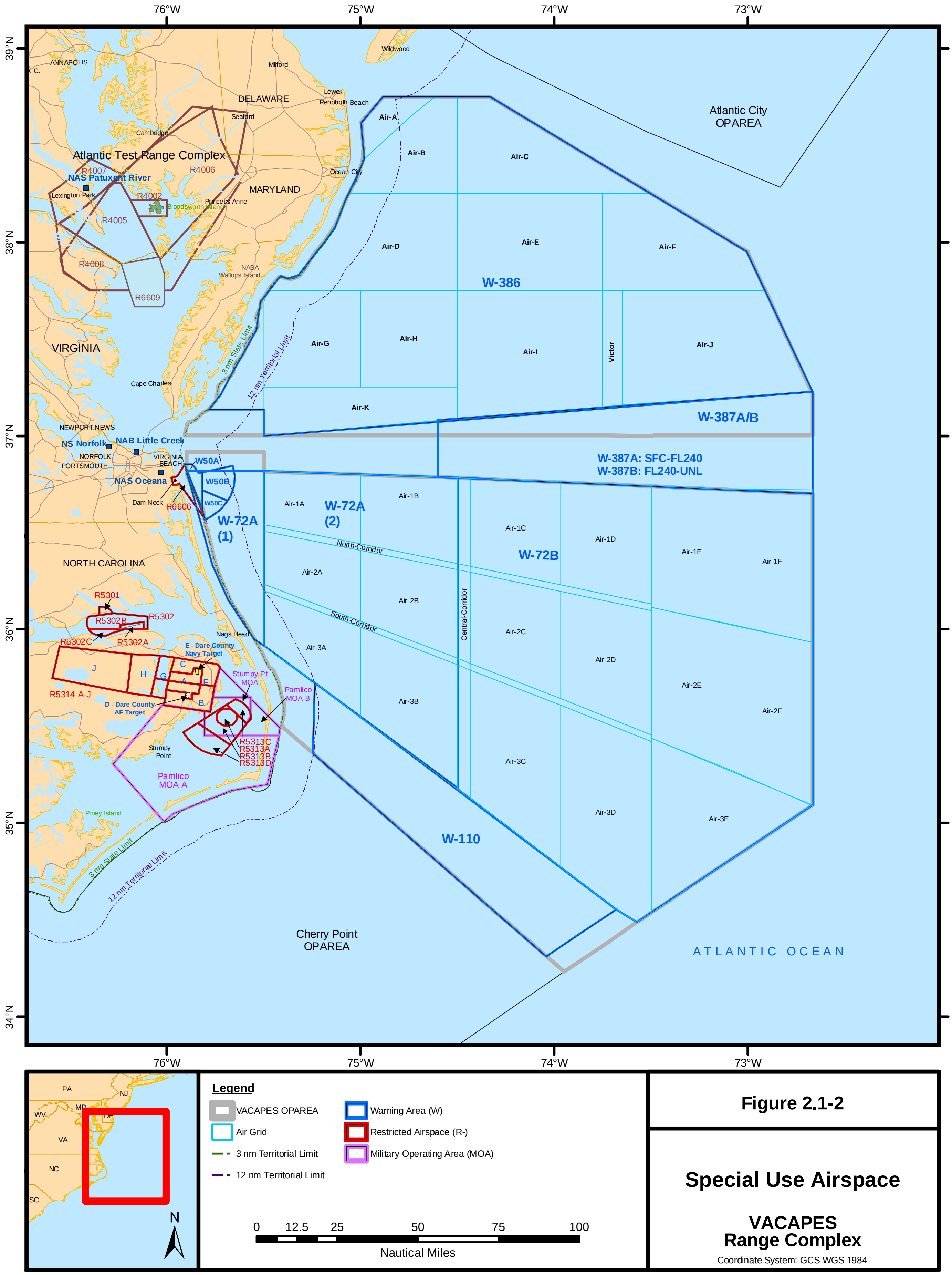


Figure 2.1-2

Special Use Airspace

VACAPES Range Complex

Coordinate System: GCS WGS 1984

TABLE 2.1-1
VACAPES OPAREA AND WARNING AREA DESCRIPTIONS

Component	Description
Operating Area (OPAREA) - Surface Waters	The surface OPAREA within of the VACAPES Range Complex has an area of 27,661 nm^2. The shoreward extent of the OPAREA is roughly aligned with 3 nm state territorial limits. See Figure 2.1-1.
Operating Area (OPAREA) - Subsurface Waters	This area of the VACAPES Range Complex is undersea space that underlies the surface OPAREA. The volume of undersea space associated with a particular portion of the VACAPES Range Complex OPAREA varies greatly, based on the sea floor depth. The types of underwater environments include: • shallow littoral waters (less than 60 feet) • shallow offshore waters (less than 600 feet) • deepwater sloping sea floor and canyons (up to 9,600 feet) • deepwater ocean areas (up to 13,000 feet) This variety in water depth environments offers a challenging setting for submarine training. See Figure 2.1-1.
Special Use Airspace (SUA) - Warning Areas	Warning Areas of the VACAPES Range Complex are large blocks of SUA generally overlaying the VACAPES OPAREA from the surface to an unlimited altitude. Operations conducted in these Warning Areas include all-weather flight training, UAV flights, refueling, test flights, rocket and missile firing, bombing, Fleet training, independent unit training, anti-submarine warfare, aircraft carrier, ship and submarine operations, and anti-air and surface gunnery. Conventional ordnance is permitted. The Warning Areas of the VACAPES Range Complex are: W–50A/B/C; W-72A/B; W-110; W-386A/B/C/D/E/F/G/H/I/J; and W–387A/B. See Figure 2.1-2.
Special Use Airspace (SUA) – Restricted Airspace	R-6606 is SUA associated with Dam Neck Range. The airspace is located approximately 5 nm east of the NAS Oceana Tactical Air Navigation, between the coast at NAS Oceana Dam Neck Annex and the 3-nm territorial sea limit. It borders the western limit of W-50 from the surface to Flight Level 510. Activities conducted within R-6606 include parachute drops, RDT&E, target transit and recovery, exclusive air operations, remotely piloted vehicle operations, and anti-submarine tactical air control. See Figure 2.1-2.

If either Alternative 1 or Alternative 2 is selected, then:

- Increase or modify training and RDT&E operations from current levels as necessary in support of the FRTP.
- Accommodate mission requirements associated with force structure changes, including those resulting from the introduction of new platforms (aircraft and weapons systems).
- Implement enhanced range complex capabilities.

The decision-maker for this FEIS/OEIS will decide both the level and mix of training and testing, and range capability enhancements, that best meet Navy requirements within the VACAPES Range Complex. The following sections discuss the Navy's alternatives with respect to the components that make up the Proposed Action.

2.2.2 Alternatives

Alternatives in this EIS/OEIS were evaluated to ensure they met the purpose and need, giving due consideration to range complex attributes such as the capability to support current and emerging Fleet tactical training and RDT&E requirements; the capability to support realistic, essential training at the level and frequency sufficient to support the FRTP and TAP Program; and the capability to support training requirements while following Navy Personnel Tempo of Operations (PERSTEMPO) guidelines[3].

Three alternatives are analyzed in this EIS/OEIS and are summarized below:

1) The No Action Alternative – Current Operations to include surge consistent with the FRTP;
2) Alternative 1 – No Action Alternative plus: increase operational training, expand warfare missions, accommodate force structure changes[4] (including training resulting from the introduction of new platforms), and implement enhancements, to the minimal extent possible, to meet the components of the proposed action. This alternative is composed of all operations currently conducted under the No Action Alternative, with modifications to current training or introduction of new training. These would include
    a. Using more commercial aircraft to serve as oppositional forces rather than using Navy aircraft for air-to-air missile exercise, surface-to-air gunnery exercises, air intercept control exercises, and detect-to-engage exercises;
    b. Incorporating maritime security training into existing training events;
    c. Adjusting training levels to ensure that deployment can be accelerated quickly and at multiple locations in response to world events; and
    d. Conducting new or modified training associated with the introduction of new MH-60R/S helicopter missions, and new organic mine countermeasure systems.
3) Alternative 2 – Alternative 1 plus: additional increase in operational training, and implementation of additional enhancements to enable the range complex to meet foreseeable needs. This alternative is composed of all operations, force structure changes, and enhancements proposed for Alternative 1, along with the designation of a mine warfare training area in the lower Chesapeake Bay and along the Virginia coast to maximize mine warfare training value, and reducing high explosive BOMBEXs by 96 percent.

2.2.3 No Action Alternative – Description of Current Training Operations within the VACAPES Range Complex

2.2.3.1 Baseline[5] Training Operations

The No Action Alternative is required by regulations of the Council on Environmental Quality (CEQ) as a baseline against which the impacts of the Proposed Action are compared. For the purposes of this EIS/OEIS, the No Action Alternative serves as the baseline level of operations on the VACAPES Range Complex, representing the regular and historical level of training and testing activity necessary to maintain Navy readiness. Consequently, the No Action Alternative stands as no change from current levels of training and testing usage.

Training operations in the VACAPES Range Complex span from unit-level exercises to integrated, major, range training events. The scope of operations consists of air combat maneuvers or ordnance delivery by a single aircraft, to Joint Task Force Exercises (JTFEX) that may involve thousands of participants over a period of two weeks.

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[3] PERSTEMPO is defined by the Navy as time away from homeport, as tracked at the unit level.
[4] Force Structure Changes include changing weapon systems and platforms and homebasing new aircraft and ships.
[5] Baseline training refers to typical training that currently occurs in the Study Area. The numbers of operations were taken from various sources in the most recent years available.

A general description of training operations typically conducted in the VACAPES Study Area is shown in Table 2.2-1. Each military operation described in this EIS/OEIS meets a requirement established by the FRTP. RDT&E events similar to training activities conducted in the VACAPES Range Complex are accounted for in the total events for each warfare area. Training or range enhancements discussed in the VACAPES Range Complex Management Plan (DoN, 2006a) that do not involve environmental resources are not included in the analysis of this EIS/OEIS. Table 2.2-4 provides specific operational data for each range operation listed in Table 2.2-1, including types of vessel/aircraft (platform) used; numbers of annual events; types and quantities of ordnance used; and training areas where the operation would take place. A more detailed summary of each of the training operation, including vessels, aircraft, and weapons systems involved in each event type, and ordnance expended and duration of each event type, is provided in Appendix D.

TABLE 2.2-1
VACAPES STUDY AREA TYPICAL OPERATIONS INCLUDED IN THIS EIS/OEIS [6]

Range Operation	Description	Training Area
Mine Warfare (MIW)		
Mine countermeasures exercise	These exercises train forces to detect, identify, classify, mark, avoid, and disable (or verify destruction of) sea mines using a variety of methods, including air, surface, and subsurface assets.	W-50A/C, W-72, W-386, lower Chesapeake Bay
Mine neutralization	Helicopters, surface and subsurface units, and EOD personnel identify, evaluate, localize and destroy or render safe sea mines that constitute a threat to ships, landing craft or personnel.	W-50C
Surface Warfare (SUW)		
Bombing exercise (BOMBEX) (sea)	These exercises allow aircrew to train in the delivery of bombs against maritime targets.	W-386 (Air-K), W-72A (Air-3B), W-72A/B
Missile exercise (MISSILEX) (air-to-surface)	These exercises use laser and live fire to train fixed-wing aircraft and helicopter aircrews in the delivery of optical, infrared seeking, or laser guided missiles at surface targets.	W-386 (Air-K), W-72A (2)
Gunnery exercise (GUNEX) (air-to-surface)	Gunnery exercises train fixed-wing aircraft and helicopter aircrews to attack at-sea surface targets using guns.	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C
GUNEX (surface-to-surface) (boat)	In these exercises, small boat gun crews train by firing against surface targets at sea.	W-50C, R-6606
GUNEX (surface-to-surface) (ship)	Ship gun crews in these exercises train by firing against surface targets at sea.	W-72, W-386
Laser targeting	Laser targeting exercises are used to train aircraft personnel in the use of laser targeting devices to illuminate designated targets for engagement with laser-guided weapons.	W-386 (Air-K)
Maritime Security (MS) to include Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- Ship and Helo; anti-piracy operations; and special operations forces	VBSS/MIO: Crews from Navy helicopters and surface ships identify, track, intercept, board and inspect foreign merchant vessels suspected of not complying with United Nations/allied sanctions and/or conflict rules of engagement. The boarding party will be delivered from a surface ship via Rubber-hull Inflatable Boat (RHIB) or similar small craft if the target vessel is non-hostile, or via helicopter if hostile. This training event is non-firing. See Appendix D for more descriptions.	VACAPES OPAREA

[6] Anti-Submarine Warfare (ASW) training takes place in the VACAPES Study Area and is analyzed separately in the AFAST Final EIS/OEIS. Potential effects are summarized in Section 3.19 of this document.

TABLE 2.2-1
VACAPES STUDY AREA TYPICAL OPERATIONS INCLUDED IN THIS EIS/OEIS
(Continued)

Range Operation	Description	Training Area
Air Warfare (AW)		
Air combat maneuver (ACM)	ACM is the general term used to describe an air-to-air event involving two or more aircraft, each engaged in continuous proactive and reactive changes in aircraft attitude, altitude, and airspeed. No weapons are fired during ACM operations.	W-72A (Air-2A/B, 3A/B)
GUNEX (air-to-air)	In these training operations, guns are fired from aircraft against unmanned aerial target drones.	W-72A
MISSILEX (air-to-air)	These are training operations in which air-to-air missiles are fired from aircraft against unmanned aerial target drones such as BQM-34 and BQM-74.	W-386 (Air D, G, H, K), W-72A
GUNEX (surface-to-air)	These operations are conducted by surface ships with 5-inch, 76 mm, and 20 mm Close-In Weapons Systems. Targets include unmanned drones or targets towed behind aircraft.	W-386, W72
MISSILEX (surface-to-air)	These operations train surface ship crews in defending against airplane and missile attacks with the ship's missiles. Missile firing ships, including guided missile cruisers, frigates, and destroyers, armed with surface-to-air missiles are required to engage each of three different presentations of aerial threats once per FRTP. The targets used are unmanned aerial drones, such as BQM-34, BQM-74, and GQM-163 Coyote.	W-386 (Air D, G, H, K)
Air intercept control	Surface ship and fixed-wing aircraft crew train in using their search radar capability to direct strike fighter aircraft toward threat aircraft.	W-386, W-72
Detect-to-engage	Shipboard personnel use all shipboard sensors (search and fire control radars and Electronic Support Measures (ESM)) in the entire process of detecting, classifying, and tracking enemy aircraft and/or missiles up to the point of engagement, with the goal of destroying the threat before it can damage the ship.	W-386, W-72
Strike Warfare (STW)		
High-Speed Anti-Radiation Missile Exercise (HARMEX) (air-to-surface)	Aircraft crews train in the use of High-Speed Anti-Radiation Missiles (HARM), the primary weapon designed to target anti-aircraft missile sites.	W-386 (Air E, F, I, J)
Amphibious Warfare (AMW)		
Firing exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	FIREXs with IMPASS are training operations that direct naval gunfire to strike land targets and support military operations ashore. This training is conducted at-sea using a buoy system that simulates a land mass that a ship fires on using IMPASS	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)
Electronic Combat (EC)		
Chaff exercise	Chaff exercises train aircraft and shipboard personnel in the use of chaff to counter missile threats. Training and testing events are not necessarily dedicated sorties, but are combined with other exercises.	W-386, W-386 (Air-K) and W-72
Flare exercise	These exercises train aircraft personnel in the use of flares for defensive purposes when countering heat-seeking missile threats. Training and testing events are not necessarily dedicated sorties, but are combined with other exercises.	W-386, W-386 (Air-K), W-72

TABLE 2.2-1
VACAPES STUDY AREA TYPICAL OPERATIONS INCLUDED IN THIS EIS/OEIS (Continued)

Range Operation	Description	Training Area
Electronic Combat (EC) (Cont)		
Electronic combat operations	Ship-borne electronic combat operations or command and control warfare attempts to control critical portions of the electromagnetic spectrum.	VACAPES OPAREA
Test and Evaluations		
Shipboard Electronic Systems Evaluation Facility (SESEF) utilization	SESEF operations test ship antenna radiation pattern measurements and communication systems.	VACAPES OPAREA

The levels of operations described are derived from data collected during development of the VACAPES Range Complex Management Plan (RCMP) (DoN, 2006a) as documented in the Operations Data Book (DoN, 2006b), data from the Navy's Target and Range Information Management System, personal interviews with naval operators and subject matter experts, and other operations data logs. The data presented later in this chapter in tabular form for the No Action Alternative are an accurate representation of the training activities normally conducted within the VACAPES Range Complex and provide the basis for comparing alternatives and potential environmental impacts.

Table 2.2-2 summarizes the portion of major exercises that are performed in the VACAPES Range Complex. The Anti-Submarine Warfare and Mine Warfare training using active sonar platforms are being analyzed in the AFAST EIS/OEIS and are summarized in Section 3.19 of this document.

Under the No Action Alternative, training operations and major range events would continue at current levels. Under this alternative, the VACAPES Range Complex would not accommodate any increase in training operations because of the requirements of the FRTP or proposed force structure changes, and it would not implement enhancements identified in the RCMP. Evaluation of the No Action Alternative in this EIS/OEIS provides a credible baseline for assessing environmental impacts of Alternative 1 and Alternative 2 (Preferred Alternative).

2.2.4 Alternative 1 – Increases and Modifications to Operational Training, Expand Warfare Missions, Accommodate Force Structure Changes, and Enhanced Range Complex Capabilities

Alternative 1 is a proposal designed to meet Navy and DoD current and near-term operational training and RDT&E requirements. If Alternative 1 were to be selected, in addition to accommodating training operations currently conducted (that is, those described in the No Action Alternative), training operations would be increased or modified, force structure changes would be accommodated, and range complex capabilities would be enhanced to the minimal extent possible to meet the components of the Proposed Action.

Under Alternative 1, training and RDT&E operations would be increased or modified as identified in Tables 2.2-3 and 2.2-4. To accommodate recent force structure changes with the introduction of the MH-60R/S Seahawk Multi-Mission Helicopter (DoN, 2002a), training areas would be needed, including limited capability to support Organic Mine Countermeasures (OMCM).

TABLE 2.2-2
VACAPES RANGE COMPLEX MAJOR EXERCISES

Operation	Warfare Area	Description	Area
Carrier Strike Group (CSG) Composite Training Unit Exercise (COMPTUEX)	Anti-Submarine Warfare; Mine Warfare	The CSG COMPTUEX is a major, at-sea training event that represents the first time before deployment that an aircraft carrier and its carrier air wing integrate operations with surface and submarine units in an at-sea environment. Training events during a CSG COMPTUEX include many of the same events listed individually in Table 2.2-1, but they are conducted together with multiple ships, submarines, and/or aircraft versus individually as with unit-level training. During a CSG COMPTUEX, participants are presented with event-driven, mini-battle problems and an event-driven final battle problem. A CSG COMPTUEX typically lasts 21 days, with training events conducted along the east coast at multiple range complexes and inland ranges. Therefore, only a portion of a CSG COMPTUEX would occur in a given range complex. Thus, CSG COMPTUEX events in the VACAPES Range Complex are limited to ASW training and mine-hunting training involving the use of active sonar; these events are analyzed separately in the AFAST EIS/OEIS [a/].	VACAPES OPAREA
Joint Task Force Exercise (JTFEX)	Anti-Submarine Warfare; Mine Warfare	A JTFEX would be scheduled after a CSG COMPTUEX. This is an advanced training event that often includes other DoD services and/or Allied forces. Like the CSG COMPTUEX, the JTFEX includes many of the same events listed individually in Table 2.2-1, but they are conducted together with multiple ships, submarines, and/or aircraft versus individually as with unit-level training. Training events in a JTFEX are non-scripted, scenario-driven battle problems that focus on mission planning and strategy, and on the orchestration of integrated maneuvers, communication, and coordination. The strike group is presented with a threat-driven scenario involving multiple threats that require advanced target-identification and rules of engagement. A JTFEX typically lasts 10 days, with training events conducted along the east coast at multiple range complexes and inland ranges. Therefore, only a portion of a JTFEX would occur in a given range complex. Like the CSG COMPTUEX, JTFEX events in the VACAPES Range Complex are limited to ASW training and mine-hunting training involving the use of active sonar; these events are analyzed separately in the AFAST EIS/OEIS. [a/]	VACAPES OPAREA

a/ The sonar component of this training is analyzed separately in the AFAST EIS. Potential effects are summarized in Section 3.19 of this document.

2.2.4.1 Proposed Increases and Modifications in Training Operations

The Navy proposes to increase training from current baseline levels at the VACAPES Range Complex by 10 percent for most operations to accommodate short-term national security contingencies and provide planners with flexibility to develop realistic battle problems for major Fleet training exercises.

TABLE 2.2-3
TRAINING ELEMENTS AFFECTED BY COMMERCIAL AIR SERVICES

Training Event	Baseline Sorties/Events	Proposed Sorties/Events	Percentage Increase
GUNEX (air-to-air)	54	60	10%
Electronic combat (aircraft)	100	110	10%
Electronic combat (ships)	165	182	10%
GUNEX (surface-to-air)	43	48	10%
Air intercept control	336	370	10%
Detect to engage	204	225	10%

2.2.4.2 Expand Warfare Missions

Conduct Maritime Security (MS) Surge Surface Strike Group (SSG) (Independent Deployment) Training. Maritime Security Surge operations are addressed in the FRP, and are in turn discussed in this document to ensure that our ability to respond to emergent requirements, such as the rise in piracy and the global war on terrorism, is maintained. The Navy proposes to use VACAPES Range Complex for preparing surface ships and embarked air, special forces and Marine Corps units for deployment as MS SSGs. The Global War on Terror brought increased requests from US combatant commanders for rapid short-term Navy support for contingencies such as anti-terrorism, maritime interception, homeland defense, information operations and special operations. Quite often, groups smaller than CSGs or ESGs can adequately respond to these contingencies if properly configured and trained.

Each fleet maintains a number of ships ready to deploy on short notice. After receiving a request, it can tailor a one to three ship MS SSG, also referred to as Independent Deployers, from among these ‘surge-capable units’ that can best accomplish the mission. Preparing these Independent Deployers includes a mix of classroom, synthetic and live training events. Live training ensures proficiency in multi-unit procedures and autonomous operations by means of anticipated region-specific scenarios. The Navy does not expect MS SSG training to significantly alter the overall type and quantity of operations currently conducted in VACAPES Range Complex.

2.2.4.3 Accommodate Mission Requirements Associated with Force Structure Changes

As part of Alternative 1, the Navy proposes to provide range support and services at the VACAPES Range Complex required to accommodate additional squadrons of aircraft, new systems, and weapons associated with force structure changes. These include:

MH-60S Multi-Mission Combat Support Helicopter missions will include organic mine countermeasures (OMCM, described in detail below), combat search and rescue (CSAR), special operations, logistics support, surface warfare (SUW), maritime intercept operations (MIO) and search and rescue (SAR). Naval Station (NS) Norfolk will host all 100 airframes destined for the Atlantic Fleet, distributed between five carrier airwing (CVW) squadrons, three expeditionary squadrons, and one Fleet replacement squadron.

Most MH-60S operations in the VACAPES Range Complex will be single-aircraft, unit-level training (ULT) sorties of less than two hours that begin and end at NS Norfolk. When participating in a major exercise, a CVW squadron will deploy as an entire squadron when part of a CSG, whereas an expeditionary squadron will deploy one- or-two helicopter detachments aboard frigates, destroyers, cruisers, and amphibious ships in support of an ESG. MH-60S training in the VACAPES Range

TABLE 2.2-4
CURRENT AND PROPOSED OPERATIONS IN THE VACAPES STUDY AREA [1]

Operation	Platform	System or Ordnance	No Action Alternative	Alternative 1	Alternative 2	Training Area
Mine Warfare (MIW)						
Mine countermeasures (MCM)	MH-53E	MK-103 [1, 2]	176 sorties [3]	200 sorties	200 sorties	W-50A/C, Figure 2.2-1
		SPU-1W	64 sorties	70 sorties	70 sorties	Lower Chesapeake Bay, Figure 2.2-2
		MK-104	104 sorties	120 sorties	120 sorties	Lower Chesapeake Bay, Figure 2.2-3
		MK-105	104 sorties	120 sorties	120 sorties	Lower Chesapeake Bay, Figure 2.2-2
		AQS-24A	480 sorties	530 sorties	550 sorties	W-386, W-72, Figure 2.2-4
	MH-60S	OASIS	--	360 sorties	370 sorties	Lower Chesapeake Bay, Figure 2.2-3
		AQS-20A	430 sorties	660 sorties	670 sorties	W-386, W-72, Figure 2.2-4
		ALMDS	--	100 sorties	110 sorties	W-50C
	DDG 91+ (Remote Mine-hunting System [RMS])	AQS-20A	--	12 events	12 events	W-386, W-72, Figure 2.2-4
Mine neutralization	MH-53E	AMNS	--	70 sorties	70 sorties	W-50C, Figure 2.2-1
	MH-60S	AMNS [4]	--	140 sorties (30 rounds)	140 sorties (30 HE rounds)	W-50C, Figure 2.2-1
		RAMICS	--	100 sorties (2500 rounds)	110 sorties (2750 rounds)	W-50C, Figure 2.2-1
	Explosive Ordnance Disposal	20-lb charges	12 events	24 events	24 events	Surface Danger Zone (W-50C), Figure 2.2-5

TABLE 2.2-4
CURRENT AND PROPOSED OPERATIONS IN THE VACAPES STUDY AREA (Continued)

Operation	Platform	System or Ordnance	No Action Alternative	Alternative 1	Alternative 2	Training Area
Surface Warfare (SUW)						
Bombing exercise (BOMBEX) (air-to-surface)	F/A-18	MK-82/GBU-30/38 or similar ordnance (500 lbs High Explosive [HE]) [5]	58 sorties (232 bombs)	58 sorties (232 bombs)	0	W-386 (Air-K), Figure 2.2-6
			20 sorties (80 bombs)	20 sorties (80 bombs)	0	W-72A (Air-3B) Figure 2.2-6
		MK-83/GBU-32 or similar ordnance (1,000 lbs HE bomb) [6]	23 sorties (92 bombs)	23 sorties (92 bombs)	5 sorties (20 bombs)	W-386, (Air-K), Figure 2.2-6 and 2.2-7
			10 sorties (40 bombs)	10 sorties (40 bombs)	0	W-72A, (Air-3B) Figure 2.2-6
		MK-84 or similar ordnance (2,000 lbs HE bomb) [7]	8 sorties (8 bombs)	8 sorties (8 bombs)	0	W-386, (Air-K) Figure 2.2-6
			1 sortie (1 bomb)	1 sortie (1 bomb)	0	W-72A, (Air-3B) Figure 2.2-6
		MK-20 (cluster bomb, HE) [7/]	12 sorties (12 bombs)	12 sorties (12 bombs)	0	W-386, (Air-K) Figure 2.2-6
		MK-20 (non-explosive practice munitions [NEPM])	25 sorties (51 bombs)	28 sorties (56 bombs)	34 sorties (68 bombs)	W-72A/B Figure 2.2-6 and 2.2-7
		MK-76 (NEPM)	25 sorties (129 bombs)	28 sorties (142 bombs)	28 sorties (142 bombs)	W-72A/B Figure 2.2-6 and 2.2-7
		MK-82 (NEPM)			75 sorties 150 bombs	W-72A/B Figure 2.2-6 and 2.2-7
		MK-83 (NEPM)			25 sorties 50 bombs	W-72A/B Figure 2.2-6 and 2.2-7
		BDU-45 (NEPM)	20 sorties (45 bombs)	22 sorties (50 bombs)	22 sorties (50 bombs)	W-72A/B Figure 2.2-6 and 2.2-7
BOMBEX (air-to-surface)	F/A-18, F-35 (Joint Strike Fighter [JSF])	BDU-33, GBU-12, JDAM, JSOW, MK-76, MK-82, MK-84 (all NEPM)	70 sorties (70 bombs)	77 sorties (77 bombs)	77 sorties (77 bombs)	W-386 (Air-K) Figure 2.2-6

TABLE 2.2-4
CURRENT AND PROPOSED OPERATIONS IN THE VACAPES STUDY AREA (Continued)

Operation	Platform	System or Ordnance	No Action Alternative	Alternative 1	Alternative 2	Training Area
Surface Warfare (SUW) (continued)						
Missile exercise (MISSILEX) (air-to-surface)	MH-60R/S, HH-60H [8]	AGM-114 (Hellfire missile; HE)	30 sorties (30 missiles)	60 sorties (60 missiles)	60 sorties (60 missiles)	W-386 (Air-K) (75%) W-72A (25%), Figure 2.2-8
	F/A 18, P-3C and P-8 [9]	AGM-65 E/F (Maverick; HE)	20 sorties (20 missiles)	20 sorties (20 missiles)	20 sorties (20 missiles)	W-386 (Air-K) Figure 2.2-9
	F/A 18, F-35 (JSF), H-60	AGM-114 (Hellfire), AGM-88 (HARM), AGM-65 LSR (Maverick), AGM-84 (Harpoon) [10]	21 sorties	23 sorties	23 sorties	W-386 (Air-K)
Gunnery exercise (GUNEX) (air-to-surface) [11]	MH-53E	.50-cal machine gun	24 sorties (48,000 rounds)	27 sorties (54,000 rounds)	27 sorties (54,000 rounds)	W-72A (Air-1A) (75%) W-50C (25%)
	MH-60R/S	2.75-inch rockets	0	97 sorties (3,700 rounds)	97 sorties (3,700 rounds)	W-386 (Air-K) (75%) W-72A (25%)
		.50-cal machine gun	200 sorties (161,280 rounds)	330 sorties (264,000 rounds)	330 sorties (264,000 rounds)	W-72A (Air-1A) (75%) W-50C (25%)
GUNEX (air-to-surface)	MH-60R/S	M-240 (7.62 mm machine gun)	100 sorties (161,280 rounds)	165 sorties (264,000 rounds)	165 sorties (264,000 rounds)	W-72A (Air-1A) (75%) W-50C (25%)
	F/A-18, F-35 (JSF)	20 mm cannon (NEPM)	10 sorties (6,000 rounds)	11 sorties (7,000 rounds)	11 sorties (7,000 rounds)	W-386, (Air-K)
GUNEX (surface-to-surface) (boat)	Vessels such as small unit river craft, combat rubber raiding craft, rigid hull inflatable boats, and patrol craft [12]	.50-cal, 7.62 mm	32 events (200,000 small cal. rounds)	36 events (220,000 small cal. rounds)	36 events (220,000 small cal. rounds)	W-50C (90%) R-6606 (10%)
		40 mm grenades	32 events (540 rounds)	36 events (600 rounds)	36 events (600 rounds)	W-50C (90%) R-6606 (10%)

TABLE 2.2-4
CURRENT AND PROPOSED OPERATIONS IN THE VACAPES STUDY AREA (Continued)

Operation	Platform	System or Ordnance	No Action Alternative	Alternative 1	Alternative 2	Training Area
Surface Warfare (SUW) (continued)						
GUNEX (surface-to-surface) (ship) [13]	CG, DDG [14]	5–inch gun	104 events (2,211 rounds)	115 events (2,430 rounds)	115 events (2,430 rounds)	W-386 (80%) W-72 (20%)
	FFG [15]	76 mm gun	20 events (335 rounds)	22 events (370 rounds)	22 events (370 rounds)	W-386 (80%) W-72 (20%)
	CG, DDG, FFG, LHA, LHD, LPD, LSD [16]	.50-cal machine gun	108 events (237,600 rounds)	120 events (261,600 rounds)	120 events (261,600 rounds)	W-386 (80%) W-72 (20%)
		25 mm machine gun	108 events (124,800 rounds)	120 events (137,400 rounds)	120 events (137,400 rounds)	
Laser targeting [17]	F/A-18	Maverick missile laser designation system	124 sorties	136 sorties	136 sorties	W-386 (Air-K), W-72A
	H-60	Hellfire missile laser designation system	124 sorties	136 sorties	136 sorties	
Maritime Security Operations to include VBSS/MIO	Rigid Hull Inflatable Boat (RHIB) or similar small boat, and CG, DDG, FFG, LPD or LSD	No ordnance used	84 events	92 events	92 events	VACAPES OPAREA
VBSS/MIO- Helo	H-60	No ordnance used	40 events (3 sorties/event)	44 events (3 sorties/ event)	44 events (3 sorties/event)	VACAPES OPAREA
Air Warfare (AW)						
Air Combat Maneuver (ACM)	F/A-18[18]	Captive-carry missile or telemetry pod	5,264 sorties	5,800 sorties	5,800 sorties	W-72A (Air-2A/B, 3A/B)
GUNEX (air-to-air)	F/A-18[19]	20 mm cannon	54 sorties (13,500 rounds)	60 sorties, (15,000 rounds)	60 sorties (15,000 rounds)	W-72A
MISSILEX (air-to-air)	F/A-18 [20]	AIM-7, AIM-9, AIM-120	143 sorties (43 HE and 100 NEPM missiles)	160 sorties (48 HE and 112 NEPM missiles)	160 sorties (48 HE and 112 NEPM missiles)	W-72A

TABLE 2.2-4
CURRENT AND PROPOSED OPERATIONS IN THE VACAPES STUDY AREA (Continued)

Operation	Platform	System or Ordnance	No Action Alternative	Alternative 1	Alternative 2	Training Area
	F/A-18, F-35 (JSF) [21]	AIM-7, AIM-9, AIM-120, AIM-132 (ASRAAM)	30 sorties (30 missiles)	33 sorties (33 missiles)	33 sorties (33 missiles)	W-386 (Air D, G, H, K)
Air Warfare (AW) (Continued)						
GUNEX (surface-to-air) [22]	CG, DDG	5–inch gun	13 events (264 rounds)	15 events (290 rounds)	15 events (290 rounds)	W-386 (80%), W-72 (20%)
	FFG	76 mm gun	3 events (72 rounds)	3 events (72 rounds)	3 events (72 rounds)	W-386 (80%), W-72 (20%)
	CG, DDG, FFG, CVN, [23] LHA, LHD, LPD, LSD	20 mm Close-in Weapons System	27 events (57,400 rounds)	30 events (64,000 rounds)	30 events (64,000 rounds)	W-386 (80%), W-72 (20%)
MISSILEX (surface-to-air)[24]	AOE [25], LHD, CVN	NATO Sea Sparrow	30 RDT&E events	33 RDT&E events	33 RDT&E events	W-386 (Air D, G, H, K)
	CG, LHA, AOE	Evolved NATO Sea Sparrow				
	CVN, FFG, LHA, LHD, LSD, LPD	Rolling Airframe Missile				
	CG, DDG	SM-2				
MISSILEX (surface-to-air)[26]	CG, DDG, LHA, LHD, LSD, LPD	SM-2 (20 missiles); Sea Sparrow (2 missiles); RAM (2 missiles)	0 events	0 events	24 events (24 missiles)	VACAPES OPAREA
Air intercept control (AIC) [27]	F/A-18, E-2C, CVN, CG, DDG, LHA, LHD	Air search & fire control radars	366 events	370 events	370 events	W-386 and W-72
Detect to engage (DTE) [28]	CG, DDG, FFG, LHA, LHD, LPD, LSD, CVN	Air search & fire control radars	204 events	225 events	225 events	W-386 and W-72
Strike Warfare (STW)						
HARM missile exercise (HARMEX) (air-to-surface)	F/A-18 [29]	AGM-88 (HARM)	26 sorties (26 missiles)	26 sorties (26 missiles)	26 sorties (26 missiles)	W-386, (Air E, F, I, J) Figure 2.2-9

TABLE 2.2-4
CURRENT AND PROPOSED OPERATIONS IN THE VACAPES STUDY AREA (Continued)

Operation	Platform	System or Ordnance	No Action Alternative	Alternative 1	Alternative 2	Training Area
Amphibious Warfare (AMW)						
FIREX with IMPASS	CG, DDG	5-inch gun (IMPASS) [30]	22 events (1,540 rounds)	22 events (1,540 rounds)	22 events (1,540 rounds)	(Preferred Areas W-386 7C/D, 8C/D, W-72 (1C1/2)), (Secondary Areas W-386 [5C/D])[31] Figure 2.2-10
Electronic Combat (EC))						
Chaff exercise	F/A-18	RR-144A/AL defensive chaff [32]	1,770 sorties (17,700 canisters)	1,950 sorties (19,500 canisters)	1,950 sorties (19,500 canisters)	W-72 (85%) W-386 (15%)
	MH-60R/S		6 sorties (180 canisters)	17 sorties (510 canisters)	17 sorties (510 canisters)	W-386 (Air-K)
	F/A-18, MH-60R/S, F-35 (JSF)		12 sorties (120 canisters)	14 sorties (140 canisters)	14 sorties (140 canisters)	W-386 (85%) W-72 (15%)
	CG, DDG, FFG, LCC, LHA, LHD, LPD, LSD	MK-214 or MK-216 Super Rapid Bloom Off-board Chaff (SRBOC) defensive chaff [33]	MK-214 25 events (150 canisters) MK-216 8 events (48 canisters)	MK-214 28 events (168 canisters) MK-216 9 events (54 canisters)	MK-214 28 events (168 canisters) MK-216 9 events (54 canisters)	
Flare exercise	F/A-18	Defensive flares [34]	50 sorties (250 flares)	55 sorties (275 flares)	55 sorties (275 flares)	W-72 (85%) W-386 (15%)
	MH-60R/S		6 sorties (180 flares)	17 sorties (510 flares)	17 sorties (510 flares)	W-386 (Air-K)
	F/A-18, MH-60R/S, F-35 (JSF)		7 sorties (35 flares)	8 sorties (40 flares)	8 sorties (40 flares)	W-386 (85%) W-72 (15%)
Electronic combat (EC)operations	F/A-18 F-35 (JSF)	ALE-50/55 electronic jammer	9 sorties	10 sorties	10 sorties	W-386 (Air-K)
EC operations	F/A-18		100 sorties	110 sorties	110 sorties	W-386 (15%) W-72 (85%)
EC operations	AOE, CG, CVN, DDG, FFG, LHA, LHD, LPD, LSD	SLQ-32	165 events	182 events	182 events	VACAPES OPAREA

TABLE 2.2-4
CURRENT AND PROPOSED OPERATIONS IN THE VACAPES STUDY AREA (Continued)

Operation	Platform	System or Ordnance	No Action Alternative	Alternative 1	Alternative 2	Training Area
Test and Evaluation						
Shipboard Electronic Systems Evaluation Facility Utilization (SESEF)	All Hampton Roads-based ships	Radio and radar only	3,456 tests[35]	3,800 tests	3,800 tests	VACAPES OPAREA (SESEF ULM-4 Range and RCS Range)

1 Shaded rows signify "High-Explosive (HE)" rounds. The Net Explosive Weights (NEW) of each is listed in Table 2.2-7.
2 MK-103 uses a 0.002 lb Net Explosive Weight (NEW) charge. Up to 25% of the sorties would use HE cartridges (50 cartridges) and only in Alternative 2; all other sorties would only tow the cable.
3 Sortie is defined here as a single operational training or testing event conducted by one aircraft in a range or operating area. A sortie is one complete flight (one take-off and one full stop landing). In this table "events" are non-aircraft training or testing platforms. See Chapter 8 (Glossary for detailed explanations).
4 AMNS uses a 3.24 lb NEW charge. HE rounds would be used in 20% of the sorties for Alternative 1 or 2.
5 Assumes 4 MK-82 bombs/sortie and 1 GBU-30/38 Joint Direct Attack Munitions (JDAM) bomb/sortie.
6 Assumes 4 MK-83 bombs/sortie and 1 GBU-30/38 Joint Direct Attack Munitions (JDAM) bomb/sortie.
7 Assumes 1 bomb per sortie.
8 Improved Surface Towed Target (ISTT), which is a laser target on a barge; missile detonates 10-20 ft above surface target.
9 P-8 will be the replacement platform for the P-3C; uses ISTT.
10 100% Non-explosive practice munitions except Hellfire and an occasional test with HE round.
11 Targets for helicopters are smoke floats; F/A-18, F-35 (JSF); RDT&E only.
12 Navy Special Warfare Small Boat Teams or other local maritime security units.
13 CG: Cruiser; DDG: Guided Missile Destroyer; FFG Guided Missile Frigate; LHA: Amphibious Assault Ship, general purpose; LHD: Multipurpose Amphibious Assault Ship; LPD: Amphibious Assault Ship, Transport Dock; LSD: Dock Landing Ship; all rounds are non-explosive practice munitions.
14 Targets vary depending on training event: High speed Maneuvering Surface Target (HSMST), Mk-33 SEPTAR, trimaran or radar reflective surface balloon (killer tomato).
15 Targets vary depending on training event: HSMST or killer tomato.
16 Targets: 55 gallon drum, balloon (weather, Mylar, or target), or Floating At Sea Target (FAST).
17 Non-firing Missile Exercise (Air-to-Surface). Aircrews perform all procedures for missile deployment short of launching the missile, including acquiring and designating target with laser.
18 100% captive carry (no ordnance launched); CATM-9 used for pilot training in aerial target acquisition and use of aircraft controls/displays.
19 Live fire against towed banner.
20 Uses drone targets (BQM-74E) launched from FTC Dam Neck (~33%) or Tactical Air Launch Decoy (TALD) (~67%). Missiles are 30% HE and 70% NEPM.
21 Training flights; uses drone targets (BQM-34, BQM-74, or Coyote) launched from NASA Wallops Island.
22 Exercises use towed banner targets
23 Aircraft carrier, nuclear.
24 NAVAIR launches drones (subsonic BQM-34/74 and supersonic Coyote) out of Goddard Flight Facility, NASA Wallops Island to support tests; all NEPM missiles.
25 Fast Combat Support Ship
26 SM-2 would be fired from CG/DDG; Sea Sparrow would be fired from LHA/LHD; RAM would be fired from LSD/LPD; Targets for SM-2/Sea Sparrow would be BQM-74 launched from Gulfstream aircraft, surface vessel, or land-based (Dam Neck); RAM target would be BQM-34 launched from Wallops Island
27 Unit-level training only (ULT); commercial air services (CAS) provides intercept or threat aircraft or both
28 ULT only. CAS to provide threat aircraft or simulated missile.
29 Uses target on a barge; all missiles are HE rounds; missile detonates approximately 30-60 ft above the water.
30 High-explosive rounds have an 8 lb NEW. Both HE and NEPM rounds are used; notionally 39 HE rounds and 31 NEPM rounds used per event.
31 Assumed equal IMPASS use of three areas: (1) 7C/D and 8C/D; (2) 1C1 and 1C2; and (3) 5C/D.
32 Training and test events. Chaff release events not necessarily dedicated sorties.
33 Assume 4 canisters per event.
34 Training and test events. Flare release events are not necessarily dedicated sorties.
35 Generates electronic and radio signals to current shipboard systems for calibration; SESEF testing is not analyzed in this EIS/OEIS; there are no munitions or military expendable materials used.

Complex addressed in this EIS/OEIS is all at-sea training, including OMCM, air-to-surface missile and gunnery exercises (components of CSAR, special operations, and SUW capability), and chaff and flare exercises (electronic combat capability that supports all other mission areas).

MH-60R Multi-Mission Helicopter missions will include anti-submarine warfare (ASW), SUW, MIO, and SAR. The Atlantic Fleet will split the projected 105 airframes between Naval Air Station (NAS) Jacksonville and NS Mayport, distributed between five CVW squadrons, two expeditionary squadrons, and one Fleet replacement squadron.

Most MH-60R ULT operations will occur in the Jacksonville Range Complex near their home bases. With few exceptions, the MH-60R will only train in the VACAPES Range Complex when participating in a major exercise. A concurrent EIS/OEIS analyzes these operations.The deployment and training patterns for the MH-60R resemble those for the MH-60S described above. MH-60R operations in the VACAPES Range Complex are primarily sonar training, which is not addressed in this EIS/OEIS. All Navy sonar operations in the Atlantic Ocean and Gulf of Mexico are analyzed separately in the Atlantic Fleet Active Sonar Training (AFAST) EIS/OEIS, summarized in Section 3.19 of this document.

Conduct Training with Organic Mine Countermeasures (OMCM) Systems

The Navy proposes to accommodate operations of MH-60S helicopters, surface ships, and submarines equipped with new OMCM systems in the VACAPES Range Complex. This will entail some changes in tactics, techniques, and procedures from current mine warfare training. “Organic” refers to the concept of embedding mine warfare capability into the strike group rather than as an external capability of specialized ships and aircraft, only brought in on an as-needed basis.

The Navy will configure 51 of the 102 MH-60Ss eventually homebased at NS Norfolk with OMCM capability. These systems, described below and in Appendix D, include:

- Towed mine-hunting sonar (AN/AQS-20A);
- Towed magnetic influence and acoustic, mine-sweeping body (OASIS);
- Airborne mine-hunting laser (ALMDS);
- Submerged mine-neutralization, self-propelled device using explosive charges (AMNS); and
- Airborne, mine-neutralization ordnance (RAMICS).

Potential effects associated with the active sonar component of AQS-20 and AMNS are analyzed separately in the Atlantic Fleet Active Sonar Training (AFAST) EIS/OEIS, and summarized in Section 3.19.

AN/ASQ-235 Airborne Mine Neutralization System (AMNS) is a non-towed system designed to identify and neutralize bottom and moored mines in the ocean environment. A hovering MH-60S or MH-53E helicopter lowers an expendable, self-propelled, neutralizer device into the water at a safe distance from a potential mine previously identified with a separate mine-hunting system. A fiber-optic cable connected to the neutralizer relays depth, position, and sensor (sonar and video) information to the operator in the helicopter, who sends control and guidance commands back to the neutralizer. The operator guides the lightweight (15.5 kg) and highly maneuverable vehicle to the target location using on-board high frequency sonar. After the target is viewed and positively identified with an on-board video camera, the operator fires an armor-piercing warhead from the vehicle to neutralize the mine.

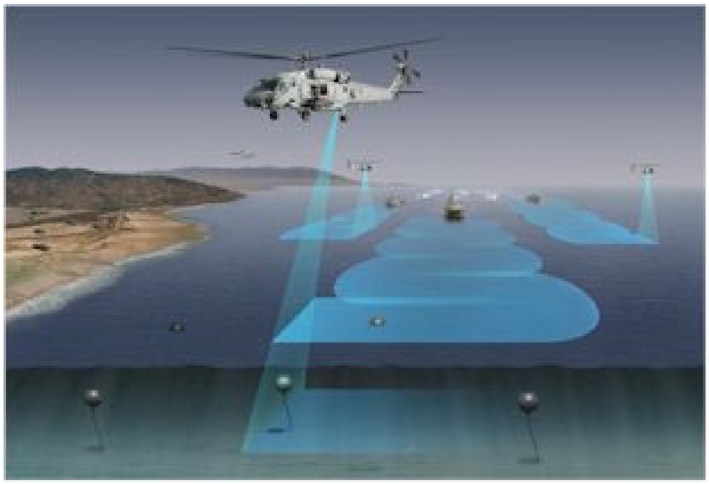
For training and testing purposes, the AMNS explosive charge can be replaced with a ballast device that will cause the neutralizer to float to the surface for recovery and reuse after completion of the exercise. Training targets are expendable, non-explosive, bottom and moored mineshapes. The Navy evaluated the potential environmental effects of testing AMNS and concluded that significant impacts would not occur (DoN, 2001; 2002b).

A/AWS-2 Rapid Airborne Mine Clearance System (RAMICS) is a non-towed system designed to neutralize floating and near-surface mines. RAMICS is a MK44 Bushmaster II cannon with a laser Light Detection and Ranging (LIDAR) targeting fire control system that fires a flat-nosed, 30 mm, armor-piercing, non-explosive, super-cavitating projectile.

A hovering MH-60S helicopter uses the LIDAR to reacquire a mine previously located with a separate mine hunting system. Once the target is acquired, an onboard fire control subsystem automatically tracks it and aims the gun, firing the projectiles in bursts. A successful neutralization will disable the mine at a safe distance from the helicopter. Training targets are expendable, non-explosive, bottom and moored mineshapes. The Navy evaluated the potential environmental effects of testing RAMICS and concluded that significant impacts would not occur, though the gun tested was a 20-mm Gatling gun and not the current 30-mm Bushmaster (DoN, 2000).

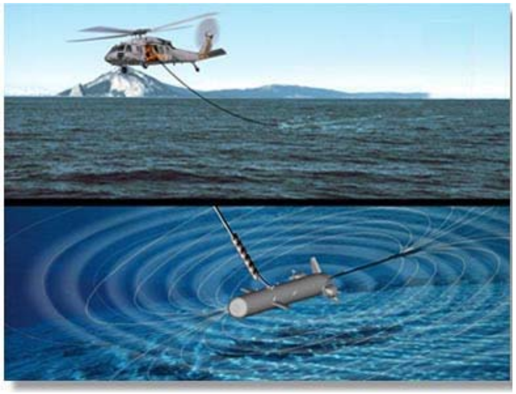
AN/AES-1 Airborne Laser Mine Detection System (ALMDS) is a non-towed (airborne) mine-hunting system designed to rapidly detect, classify, and locate near-surface floating or moored mines. A pod mounted on the MH-60S pylon contains the laser LIDAR system used to detect mines. An operator on the helicopter identifies potential mines from the laser images on a video monitor and marks their exact locations. A separate mine neutralization system is needed to disable or destroy mines once they have been identified. The Navy evaluated the potential environmental effects of testing ALMDS and concluded that significant impacts would not occur (DoN, 2003b).

MH-60S Helicopter with RAMICS



ALMDS

AN/ALQ-220 Organic and Surface Influence Sweep (OASIS) is a high-speed (25 knots), towed, minesweeping system designed to rapidly neutralize magnetic and acoustic mines in shallow coastal waters. It emulates the magnetic and acoustic signatures of transit platforms, causing nearby mines to detonate. An underwater, towed body attached to a MH-60S helicopter with an electromechanical cable contains the electromagnetic field generator and the acoustic generator, a mechanical device that needs no external power. The Navy evaluated the potential environmental effects of testing OASIS in the Chesapeake Bay and concluded that significant impacts would not occur (DoN, 2005).



OASIS

AN/AQS-20

AN/AQS-20 is a towed, mine-hunting system designed to detect, classify, and localize bottom and moored mines in deep or shallow water. An underwater, towed body attached to an MH-60S helicopter with an electromechanical cable that contains the high-frequency, high-resolution, side-looking, multi-beam sonar system. It can also be configured with an electro-optic identification sensor that incorporates a laser LIDAR system to identify bottom mines. An operator on the helicopter identifies potential mines from the sonar and laser images on a video monitor and marks their exact locations. A separate mine neutralization system is needed to disable or destroy mines once identified. The Navy evaluated the potential environmental effects of AN/AQS-20 inert mission tests and determined that there were no significant impacts on marine resources (DoN, 2003a).

Description of Mine Neutralization Training Area

Except for training with the new organic mine neutralization systems (RAMICS and AMNS), Navy MH-53E and MH-60S helicopter Mine Warfare training in the VACAPES Range Complex will continue as it is done currently. Most operations are single-aircraft, ULT events accomplished without training mines, an omission that seriously compromises the quality of training. These flights involve planning an appropriate search, deploying the equipment, flying the search pattern, familiarizing the operators with system procedures, and recovering the equipment, all useful exercises. Some systems have an organic simulation capability. However, without training mines, the operators can not gain experience in actually detecting, identifying, and localizing mines, and the trainers can not provide feedback to the aircrew about the efficacy of their tactics and technique.

The squadrons work around this range capability shortfall by, on occasion, temporarily deploying non-explosive recoverable training mines in the VACAPES Range Complex for a week or so, or by sending detachments to the Navy RDT&E minefield off the coast of Panama City, Florida. Both of these options are expensive and laborious, and may become untenable as the fleet of NS Norfolk-based mine warfare helicopters increase from one MH-53E squadron to two MH-53E and four MH-60S squadrons.

The aircrews can derive value, albeit compromised, by training with mine hunting and sweeping systems without training mines. However, target non-explosive mine shapes are critical for training with mine neutralization systems. As discussed above, mine hunting and sweeping operations entail fairly elaborate planning, streaming, searching, and recovering procedures that the aircrews need to master independent of detecting, identifying, and neutralizing mines. In contrast, mine neutralization operations with RAMICS and AMNS are more straightforward, consisting of relocating and destroying previously located mines. As in target practice with a gun, the primary training value is in hitting the target, not deploying the system.

Alternative 1 would address this deficiency by establishing a **Mine Neutralization Training Area** in the VACAPES OPAREA underneath the W-50C SUA (Figure 2.2-1), designated as a Safety Danger Zone under 33 CFR §334.390. In this area, the Navy will deploy about 140 non-explosive, expendable mine shapes per year in addition to the 24 underwater detonations already conducted by EOD personnel. The helicopters will concentrate their operations in two relatively small (about 1 square mile) training minefields:

- **Airborne Mine Neutralization System (AMNS) Training Minefield** will support H-60 and H-53 operations with explosive and non-explosive AMNS. While most of these operations will use training neutralizers with no explosive materials, the Navy proposes to conduct about 30 operations per year with live warheads against expendable, non-explosive, bottom and moored mine shapes.
- **Rapid Airborne Mine Clearance System (RAMICS) and Airborne Laser Mine Detection System (ALMDS) Training Minefield** will support H-60 operations with the RAMICS mine-neutralization system and ALMDS mine-hunting system. RAMICS is a 30-mm cannon that fires an armor-piercing, non-explosive, super-cavitating projectile that destroys the expendable, non-explosive, moored mine shapes. While ALMDS is not a mine-neutralization activity, the Navy will take advantage of the moored training mines available in this training area.

Table D-1 in Appendix D lists planning criteria for these training minefields, including depth, distance from home base, and number and type of training mines. Several factors make this proposed area off the Virginia Beach coast particularly attractive for mine neutralization training.

- In this area, the Navy has already studied the environmental effects and received permits to conduct underwater detonations, and the U.S. Army Corps of Engineers has designated it a Surface Danger Zone. This is important for AMNS operations with explosive charges in the neutralizers.
- This area is close to Naval Air Station (NAS) Oceana, which has an area for loading the live ordnance components of AMNS and RAMICS into the helicopters, a capability that NS Norfolk lacks.
- It is close to Fleet Training Center Dam Neck, which will need to frequently launch surface support craft to replace mines destroyed during AMNS and RAMICS operations.
- Co-locating helicopter mine-neutralization training with Navy Explosive Ordnance Disposal (EOD) underwater detonations using explosive charges up to 20 lbs Net Explosive Weight (NEW) creates some synergy in the process of deploying and servicing the expendable non-explosive mine shapes used by both parties.

Non-explosive Training Mines will serve as targets in both the AMNS and RAMICS/ALMDS training minefields. The training mines consist of three components:

- **Non-explosive mine shapes** support mine-hunting systems (sonar and/or laser sensors) and mine-neutralization systems. They replicate the appearance of mines that naval forces could encounter throughout the world. The non-explosive mine shapes have an outer shell of glass-reinforced plastic or steel, do not contain explosives or target detecting or actuating mechanisms, and are filled with concrete or other inert material. Some mine shapes will rest on or near the bottom, while others would be moored at various depths, depending on training requirements.
- **Concrete anchors** hold the mine shapes in place, one for each non-explosive bottom or moored mine shape. Each anchor would weigh between 1,200 and 2,300 pounds and measure 2 to 2.5 feet on each side (about 8 to 16 cubic feet). Anchors are deployed from a surface vessel with a crane or similar equipment that can lower the anchor into the water at a designated location so that it rests on the bottom. Recovery of the anchor is performed with similar equipment, except that a diver hooks the crane's cable in order to hoist the anchor. The Navy has specific instruction manuals describing deployment and recovery of anchors.

- **Mooring lines** are steel cable or chains that connect non-explosive moored mine shapes to the concrete anchors.

A boat could deploy the mine shape, mooring line, and anchor as a pre-assembled unit. Alternately, divers could attach mooring lines and mine shapes to previously placed concrete anchors for specific exercises or to replace destroyed mine shapes.

Non-explosive training mines could stay in place for up to six months at a time before Navy divers would recover them for refurbishment and repositioning. The Navy anticipates the need to occasionally relocate existing concrete anchors or add new ones to modify minefield configuration, or to replace those that become unusable or cannot be located. Following a mine neutralization operation, divers gather expended mine shapes (as practicable) in order to assess training success.

2.2.4.4 Enhanced Range Complex Capabilities

Increase Commercial Air Services (CAS) Support for Fleet Training. The Navy proposes to increase the number, type, and operation of CAS within the VACAPES Range Complex. These contractor-owned and -operated supersonic and subsonic aircraft carry a variety of electronic threat emitters, perform aircraft maneuvers and flight profiles that mimic enemy aircraft, provide air-to-air refueling capabilities, and tow and stream targets used for surface-to-air gunnery training. Their use enhances the following range capabilities:

- Opposition Force (OPFOR) aircraft against naval aircraft and ships in air defense events, such as air intercept control (AIC) and detect to engage, and sometimes intercept aircraft for AIC events;
- Threat missile and aircraft profiles against naval aircraft and ships in electronic combat events;
- Refueling tanker support during major exercises; and
- Tow aircraft for target banners in air-to-air and surface-to-air gunnery exercises.

Increased use of CAS to support Fleet training would not substantially increase aircraft numbers, emissions, or time spent in the warning areas, or alter current airspace usage. Rather, CAS would displace Fleet assets now used to support Fleet training events listed in Table 2.2-3, and greatly increase the quality of Fleet training by making it a dedicated mission in specially equipped aircraft for the CAS aircrew.

Conduct Surface-to-Air Missile (MISSILEX (S-A)) training. The Navy proposes to conduct up to 24 High Explosive MISSILEX (S-A) events annually in VACAPES OPAREA. In these air defense exercises, surface ships launch surface-to-air missiles with high explosive warheads at target drones simulating enemy aircraft. Once a required training event, the Navy suspended live missile training launches from all surface ships except aircraft carriers in 2004. However, it continues to conduct MISSILEX (S-A) test and evaluation events in the northern part of VACAPES OPAREA off-shore from the Goddard Flight Facility, Wallops Island, VA. If the Navy decides to reinstate MISSILEX (S-A) training events, it will conduct most of them in the VACAPES OPAREA. Participants could include cruisers (CG) or destroyers (DDG) launching SM-2 Standard Missiles, large amphibious ships (LHA or LHD) launching NATO Sea Sparrow missiles, or the smaller amphibious ships (LPD or LSD) launching Rolling Airframe Missiles (RAM). The targets are BQM-74 drones, launched from either G-1 Commercial Air Services aircraft or the Mobile Sea Range for SM-2 and Sea Sparrow missiles and BQM-34 drones launched from Dam Neck, VA.

These missiles have self-destruct mechanisms that cause the missiles to explode after a pre-set period of flight time. Therefore, the Navy does not anticipate any underwater detonations from high explosive warheads that fail to detonate near the target. Appendix D has detailed information about these training activities.

2.2.5 Alternative 2 – Increases and Modifications in Operational Training, Accommodate Force Structure Changes, and Implement Enhancements (Preferred Alternative)

Alternative 2, the Preferred Alternative, includes implementation of Alternative 1 with additional increases in some operations, a reduction of bombing exercises (see Table 2.2-4), and designation of additional mine warfare training areas within the VACAPES Study Area to provide additional support during training events. If the Preferred Alternative were to be selected, all components of the proposed action (for example, increases in training and RDT&E operations, force structure changes, and implementation of enhancement recommendations) would be achieved, based on the goal of meeting the purpose and need of the proposed action to the maximum extent possible by optimizing training to support future contingencies.

Reduction of High Explosive Bombing Events (BOMBEX) (at-Sea). Under Alternative 2, the Navy proposes to reduce the number of high explosive BOMBEX training events that involve dropping high-explosive (live) ordnance on targets at-sea by 96 percent. The at-sea target in these exercises is usually a flare or smoke float. This reduced number of BOMBEX events would take place in the area shown in Figure 2.2-7.

Enhanced Mine Warfare (MIW) Training Areas. Alternative 1 addresses the more *routine evolution* of the range complex that result from changing force structure, expanding missions, and new range capabilities. In Alternative 2, the Navy proposes to implement Alternative 1 plus create six separate MIW training areas, two in the lower Chesapeake Bay and four in VACAPES OPAREA, primarily for enhanced mine countermeasures (MCM) and neutralization ULT. Each training area would accommodate one to four individual minefields with semi-permanent training mines, and would be sized, located, and equipped to support several systems with similar criteria for water depth and distance from Naval Station (NS) Norfolk. The total capability would support training with all mine systems homebased in the Hampton Roads area.

The nature of naval warfare has been evolving in the post-Cold War era. It is likely that Navy ships will conduct increasing portions of their operations in areas close to shore where mines are most effective. In response, the Navy is developing an MCM and neutralization capability to embed in its strike groups (see description of organic mine countermeasures systems in Section 2.2.4.3 above), and desires to improve the quality of MIW training.

As the Navy consolidates its fleet of MIW-capable MH-53E and MH-60S helicopters at NS Norfolk, the VACAPES Range Complex will become the backyard range for most MIW ULT. Helicopter ULT typically entails a high volume of single-aircraft sorties, typically lasting about four hours, that begin and end at homebase, and should not involve extensive preparation of the training areas.

As discussed in Section 2.2.4.3, most mine operations currently conducted in the VACAPES Range Complex are done without training mines, which greatly reduces the effectiveness of training and reduces readiness. As the number of MIW-capable helicopters homebased in the Hampton Roads area grows from 12 to 75 airframes, the current situation will become untenable. To address this, Alternative 2 will expand the area of current preferred mine training areas to handle the increased throughput, and include training mines semi-permanently placed to provide aircrews with a more realistic training environments and feedback about their performance. Appendix D describes the MH-60S and MH-53E MIW systems and operations in detail. Table 2.2-4 presents the total number of operations that the Navy would conduct on the proposed training areas.

The type of non-explosive mines in a particular MIW training area will depend on the characteristics of the systems for which they are targets. The two broad categories of training mines include:

- **Non-explosive mine shapes**, which support mine hunting systems (sonar and/or laser sensors) and mine neutralization systems. These were described in detail in Section 2.2.4.3.
- **Versatile Exercise Mine Systems (VEMS)** support mine-sweeping systems (magnetic and/or acoustic signal generators). They are electronic devices shaped like bottom mines that detect and record acoustic and magnetic fields that pass over them.


VEM Unit Examples

Each VEMS unit consists of a ballast section and a buoy section with all of the sensors. They do not contain any explosive material. A surface vessel will seed a minefield with about 20 VEMS units that could remain in place for up to 90 days (but more typically for no more than 14 days) to support multiple events.

A command from an acoustic link or at a programmed time activates the self-recovery system, causing the ballast section to release the buoy section. It rises to the surface, but remains tethered by a recovery line to the ballast section, which acts as an anchor. A surface vessel can then recover both sections. After extracting the data to provide feedback to the aircrew, maintenance personnel can reassemble and redeploy the VEMS unit.

The six MIW training areas overlay existing MH-53E preferred training areas. Each is located to satisfy depth, distance from homebase, and other requirements specific to the supported mine systems and helicopter or ship. Each training area will have one to four simulated threat minefields of about 4 nm^2, each with 10 to 25 non-explosive training mines. Detailed information on specific planning criteria for each MIW training area is included in Appendix D. Prominent features of each training area are described below.

Instrumented Training Area (South) will support MH-53 operations with the MK-105 and SPU-1W mine sweeping systems (Figure 2.2-2). The overriding design criterion is distance from NS Norfolk (within 15 nm). All other MCM systems are transported within the helicopter, allowing normal cruise airspeeds (about 100 knots) to and from the training area. In contrast, the MK-105 is a bulky sled that must be streamed for operation at the departure point (in this case, the NS Norfolk seawall) and dragged through the water to the training area. The SPU-1W is a 30-foot-long pipe, which is transported externally underneath the helicopter by a long cable during the transit to and from the training area. For both systems, the maximum transit speed is 27 knots. Because both systems operate on or just below the surface, their training areas can be in shallow water. Both these factors (towing of a large sled at a slow speed) dictate the need for a mine training area in the lower Chesapeake Bay, very close to NS Norfolk. It will use VEMS for training mines.

Instrumented Training Area (North) will support H-53 operations with the MK-104 and MH-60S operations with the Organic and Surface Influence Sweep (OASIS) mine-sweeping systems (Figure 2.2-3). This area must have deeper water to ensure that the MK-104 and OASIS, both of which are underwater towed bodies, will not hit bottom. Distance to homebase is not as critical, because the helicopters can transit to and from the training area at normal cruise airspeed. However, the H-53s will occasionally use the area to train with the MK-106, which is the MK-104 attached to the MK-105 sled. Also, the Navy will need to send small surface craft to the training area fairly often to deploy and recover VEMS units. Both of these factors, which result in slow transit times from NS Norfolk to the training area, encourage locating the training site in the lower Chesapeake Bay instead of the open ocean. It will use VEMS as training mines.

Sonar Training Areas will support H-53 operations with the AQS-24A; MH-60S operations with the AQS-20A; and cruiser (CG), destroyer (DDG), and frigate (FFG) operations with their hull-mounted mine hunting sonar systems. These areas must have deeper water to ensure that the AQS-20 and AQS-24, both of which are underwater towed bodies, will not hit bottom. Distance to homebase is not as critical because the helicopters can transit to and from the training area at normal cruise airspeed. Also, areas outside the Chesapeake Bay are desirable to remain clear of the fishing nets, commercial traffic and other obstructions frequently found there. To provide sufficient capacity for the high volume of ships and helicopters needed to train with these systems, the Navy proposes to establish three separate sonar training areas (Figure 2.2-4):

- **Shallow Water Sonar Training Area (South).** This area, which is closest to NS Norfolk, will host most (about 75%) of H-60 AQS-20 operations to accommodate its shorter on-station time compared to the H-53. The H-53 will infrequently train there with its AQS-24, filling in the few remaining time periods. All training mines will be non-explosive bottom mine shapes.
- **Shallow Water Sonar Training Area (North).** This area will handle the overflow MH-60S operations from the south training area, about 25 percent of the total AQS-20 operations, and about half of the H-53 AQS-24 operations. Also, most AQS-20 operations with the Remote Mine-hunting System (RMS) Unmanned Underwater Vehicle (UUV) will occur here. All training mines will be non-explosive bottom mine shapes.
- **Deep Water Sonar Training Area.** About half the H-53 AQS-24 operations and all surface ship operations will take place in this area. The training mines will be an even split of bottom and moored non-explosive mine shapes.

Mine Neutralization Training Areas require three individual minefields with slightly different capabilities, all of which could be co-located in the same training area (W-50, Figure 2.2-1).

- **MK-103 Training Minefield** will support H-53 operations with the MK-103, a mechanical mine sweeping system that consists of a Y-shaped, split cable dragged behind the helicopter that rides just below the surface. The cables have a series of cutters with small charges (.002 lbs. NEW) that shear the anchoring cables of moored mines, releasing them to float to the surface. The cutters do not use live charges for most training flights. However, the Navy proposes to use live cartridges for about 25 percent of MK-103 training flights against non-explosive, moored mine shapes. In these live operations, after the cutter has sheered the mooring line connecting the non-explosive mine shape to its concrete anchor, the mine shape will float to the surface where a boat can recover it. These operations would occur in W-50A and C (Figure 2.2-1).
- **Airborne Mine Neutralization System (AMNS) Training Minefield** will support H-60 and H-53 operations with live and non-explosive AMNS. While most of these operations will use training neutralizers with no explosive materials, the Navy proposes to conduct about 30 operations per year with live warheads against expendable non-explosive bottom and moored mine shapes. See Section 2.2.4.3 for more detail. The AMNS operations would occur in W-50C (See Figure 2.2-1).
- **Rapid Airborne Mine Clearance System (RAMICS) and Airborne Laser Mine Detection System (ALMDS) Training Minefield** will support H-60 operations with the RAMICS mine-neutralization system and ALMDS mine-hunting system. See Section 2.2.4.3 for more detail. The RAMICS/ALMDS operations would occur in W-50C (See Figure 2.2-1).

The addition of MK-103 training with live cartridges in Alternative 2 will require a larger mine neutralization training area than in Alternative 1. All operations with live cartridges should be conducted in W-50A and C, where the Navy has already studied the environmental effects and received permits to conduct underwater detonations, and the U.S. Army Corps of Engineers has already designated a Surface Danger Zone (33 CFR §334.390). An advantage of the W-50 site is that it is close to Fleet Training

Center Dam Neck, which will need to frequently launch surface support craft to recover floating mines severed during MK-103 operations.

2.2.6 Summary of Operational Parameters for all Alternatives

The Navy's proposed operational data for the No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) are presented in Table 2.2-4. The No Action Alternative data are based on numbers of events and sorties currently performed on a yearly basis, with the incorporation of data to allow for the surging of operations in time of need. Current training descriptions are in Appendix D and Appendix E contains weapon systems descriptions.

Tables 2.2-5, 2.2-6, and 2.2-7 summarize data from Table 2.2-4 for purposes of the environmental analysis presented in Chapter 3.

- Table 2.2-5 summarizes the Navy operations considered to be operational stressors to the marine environment and compares the levels of these operations per year for each of the proposed alternatives.
- Table 2.2-6 summarizes the various ordnance types for each training area within the study area. The table compares numbers of rounds per year for the three alternatives.
- Table 2.2-7 lists the in-water explosive ordnance proposed for each alternative by training area per year.

2.2.7 Alternatives Considered but Eliminated from Further Analysis

The following alternatives were considered, but do not meet the purpose and need.

2.2.7.1 No Training Alternative

If the Navy did not conduct training exercises along the East Coast, they would not be able to meet its obligations, as identified in Title 10 United States Code, Section 5062, which requires the Navy to be "organized, trained, and equipped primarily for the prompt and sustained combat incident to operations at sea." Without proper training, U.S. combat forces would not be capable of deploying at a level of readiness necessary to respond to "real world" contingency situations as have recently occurred in the eastern Mediterranean and the Arabian Sea, or potential future threat situations in the China Sea and Sea of Japan. Additionally, RDT&E supports the Title 10 mandate because it provides the Navy the capability of developing weapon systems and ensuring their safe and effective implementation for the Atlantic Fleet. For these reasons, an alternative that would decrease military training from current levels or eliminate training altogether would not meet the purpose and need of the Proposed Action. The CEQ requires an EIS to include an alternative of No-action. The CEQ defines "No-action" as no change from current activities. This alternative has been eliminated from further consideration in the EIS/OEIS.

2.2.7.2 Alternative Range Complex Locations

No single range complex on the east coast can accommodate the entire spectrum of Navy and Marine Corps training and testing. To maintain a high level of combat readiness for naval forces at best value to the U.S. taxpayer, the Navy and Marine Corps homeported their forces in multiple concentration areas rather than a single area, in part to ensure the surrounding training and testing areas could support their specific needs. The result is a system of range complexes, each optimized to support the limited set of warfare areas that predominate in that locale. Taken as a whole, this system of ranges provides a robust training and testing capability for all naval warfare missions, but no one range complex can cover them alone.

TABLE 2.2-5
SUMMARY OF PROPOSED CHANGES IN ANNUAL OPERATIONS FOR ALTERNATIVES IN THE VACAPES STUDY AREA

Potential Stressor	No Action	Alternative 1		Alternative 2	
	Number per Year	Number per Year	Change from No Action	Number per Year	Change from No Action
Vessel Movements					
Approximate steaming days/yr [a/]	1400	1420	1.4%	1420	1.4%
Aircraft Overflights					
Fixed-wing aircraft sorties/yr [b/]	5,966	6,558	10%	6,234	4.5%
Helicopters sorties/yr [c/]	1,968	3,463	76%	3,523	79%
Mine Warfare Devices Towed Through Water by Helicopters					
Sorties/yr	1,358	2,172	60%	2,222	64%
Fixed Mine Shapes (Non-explosive)					
Mine shapes deployed/yr	0	20	N/A	270	N/A
Munitions Use/Non-Explosive Practice Munitions (NEPM)					
Bombs/yr	295	325	10%	537	82%
Missiles (air-to-surface)/yr	21	23	10%	23	10%
Missiles (air-to-air)/yr	30	33	10%	33	10%
Missiles (surface-to-air)/yr	30	33	10%	33	10%
Naval gun shells/yr (5-inch & 76 mm)	3,564	3,844	8%	3,844	8%
Cannon shells/yr (20 mm – 30 mm)	201,700	223,400	11%	223,400	11%
40 mm grenades/yr	540	600	11%	600	11%
Small caliber/yr (.50-cal, 7.62 mm)	808,160	1,063,600	32%	1,063,600	32%
Rockets (2.75-inch)/yr	0	3,700	N/A	3,700	N/A
RAMICS 30-mm rounds [g]	0	2500	N/A	2750	N/A
Underwater Explosions/High-Explosive (HE) Use					
Bombs					
MK-20/yr	12	12	0%	0	-100%
MK-82/yr	312	312	0%	0	-100%
MK-83/yr	132	132	0%	20	-85%
MK-84/yr	9	9	0%	0	-100%
Missiles (Maverick) (air-to-surface)/yr	20	20	0%	20	0%
Hellfire (air-to-surface) missiles/yr	30	60	100%	60	100%
Naval gun shells (5-inch)	858	858	0%	858	0%
Underwater Detonation					
0.002-lb NEW charges/yr [d/] (MK-103)	0	0	0%	50	N/A
3.24-lb NEW charges/yr [e/] (AMNS)	0	30	N/A	30	N/A
20-lb NEW charges/yr (EOD)	12	24	100%	24	100%
Above Surface Explosions/High-Explosive (HE) Use					
HARM air-to-surface missiles/yr	26	26	0%	26	0%
SM-2 surface-to-air missile/yr	0	20	N/A	20	N/A
Sea Sparrow/yr	0	2	N/A	2	N/A
Rolling Airframe Missile/yr	0	2	N/A	2	N/A
Missiles (AIM-7, -9, -120) (air-to-air)/yr	143	160	12%	160	12%
Expended Materials					
Ordnance related materials [f/]	-- [f/]	-- [f/]	-- [f/]	-- [f/]	-- [f/]
Targets/yr	360	397	10%	397	10%
Chaff RR-144A canisters/yr	18,000	20,150	12%	20,150	12%
Chaff, MK-214 or 216/yr	198	222	12%	222	12%
Flares/yr	465	825	77%	825	77%
M-58 marine markers (smoke floats)/yr	300	495	65%	495	65%

a/ Vessel movement was computed as the number of steaming days per year by summing the number of steaming hours proposed in the range complex, dividing by 24 hours per day, and rounding to the nearest 10 days.
b/ Commercial air services (CAS) not counted in total; chaff and flare exercise sorties assumed all performed during other mission training and not counted in total.
c/ Chaff and flare exercise sorties not counted in total; assumed all performed during other mission training.
d/ Explosive cartridges from MK-103 would only be used in Alternative 2.
e/ Explosive rounds from AMNS would only be used in Alternative 2.
f/ Values are the same as those presented for weapons firing and ordnance use.
g/ Assumes 25 rounds per sortie or mission

TABLE 2.2-6
SUMMARY OF ORDNANCE USE BY TRAINING AREA
IN THE VACAPES EIS/OEIS STUDY AREA

Training Area and Ordnance Type	Number of Rounds Per Year		
	No Action	Alternative 1	Alternative 2
R-6606			
Small caliber (.50-cal and 7.62 mm)	20,000	22,000	22,000
40 mm grenades (NEPM)	54	60	60
Subtotal =	20,054	22,060	22,060
W-50C			
Small caliber (.50-cal and 7.62 mm)	274,140	343,500	343,500
MK-103 cartridges (High-explosive [HE], 0.002 lbs NEW)	0	0	50
AMNS (HE rounds, 3.24 lbs NEW)	0	30	30
RAMICS (30 mm)	0	2500	2750
40 mm grenades	486	540	540
Subtotal =	274,626	346,570	346,980
W-72			
Small caliber (.50-cal and 7.62 mm)	47,520	52,320	52,320
Cannon shells (20 and 25 mm; NEPM)	36,440	40,280	40,280
Naval gun shells (NEPM, 5-inch and 76 mm)	576	632	632
Missiles, Hellfire (HE, 8.0 lbs NEW) [a/]	8	15	15
Missiles, SM-2 (HE, 76 lbs NEW)	0	10	10
Missiles, RAM (HE, 7.34 lbs NEW)	0	2	2
Rockets (2.75-inch; NEPM)	0	925	925
Small caliber (.50-cal and 7.62 mm)	12,000	13,500	13,500
Subtotal =	96,544	107,684	107,684
W-72A (Air-3B)			
Bombs (HE rounds)	121	121	0
W-72A (Air-1A)			
Cannon shells (20 mm; NEPM)	13,500	15,000	15,000
Small caliber (.50-cal and 7.62 mm)	241,920	396,000	396,000
Subtotal=	255,420	411,000	411,000
W-72 (1C1 and 1C2)			
Naval gun shells (5-inch and 76 mm; HE, 8 lbs NEW) [b/]	285	285	285
Naval gun shells (5-inch and 76 mm; NEPM) [c/]	226	226	226
Subtotal =	511	511	511
W-72A/B			
Bombs (MK-20, -76, -82, -83, BDU-45; NEPM)	225	248	460
W-386			
Missiles, SM-2, Sea Sparrow (HE, 76 lbs NEW)	0	10	10
Missiles, Sea Sparrow (HE, 35 lbs NEW)	0	2	2
Naval gun shells (5-inch and 76 mm; NEPM)	2,306	2,530	2,530
Cannon shells (20 mm and 25 mm; NEPM)	145,760	161,120	161,120
Small caliber (.50-cal and 7.62 mm)	190,080	209,280	209,280
Subtotal =	338,146	372,942	372,942

TABLE 2.2-6 (Continued)
SUMMARY OF ORDNANCE USE BY TRAINING AREA
IN THE VACAPES EIS/OEIS STUDY AREA

Training Area and Ordnance Type	Number of Rounds Per Year		
	No Action	Alternative 1	Alternative 2
W-386 (Air-E, F, I, J)			
Missiles (HARM; HE rounds)	26	26	26
W-386 (Air-D, G, H, K)			
Missiles (AIM-7, -9, -120, -132; NEPM)	30	33	33
W-386 (Air-K)			
Bombs (MK-82, -83, -84, -20; HE)	344	344	20
Bombs (MK-76-, -82, -84, GBU-12, BDU-33; NEPM rounds)	70	77	77
Missiles (Hellfire; HE)	22	45	45
Missiles (Maverick; HE)	20	20	20
Missiles (NEPM)	21	23	23
Rockets (2.75-inch; NEPM)	0	2,775	2,775
Cannon shells (20, 25, 30, and 40 mm; NEPM)	6,000	7,000	7,000
Subtotal =	6,477	10,284	9,960
W-386 (5C and 5D)			
Naval gun shells (5-inch and 76 mm; HE)	285	285	285
Naval gun shells (5-inch and 76 mm; NEPM)	226	226	226
Subtotal =	511	511	511
W-386 (7C/7D and 8C/8D)			
Naval gun shells (5-inch and 76 mm; HE)	285	285	285
Naval gun shells (5-inch and 76 mm; NEPM)	226	226	226
Subtotal =	511	511	511
Study Area Total =	993,202	1,272,601	1,272,167

a/ Approximately 25% of Hellfire missiles used.
b/ Assumed 7.3 events/yr and 39 HE rounds per event. Same assumptions for 5-inch rounds in W-386 (5C/5D and 7C/7D and 8C/8D).
c/ Assumed 7.3 events/yr and 31 NEPM rounds per event. Same assumptions for 5-inch rounds in W-386 (5C/5D and 7C/7D and 8C/8D).

TABLE 2.2-7
SUMMARY OF EXPLOSIONS IN THE WATER AND THEIR NET EXPLOSIVE WEIGHTS BY TRAINING AREA IN THE VACAPES EIS/OEIS STUDY AREA

Training Area and Ordnance Type	Number of Rounds Per Year		
	No Action	**Alternative 1**	**Alternative 2**
W-386 (Air-K)			
MK-20 (109.7-lbs NEW)	12	12	0
MK-82 (192.2-lbs NEW)	232	232	0
MK-83 (415.8-lbs NEW)	92	92	20
MK-84 (944.7-lbs NEW)	8	8	0
Maverick missile (100 lb NEW)	20	20	20
Hellfire missile (8-lbs. NEW)	22	45	45
Subtotal =	386	409	95
W-72A			
Hellfire missile (8-lbs. NEW)	8	15	15
W-72 (Air-3B)			
MK-82 (192.2-lbs NEW)	80	80	0
MK-83 (415.8-lbs NEW)	40	40	0
MK-84 (944.8-lbs NEW)	1	1	0
Subtotal =	121	121	0
W-72 (1C1/2) and W-386 (5C/D, 7C/D, 8C/D)			
Naval Gun shell, 5-inch (IMPASS) (8-lbs NEW) [a/]	858	858	858
W-50C			
MK-103 (0.002-lbs NEW)	0	0	50
AMNS Charge (3.24-lbs NEW)	0	30	30
UNDET 20-lbs NEW Charge	12	24	24
Subtotal =	12	54	104
Total Explosions in Study Area =	1,385	1,457	1,062

a/ Assumes 22 IMPASS events per year with 39 HE rounds per event.

As discussed in Section 1.2.1.2, naval forces need to train for a wide variety of operations conducted on and below the ocean surface, on land and in the air. Beyond these broad categories, the Navy needs access to training areas with some very specific attributes. For example, the wide ranges of Navy and Marine Corps mission areas call for an equally wide variety of very different land ranges.

- Amphibious training requires a military beach that opens directly to maneuver areas and live fire ranges.
- Aircraft strike training requires an array of air-to-ground bombing ranges, each overlain with SUA that separates military aircraft and ordnance from civil aircraft.
- Small boat riverine operations need a stretch of inland water adjacent to land targets suitable for live fire.

Again, no single range complex on the east coast has all of the geographic attributes required to support the entire spectrum of Navy and Marine Corps training and testing. A second consideration is that there are two broad levels of training that differ in complexity and requirements: unit-level training and major exercises. Generally, these two levels of training differ in their requirements for the size of the training area, distance from home base, and sophistication of range support.

Unit-Level Training (ULT). As discussed in Section 1.2.1.3, high-volume, short-duration training exercises by individual ships and aircraft characterize ULT. The size of the training area is relatively smaller and range support requirements for ULT are not as great as with large-scale, major exercises.

In Fleet concentration areas, backyard ranges best meet these needs. Backyard ranges are training or testing areas close enough to base that an aircraft can launch from its home airfield, conduct its mission, and return to base during a single sortie. For a surface ship or submarine, the backyard range is the ocean operating area just outside its homeport where it can conduct an array of ULT events on a one- or two-day underway period. To displace training and testing areas for ULT events beyond the geographic reach of a backyard range would require thousands of sailors and marines to deploy for even the simplest training, incurring an inordinate expense, both in cost and time away from home, and would quickly degrade the combat readiness of the entire Fleet.

The Navy and Marine Corps have concentration areas near the Northeast (undersea RDT&E), VACAPES (most Atlantic Fleet surface ships, strike/fighter and mine warfare aircraft, missile and aircraft RDT&E), Cherry Point (Marine Forces Atlantic), and Jacksonville (air and surface anti-submarine warfare) Range Complexes. Consolidating training and testing support for all of these disparate mission areas, currently spread across the entire Atlantic seaboard, is highly impractical from a geographic standpoint.

Major Exercises. USFF conducts six to eight large-scale major exercises (JTFEX/COMPTUEX) every year, and each involves thousands of participants, multiple ships and aircraft, and elaborate range support requirements over a period of one to four weeks. Ideally, the venue for a major exercise would not require more than a couple of day's transit time for most participants, unlike ULT which requires training venues much closer to the home ports/home bases. Of greater importance is access to large, relatively unencumbered ocean operating areas, multiple strike targets, and specialized range attributes to support the battle scenario, such as a large military beach, opposition forces, and/or electronic combat simulators. No single east coast range complex offers the whole package of range attributes to adequately support all major exercises from start to finish.

The VACAPES Range Complex possesses a number of features that make it an indispensable component of the Navy's east coast system of ranges.

- Because of its outstanding natural harbor, Norfolk has been a Fleet concentration area since before the Civil War, and today has the largest assemblage of U.S. Navy ships, aircraft, and personnel. The VACAPES Range Complex is, by default, the backyard range for all warfare missions conducted by these forces. The local infrastructure built up over the years, such as piers, airfields, fuel depots, maintenance facilities, and support personnel, makes supporting a high volume of training operations relatively easy, an advantage that disappears if most training is done remotely. Conversely, the cost of moving either the homeport or the ULT venues for all of these forces is cost prohibitive.
- Favorable national airspace allocations have encouraged the Atlantic Fleet to concentrate most of its F/A-18 strike fighter aircraft at Naval Air Station (NAS) Oceana. A jet launching from NAS Oceana can easily access offshore training areas without traversing or interrupting the extremely busy east coast commercial jetways.
- Easy access to offshore SUA and proximity to the Naval Air Test Center at NAS Patuxent River, Maryland, has encouraged the Navy RDT&E community to concentrate its east coast supersonic aircraft and missile testing in the northern portion of the VACAPES Range Complex.

- NS Norfolk offers an airfield with direct access to coastal waters suitable for low-level training flights, resulting in the Navy's decision to concentrate the Atlantic Fleet organic mine countermeasures fleet of helicopters there, close to the ships they will support.

As a consequence to these historical and natural features that have made the Hampton Roads, Virginia area a Fleet concentration area, the Navy invested much money and effort in building the range infrastructure that supports these homeported units. For example:

- Navy Dare County Bombing Range supports ULT air-to-ground bombing and gunnery events for F/A-18s and helicopters. This investment includes not just the bombing range, but also the airspace structure overlying the range connecting it to other military airspace.
- The Tactical Aircrew Combat Training System (TACTS) range for air combat maneuvering training F/A-18s includes the range management structure at Fleet Area Control and Surveillance Facility (FACSFAC) VACAPES and complementary airspace agreements with the Federal Aviation Administration (FAA).
- The Shipboard Electronic Systems Evaluation Facility (SESEF) is available for calibrating all combat systems of all classes of surface ships and submarines. The SESEF range is in the VACAPES OPAREA, just offshore from Fleet Training Center (FTC) Dam Neck, VA.
- Missile/drone launch facilities and associated telemetry at Goddard Flight Facility, Wallops Island VA, support Navy RDT&E and similar facilities at FTC Dam Neck. These enhance Navy air-to-air and surface-to-air missile training and testing.

Over the years, a support base of commercial, industrial, and government facilities and an enabling regulatory framework have developed alongside the physical investments. Also, the Navy negotiated important agreements and established standard operating procedures (SOP) and safety processes. Examples include memorandums of agreement between the Navy and FAA regarding safe control and routing of aircraft, and lease agreements between the Navy and states or non-governmental organizations regarding the use of land for military training purposes. In today's fiscal and regulatory environment, replicating these capabilities in a different location is not realistic.

In summary, the VACAPES Range Complex is a vital component of the Atlantic Fleet system of range complexes. It is necessary and critical to ensure that naval forces are prepared and certified ready for overseas deployment and combat operations. Other locations do not provide reasonable alternatives for the required training purposes and activities described above and, as a result, alternative training locations were eliminated from further consideration.

2.2.7.3 Conduct Simulated Training Only

Under this alternative, only simulated training would be conducted, using computer models and classroom training. While computer simulation and classroom training are currently used by the Navy and are effective training tools, they cannot exclusively replace live training because they do not replicate the atmosphere or experience that live training provides. The value of live training provided by actually flying an aircraft, operating a combat system such as a shipboard gun or missile launch, or handling explosive ammunition simply cannot be substituted through simulation, particularly as it relates to the physical reaction invoked by the danger, noise, and visual effects associated with these systems.

Additionally, simulation cannot replicate the environment that is provided during coordinated training and major exercises, where multiple ships, submarines, and aircraft, and hundreds or thousands of men and women are participating in training activities in a coordinated fashion to accomplish a common military objective. Strike groups must be able to practice and hone their skills in communication, maneuvering, operating systems, repairing equipment, and firing weapons in an environment that is as realistic, and replicates the high energy and stress of what they would encounter in an actual combat situation. Because of the need to "train as we fight," this alternative would fail to meet the purpose and need of the proposed action in that it would not sufficiently prepare naval forces for combat. Therefore, this alternative is not evaluated in this EIS/OEIS.

2.2.7.4 Practice Ammunition Use

An alternative that would rely entirely on non-explosive , practice ammunition (referred to as non-explosive practice munitions or NEPM throughout this EIS/OEIS) use within the VACAPES Range Complex would not achieve the necessary levels of proficiency in firing weapons in a high-stress, realistic environment. Non-explosive , practice ammunition already is used throughout the VACAPES Range Complex, and it provides the opportunity to implement a successful, integrated training program while reducing the risk and expense typically associated with live ammunition. As such, practice ammunition is already utilized extensively to enhance combat performance in the Navy's training program. However, while it is an essential component of training, practice ammunition cannot be used exclusively to train safely in an inherently unsafe combat environment. Consequently, this alternative fails to meet the purpose and need of the proposed action. Therefore, this alternative was not carried forward for analysis.

2.2.8 Comparison of Alternatives and Effects

The comparison of alternatives presented in Table 2.2-8 is based on the information and analyses presented in Chapter 3 (Affected Environment and Environmental Consequences). The environmental stressors associated with each warfare area and operation were evaluated for each resource or issue in assessing potential environmental impacts under each alternative. There were no recordable differences in potential impacts between the alternatives for Hazardous Materials and Hazardous Waste; Water Resources; Air Quality; Airborne Noise; Land Use; Cultural Resources; Transportation; Demographics; Regional Economy; Recreation; Environmental Justice; or Public Health and Safety. The potential impacts would generally be temporary, short-term, long-term, minor, and/or localized changes to these resources or issues. As defined under NEPA, no significant impacts in U.S. Territory and no significant harm in Non-Territorial Waters to resources or issues were identified considering implementation of mitigation measures described in Chapter 5. In addition, resources were evaluated in accordance with Marine Mammal Protection Act (MMPA). Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Act (Eagle Act), and Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The potential impacts presented below provide the basis for providing choices to the decision maker.

TABLE 2.2-8
COMPARISON OF ALTERNATIVES

Resource or Issue	Alternatives		
	No Action Alternative	**Alternative 1**	**Preferred Alternative**
Bathymetry and Sediments	Short tem, minor impacts from deployment and recovery of MIW mine shapes (Section 3.1.3.1)	Short tem, minor impacts from deployment and recovery of MIW mine shapes (Section 3.1.3.2)	An increase in short tem, minor impacts from deployment and recovery of MIW mine shapes compared to No Action Alternative and Alternative 1 (Section 3.1.3.3)
Marine Communities	Long-term minor impacts to benthic habitats from accumulation of NEPM (Section 3.6.3.1)	Slight increase in potential impacts to benthic habitats from accumulation of NEPM and short tem minor impacts from deployment and recovery of MIW mine shapes considering mitigation measures in place (Section 3.6.3.2)	An increase in potential impacts to benthic habitat from accumulation of NEPM and an increase in short tem minor impacts from deployment and recovery of MIW mine shapes (Section 3.6.3.3)
Marine Mammals	Under MMPA, 7 mortality potential exposures, 63,664 non-injurious potential exposures, and 728 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.7.3.3).	Under MMPA, 7 mortality potential exposures, 63,686 non-injurious potential exposures, and 729 injurious potential exposures. Under ESA, proposed activities may affect listed species. (Section 3.7.3.4)	Under MMPA, 1 mortality potential exposure, 2,472 non-injurious potential exposures, and 25 injurious potential exposures. Under ESA, proposed activities may affect listed species. (Section 3.7.3.5)
Sea Turtles	Two mortality potential exposures, 11,340 non-injurious exposures, and 97 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.8.3.2).	Two mortality potential exposures, 11,348 non-injurious exposures, and 98 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.8.3.3).	No mortality potential exposures, 1,513 non-injurious exposures, and 15 injurious exposures. Under ESA, proposed activities may affect listed species (Section 3.8.3.4).
Fish and Essential Fish Habitat (EFH)	Under MSFCMA, no significant population-level impacts to managed species would occur; impacts would be temporary, minimal, and would not reduce the quality and/or quantity of EFH. Under ESA, there would be no effect on listed species. (Section 3.9.3.1)	Under MSFCMA, no significant population-level impacts to managed species would occur; impacts would be temporary, minimal, and would not reduce the quality and/or quantity of EFH. Under ESA, there would be no effect on listed species. (Section 3.9.3.2)	Under MSFCMA, no significant population-level impacts to managed species would occur; impacts would be temporary, minimal, and would not reduce the quality and/or quantity of EFH. Under ESA, deployment and recovery of non-explosive mine shapes may affect one listed species. (Section 3.9.3.3)
Seabirds and Migratory Birds	Under ESA and MBTA, no effect would occur to listed species and no long-term population-level effect would occur to migratory bird populations. (Section 3.10.3.1)	Under ESA and MBTA, no effect would occur to listed species and no long-term population-level effect would occur to migratory bird populations. (Section 3.10.3.2)	Under ESA and MBTA, no effect would occur to listed species and no long-term population-level effect would occur to migratory bird populations. (Section 3.10.3.3)
Atlantic Fleet Active Sonar Training (AFAST)	Potential impacts to resources or issues from AFAST and the Proposed Action combined are less than significant. (Section 3.19)	Potential impacts to resources or issues from AFAST and the Proposed Action combined are less than significant. (Section 3.19)	Potential impacts to resources or issues from AFAST and the Proposed Action combined are less than significant. (Section 3.19)

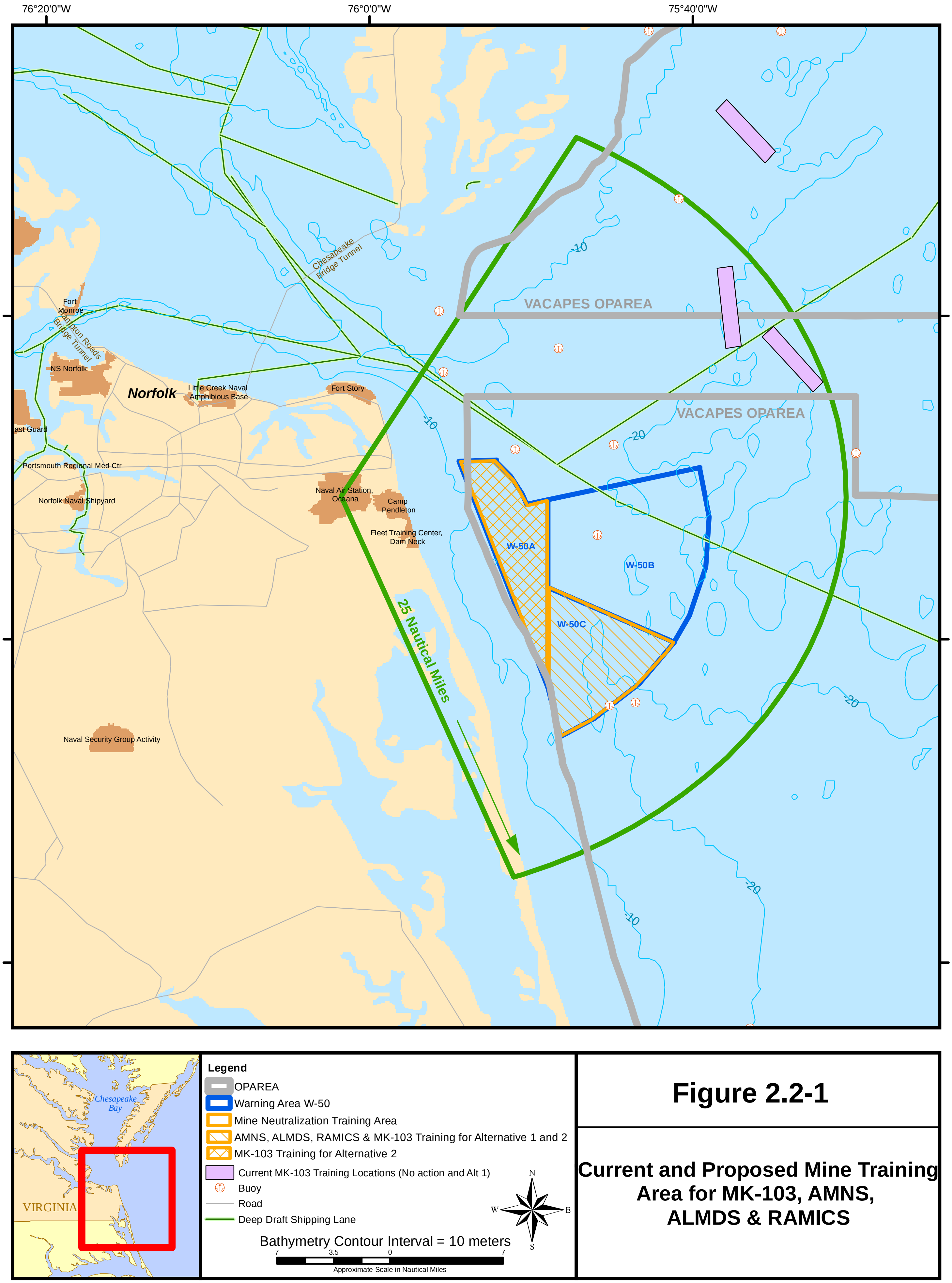


Figure 2.2-1

Current and Proposed Mine Training Area for MK-103, AMNS, ALMDS & RAMICS

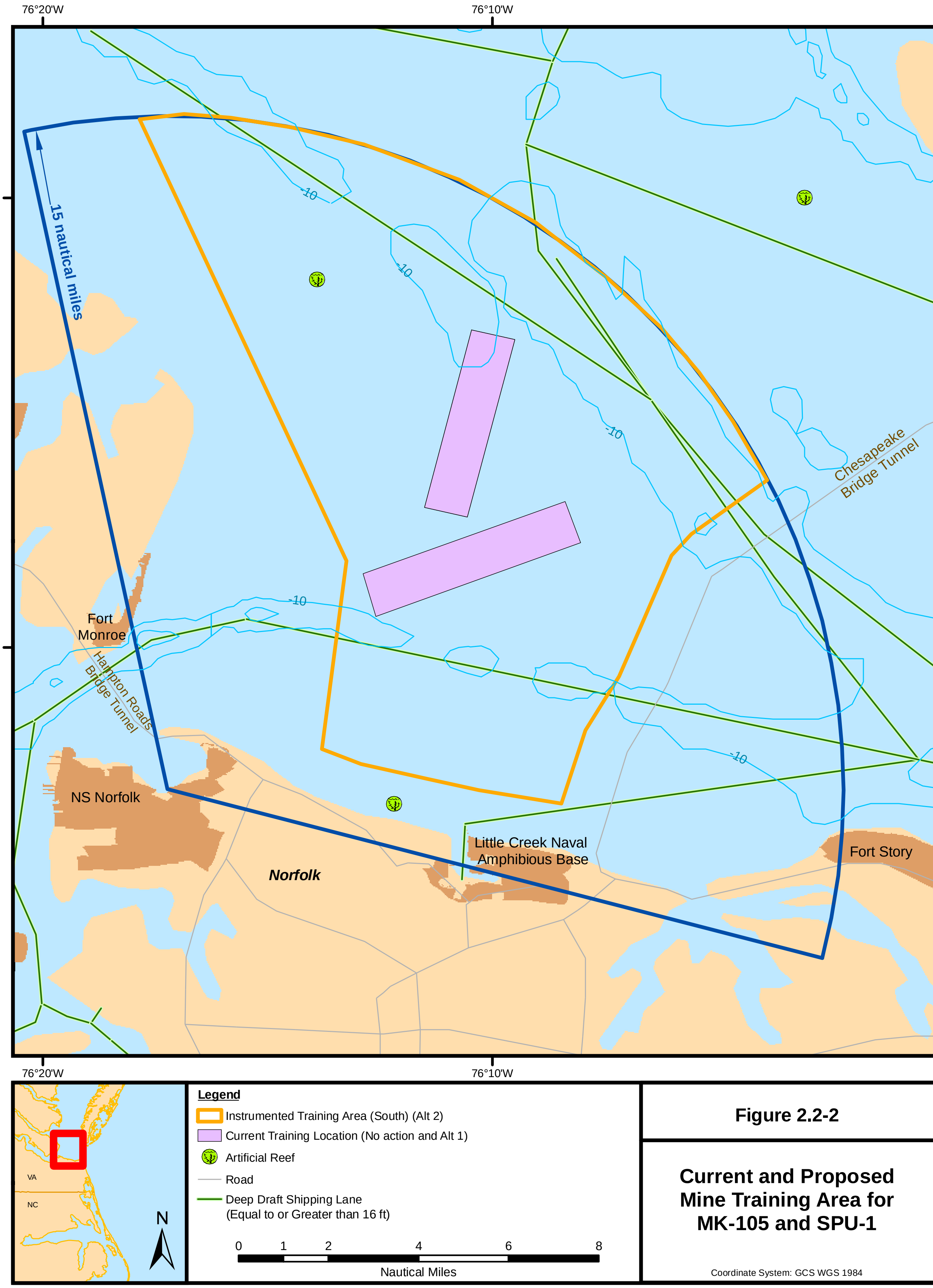


Figure 2.2-2

Current and Proposed Mine Training Area for MK-105 and SPU-1

Coordinate System: GCS WGS 1984

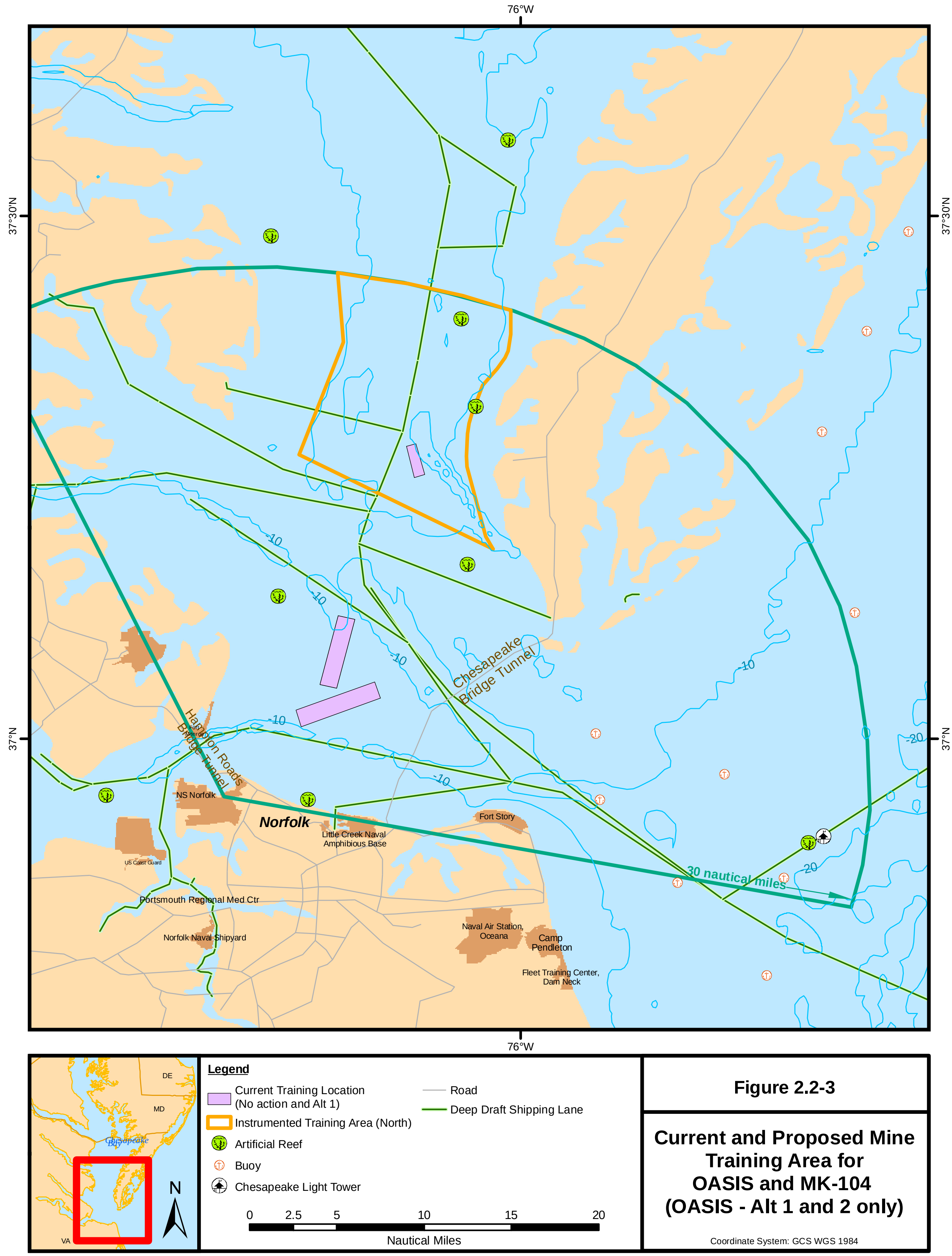


Figure 2.2-3

Current and Proposed Mine Training Area for OASIS and MK-104 (OASIS - Alt 1 and 2 only)

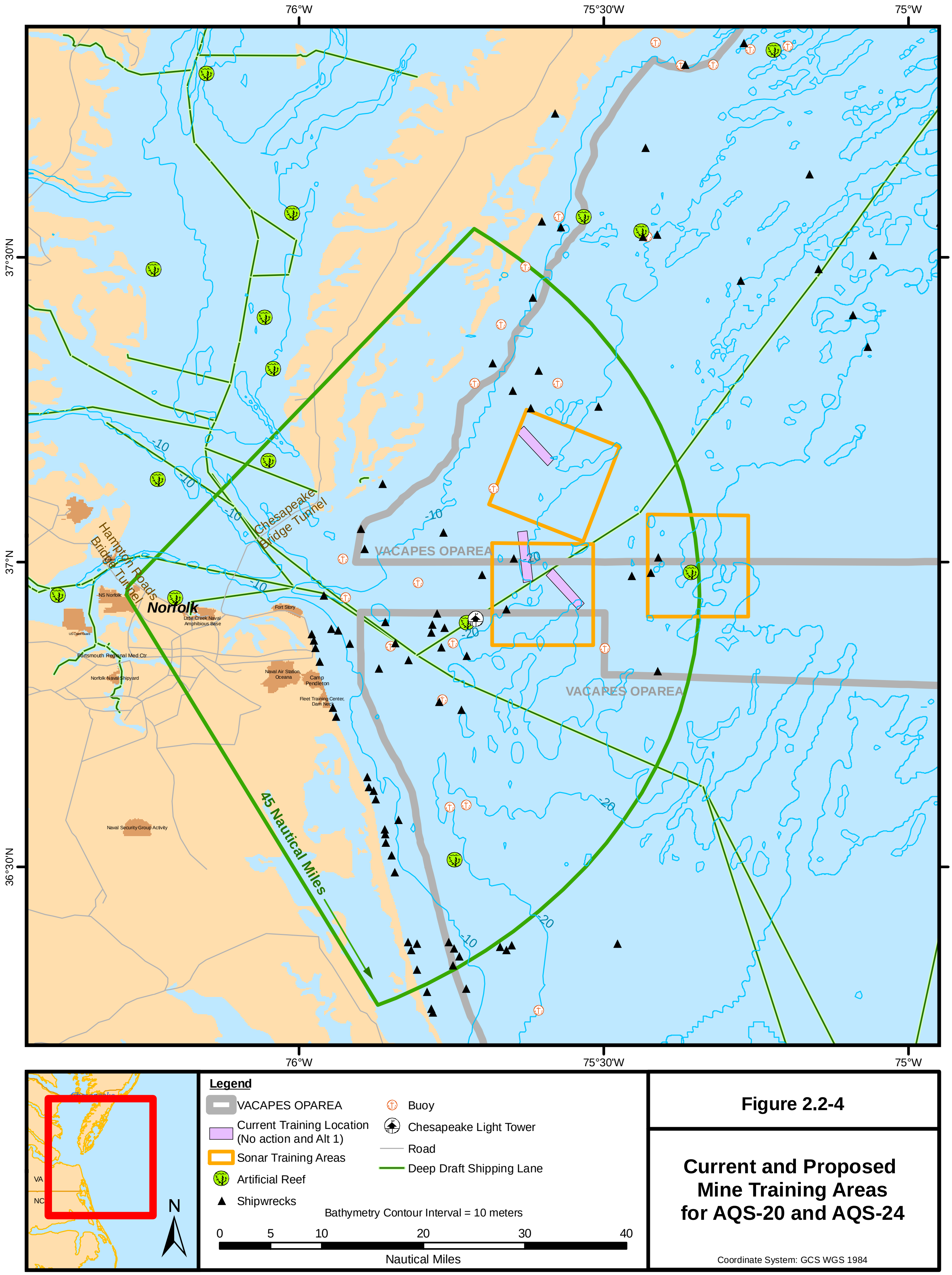


Figure 2.2-4

Current and Proposed Mine Training Areas for AQS-20 and AQS-24

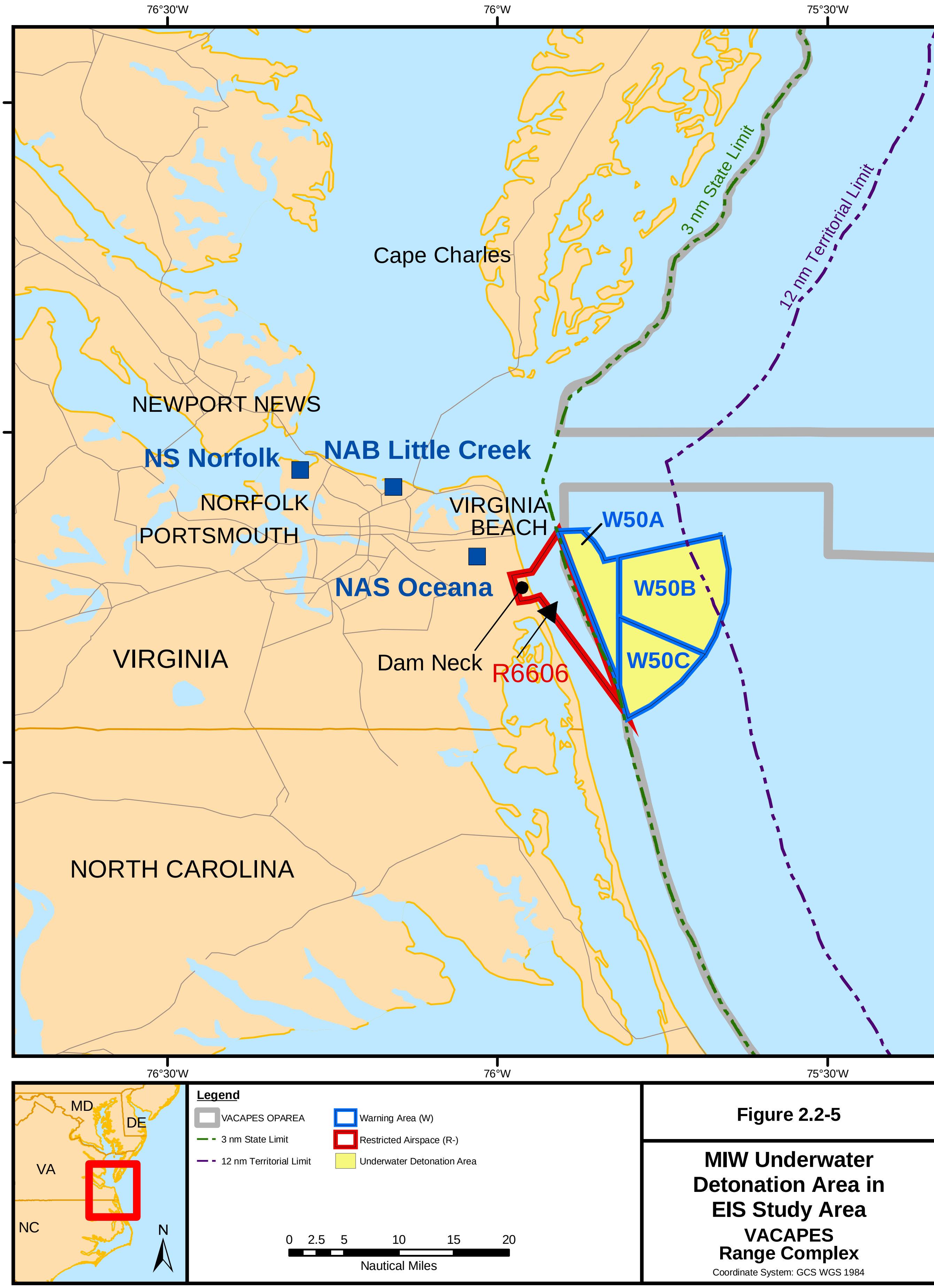


Figure 2.2-5

MIW Underwater Detonation Area in EIS Study Area

VACAPES Range Complex

Coordinate System: GCS WGS 1984

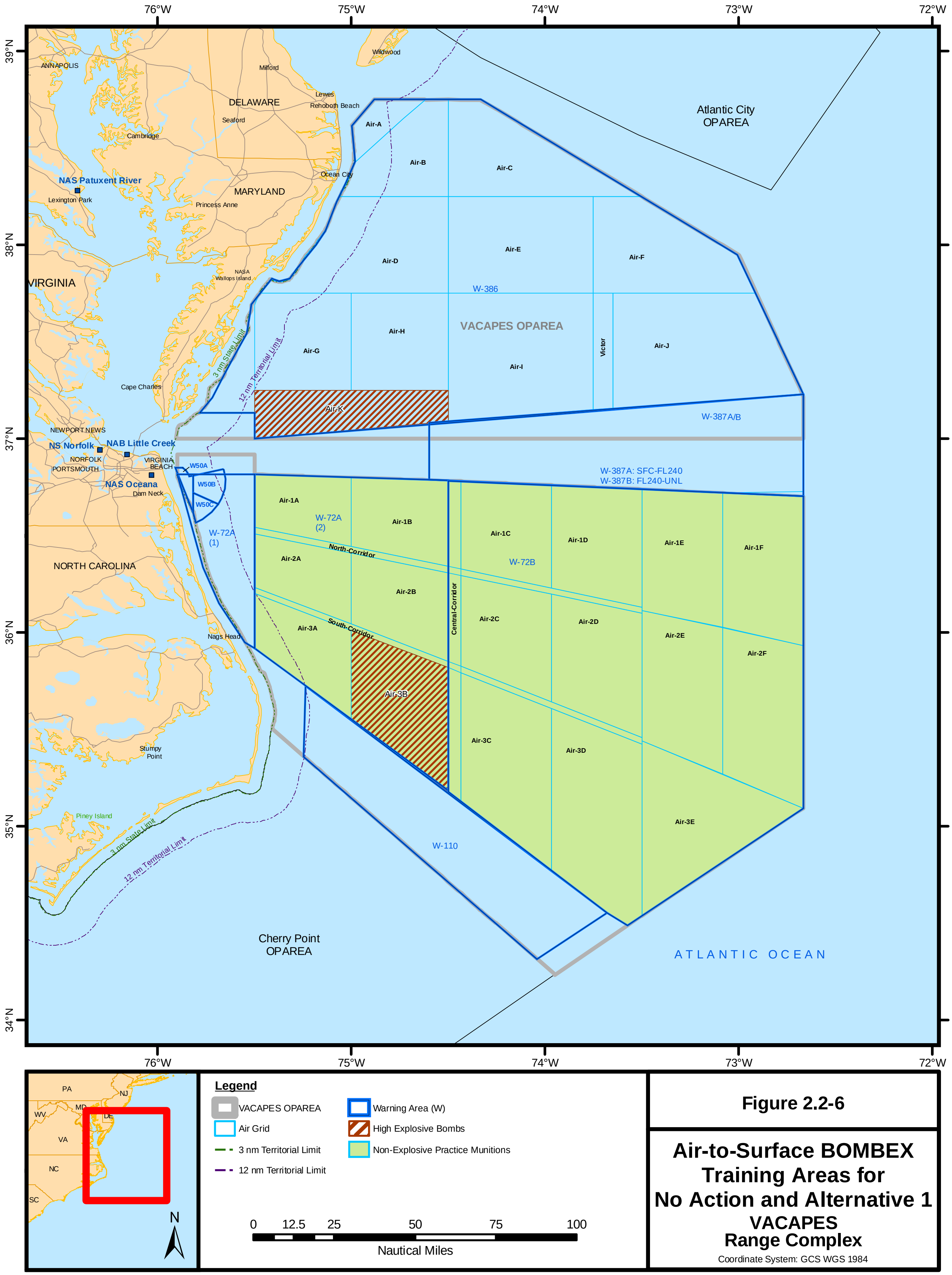


Figure 2.2-6

Air-to-Surface BOMBEX Training Areas for No Action and Alternative 1 VACAPES Range Complex

Coordinate System: GCS WGS 1984

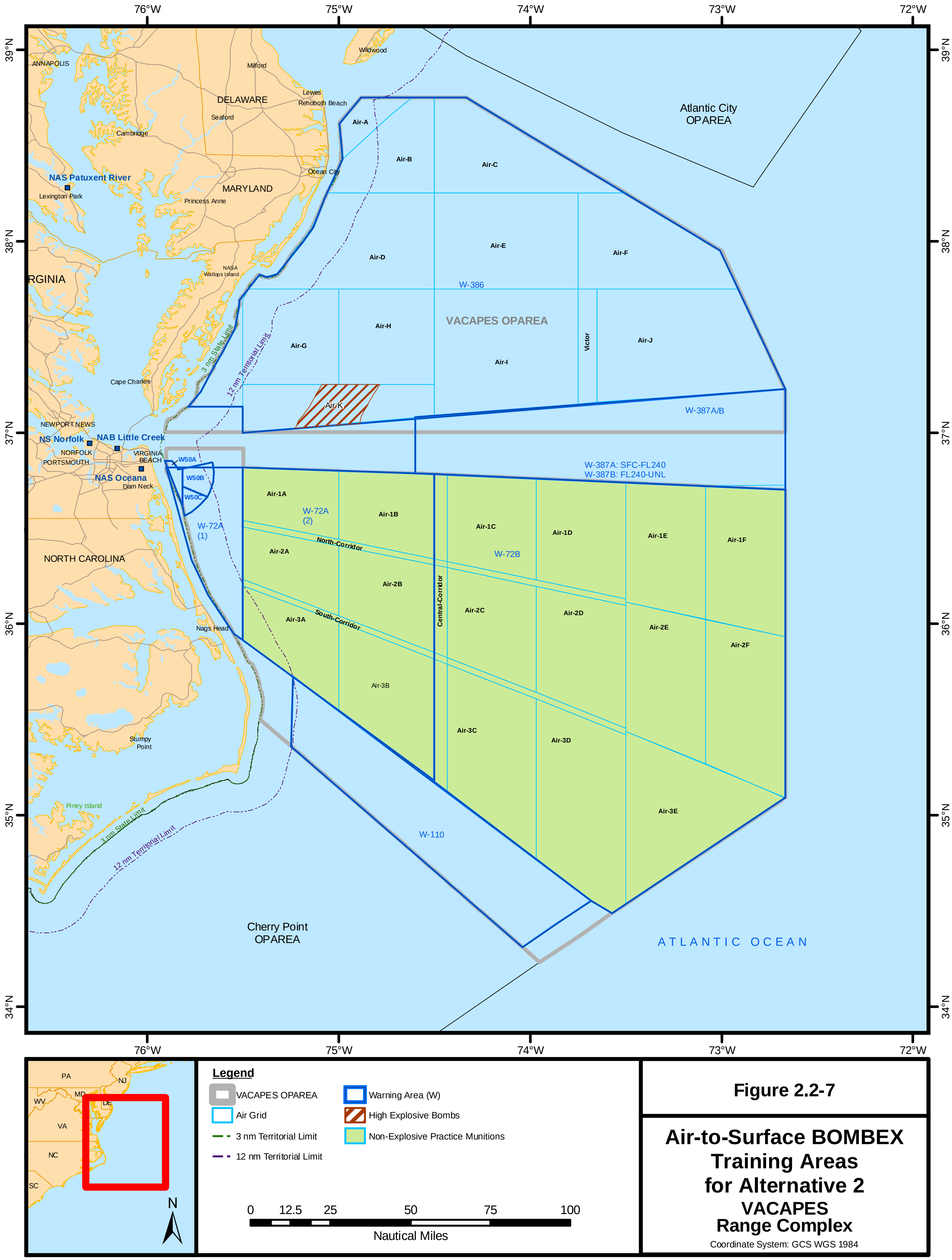


Figure 2.2-7

Air-to-Surface BOMBEX Training Areas for Alternative 2 VACAPES Range Complex

Coordinate System: GCS WGS 1984

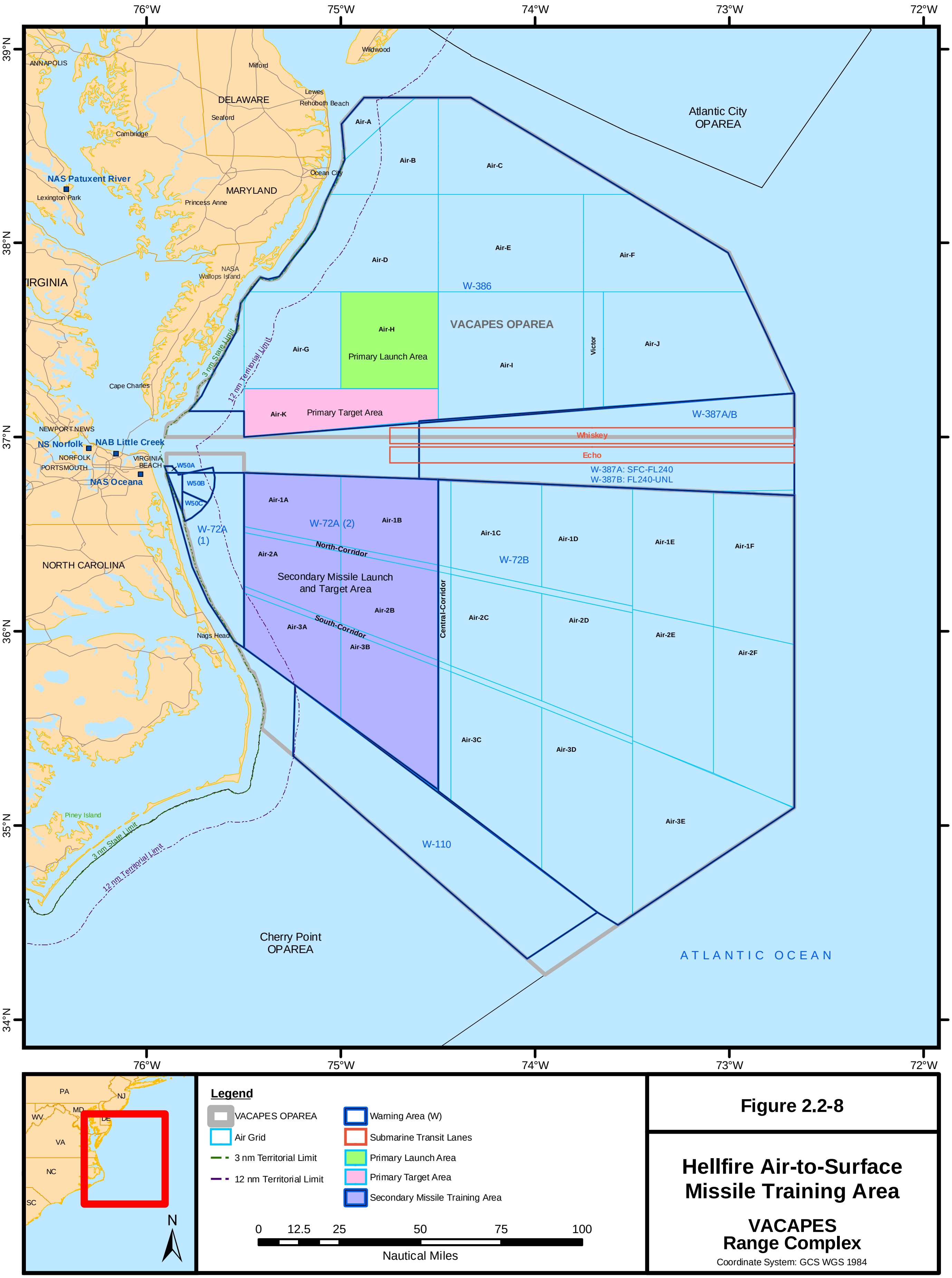


Figure 2.2-8

Hellfire Air-to-Surface Missile Training Area

VACAPES Range Complex

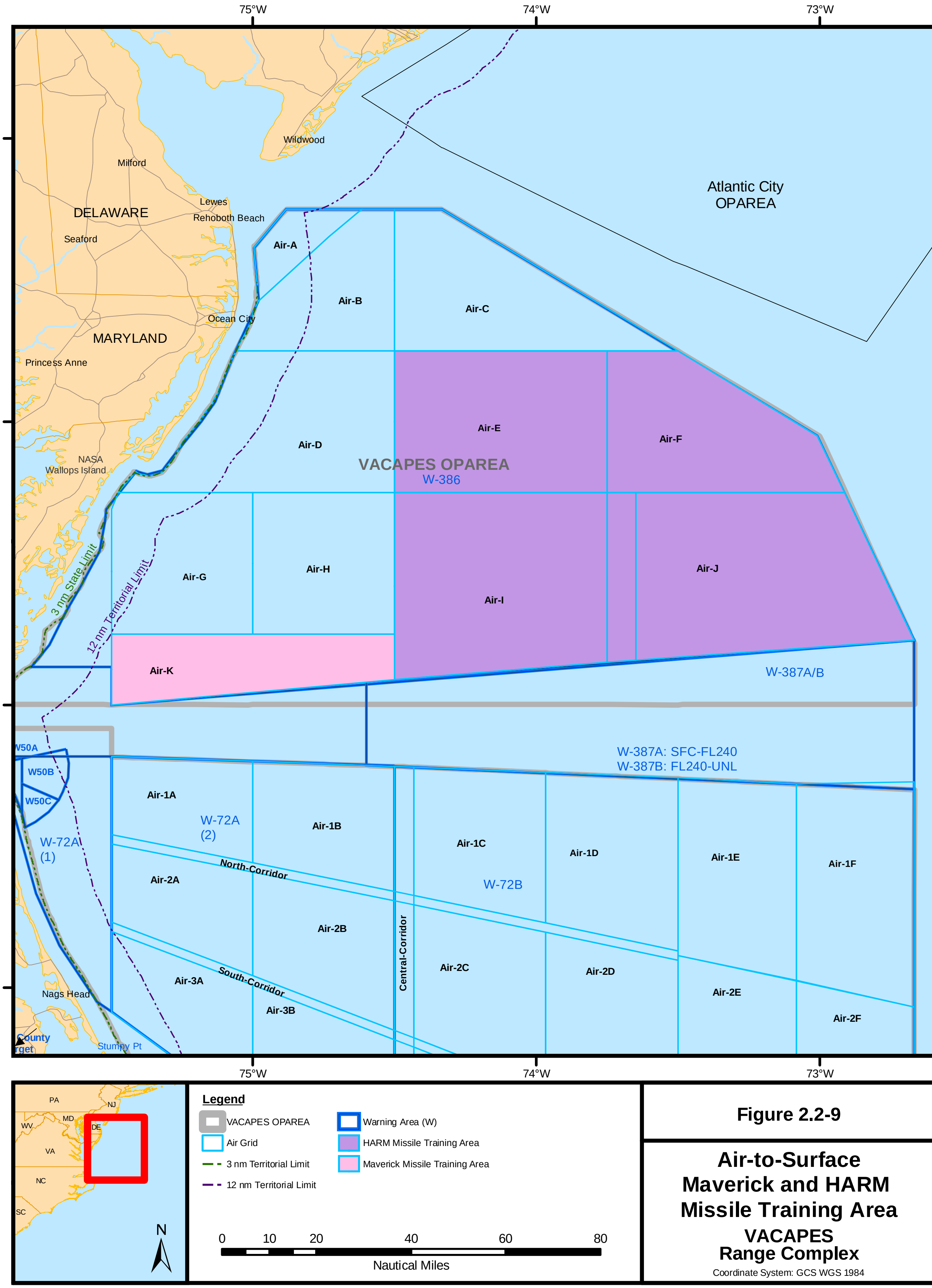
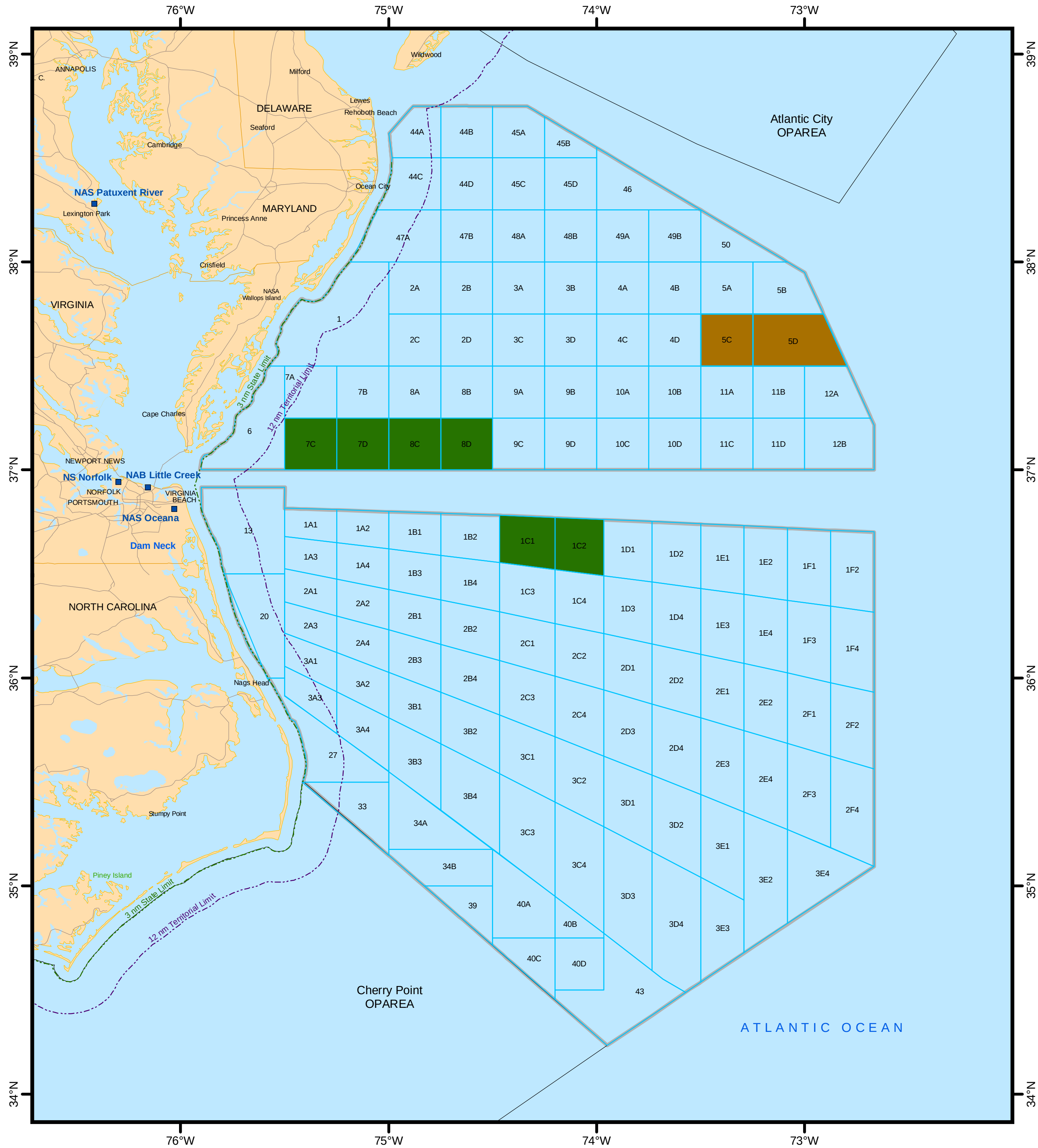


Figure 2.2-9

Air-to-Surface Maverick and HARM Missile Training Area VACAPES Range Complex



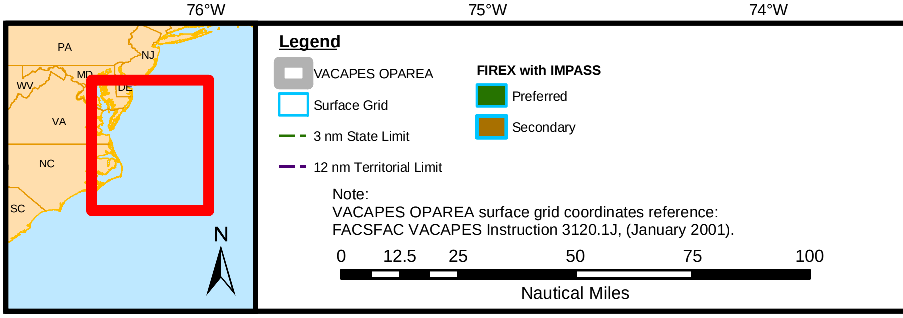


Figure 2.2-10

IMPASS Training Areas

VACAPES Range Complex

Coordinate System: GCS WGS 1984

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CHAPTER 3 : AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes existing environmental conditions for resources potentially affected by the Alternatives described in Chapter 2. This chapter also identifies and assesses the environmental consequences of the Alternatives. The affected environment and environmental consequences are described and analyzed according to categories of resources. The categories of resources addressed in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) are listed in Table 3-1:

TABLE 3-1
RESOURCE VERSUS RESOURCE CHAPTER LOCATION

Resource	Section	Resource	Section
Bathymetry and Sediments	3.1	Hazardous Materials and Hazardous Waste	3.2
Water Resources	3.3	Air Quality	3.4
Airborne Noise Environment	3.5	Marine Communities	3.6
Marine Mammals	3.7	Sea Turtles	3.8
Fish and Essential Fish Habitat	3.9	Sea Birds and Migratory Birds	3.10
Land Use	3.11	Cultural Resources	3.12
Transportation	3.13	Demographics	3.14
Regional Economy	3.15	Recreation	3.16
Environmental Justice	3.17	Public Health & Safety	3.18
Atlantic Fleet Active Sonar Training	3.19		

3.1 BATHYMETRY AND SEDIMENTS

3.1.1 Introduction and Methods

Water depth, bottom topography, and bottom composition are features that define the physical environment within the VACAPES Study Area, which is shown in Figure 1.5-1. Sediments refer to the soil, sand, organic matter, and minerals, including rock, that underlie or accumulate at the bottom of a body of water.

The VACAPES Range Complex offshore operating area (OPAREA) is in the southern portion of the Mid-Atlantic Bight, the region between Cape Cod and Cape Hatteras. It includes the near-shore area from just off the mouth of Delaware Bay south to Cape Hatteras. The western (shoreward) boundary is roughly the 3 nautical miles (nm) state territorial limit and the seaward (eastern) boundary extends 155 nm into waters more than 13,120 feet deep.

The northern limits of the VACAPES Study Area extend to Cape Henlopen, Delaware. To the south, the VACAPES Study Area extends almost to Cape Hatteras, North Carolina before angling seaward and terminating at the approximate latitude of Cape Fear. This analysis also includes proposed mine warfare training areas in the lower Chesapeake Bay, and the 3 miles from the shoreline seaward to the OPAREA.

3.1.1.1 Assessment Methods and Data Used

The proposed activities under each alternative were evaluated to determine their effects on bathymetry and bottom sediments. The primary mechanisms that would cause impacts would be underwater explosions and the accumulation of training debris on the ocean bottom. Factors that were included in the evaluation of impacts included the geographic dispersion of training activities, density of debris, and persistence or decomposition of debris on the ocean bottom.

The VACAPES Marine Resource Assessment (MRA) (DoN, 2007) was a key data source that was used for assessing the existing conditions for bathymetry and sediments. The MRA compiled and synthesized available scientific literature, including information in journals, periodicals, theses, dissertations, project reports, and other technical reports published by government agencies, private businesses, and consulting firms. These included National Marine Fisheries Service (NMFS) reports, including stock assessment reports, recovery plans, and survey reports. The MRA summarized the physical environment, including marine geology, circulation and currents, and hydrography for the study area. Unless otherwise indicated, the existing conditions information provided in this chapter was taken from the VACAPES MRA.

Internet keyword searches were performed to determine if information was available that was not captured in the MRA. The searches on bathymetry and sediments produced a number of websites that were evaluated for information quality and relevance, and that were used as appropriate.

3.1.1.2 Warfare Areas and Associated Environmental Stressors

Aspects of the proposed actions that likely would act as stressors to bathymetry and sediments were identified by analyzing the warfare areas, operations, and specific activities that would be associated with each alternative. As shown in Table 3.1-1, four stressors would have at least one operation that would affect bathymetry or sediments.

Table 2.2-5 in Chapter 2 indicates the types of military expended materials (MEM) that would result from each alternative. The types of types of training materials and locations of use were detailed in Tables 2.2-6 and 2.2-7.

3.1.2 Affected Environment

The bathymetry and sediments features in the VACAPES Study Area are shown in Figure 3.1-1 and Figure 3.1-2.

3.1.2.1 Bathymetry

Within the VACAPES Study Area, the continental shelf has an average depth of 246 feet. The continental shelf ranges in width from about 24 nm off Cape Hatteras to about 87 nm off Delaware Bay. It has a seaward gradient of less than 1:1,000 (Hollister, 1973; Kennett, 1982).

The shelf break is the seaward limit of the continental shelf and the beginning of the continental slope. At the continental shelf break, the ocean bottom drops abruptly along the continental slope in a gradient of about 1:10. The continental slope, the most prominent physiographic feature along the mid-Atlantic continental margin, extends to water depths of between about 2,000 meters and 4,000 meters.

Four submarine canyons, designated Norfolk, Washington, Accomac, and Baltimore, are found within the VACAPES Study Area. These large canyons dissect the continental slope and continue as deep-sea channels on the continental rise.

The Chesapeake Bay is relatively shallow, with an average depth of 21 feet. The bay is shaped like a shallow tray, except for the large channel, believed to be remnants of the ancient Susquehanna River, that runs the entire length of the bay. At the mouth of the bay, the channel terminates at a shallow sill that can restrict deeper water flow into and out of the bay (Reshetiloff, 2004; Kemp, *et al*., 2005).

TABLE 3.1-1
SUMMARY OF POTENTIAL STRESSORS TO BATHYMETRY AND SEDIMENTS

Warfare Area and Operation	Training Areas	Mine Warfare Deployment and Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High-Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)					
Mine countermeasures exercise (MCM)	Lower Chesapeake Bay	✓			
Mine countermeasures exercise (MCM)	W-50 A/C, W-386, W-72	✓	✓	✓	✓
Mine neutralization	W-50C	✓	✓	✓	✓
Surface Warfare (SUW)					
Bombing exercise (air-to-surface) (at sea)	W-386 (Air-K), W-72A (Air-3B), W-72A/B		✓	✓	✓
Missile exercise (MISSILEX) (air-to-surface)	W-386 (Air-K), W-72A		✓	✓	✓
Gunnery exercise (GUNEX) (air-to-surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C		✓	✓	✓
GUNEX (surface-to-surface) boat	W-50C, R-6606		✓	✓	✓
GUNEX (surface-to-surface) ship	W-386, W-72		✓	✓	✓
Laser targeting	W-386 (Air-K)		✓	✓	✓
Visit, Board, Search and Seizure/Maritime Interception Operations (VBSS/MIO)- ship	VACAPES OPAREA				
VBSS/MIO- Helicopter	VACAPES OPAREA				
Air Warfare (AW)					
Air combat maneuver (ACM)	W-72A (Air-2A/B, 3A/B)				
GUNEX (air-to-air)	W-72A				✓
MISSILEX (air-to-air)	W-386 (Air D, G, H, K), W-72A				✓
GUNEX (surface-to-air)	W-386, W-72		✓	✓	✓
MISSILEX (surface-to-air)	W-386 (Air D, G, H, K)		✓	✓	✓
Air intercept control (AIC)	W-386, W-72				✓
Detect to engage (DTE)	W-386, W-72				✓
Strike Warfare (STW)					
HARM missile exercise	W-386 (Air E, F, I, J)		✓		✓

TABLE 3.1-1 (Continued)
SUMMARY OF POTENTIAL STRESSORS TO BATHYMETRY AND SEDIMENTS

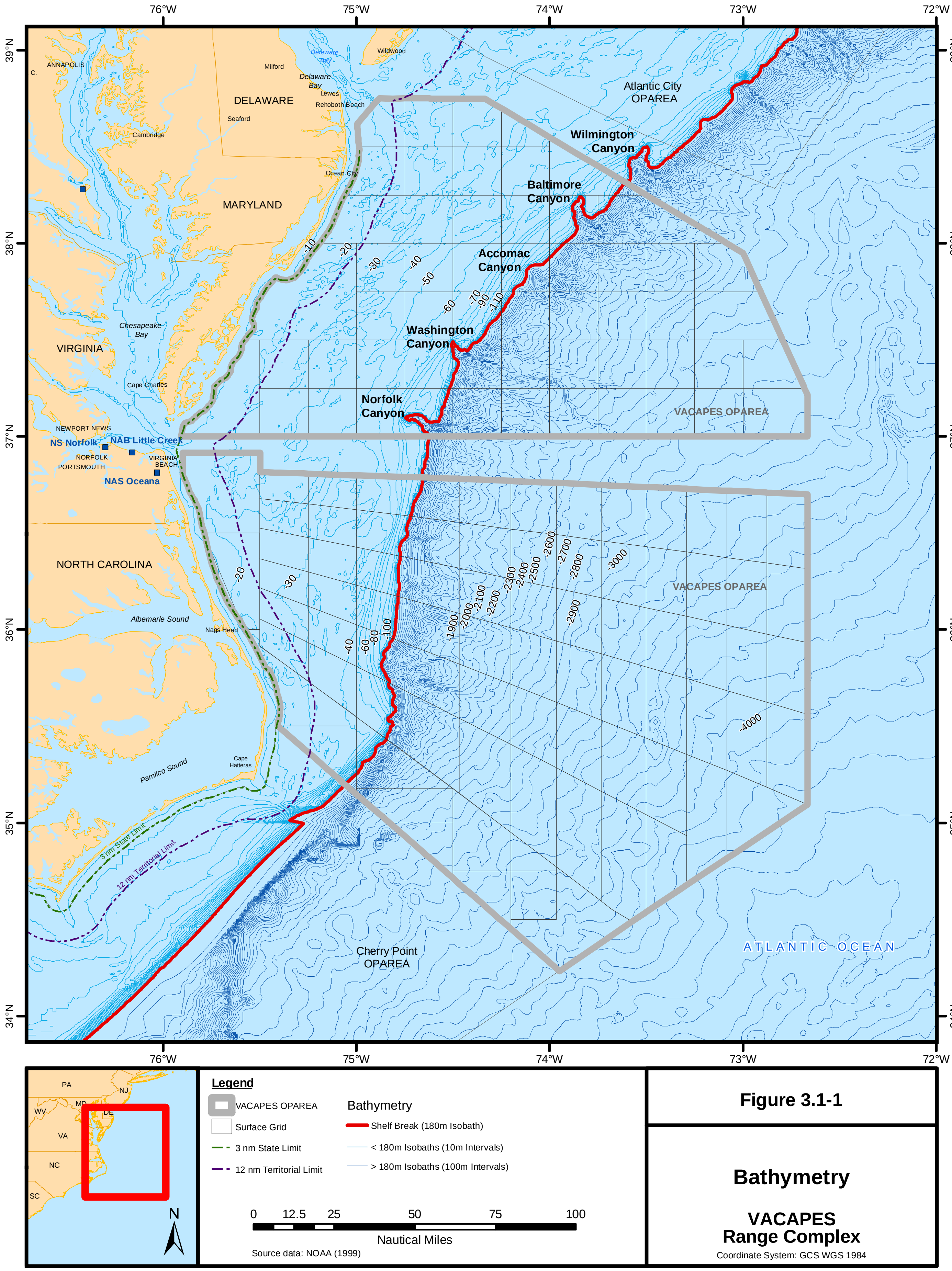
Warfare Area and Operation	Training Areas	Mine Warfare Deployment and Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High-Explosive Ordnance	Military Expended Materials
Amphibious Warfare (AMW)					
Firing exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓	✓		✓
Electronic Combat (EC)					
Chaff exercise - aircraft	W-386, W-386 (Air-K), W-72	✓	✓		✓
Chaff exercise - ship	W-386, W-72	✓	✓		✓
Flare exercise - aircraft	W-386, W-386 (Air-K), W-72		✓		✓
Electronic combat (EC) operations - aircraft	W-386 (Air-K)				
EC operations - ship	VACAPES OPAREA				
Test and Evaluation					
Shipboard Electronic Systems Evaluation Facility (SESEF) utilization	VACAPES OPAREA				

3.1.2.2 Sediments

The sediments in the VACAPES Study Area are typical of the offshore to shelf-edge area, consisting of fine quartz sand with a patchy veneer of shells (DoN, 2002). Sediment texture varies from gravel patches and a fine sand mixture inshore, to medium sand offshore extending to the shelf edge (Reshetiloff, 2004; Kemp, *et al*., 2005).

For the Lower Chesapeake Bay, the sediments consist of a sand and clay/silt mixture upstream of the mouth and sand near the mouth of the Chesapeake Bay (USGS, 2007).

Sediment stability is the degree to which the sediment bed would be mixed or eroded based on the physical characteristics of the sediments. If the stability is changed, natural processes such as wave action, or water flows could change the erosion or sediment deposition rates and then change the bathymetry of the area.



76°W
75°W
74°W
73°W
72°W
39°N
38°N
37°N
36°N
35°N
34°N
DELAWARE
MARYLAND
VIRGINIA
NORTH CAROLINA
ANNAPOLIS
Milford
Delaware Bay
Lewes
Rehoboth Beach
Wildwood
Seaford
Cambridge
Ocean City
Chesapeake Bay
Cape Charles
NEWPORT NEWS
NS Norfolk
NAB Little Creek
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
NAS Oceana
Albemarle Sound
Nags Head
Pamlico Sound
Cape Hatteras
3 nm State Limit
12 nm Territorial Limit
Atlantic City OPAREA
Wilmington Canyon
Baltimore Canyon
Accomac Canyon
Washington Canyon
Norfolk Canyon
VACAPES OPAREA
VACAPES OPAREA
Cherry Point OPAREA
ATLANTIC OCEAN
-10
-20
-30
-40
-50
-60
-70
-90
-110
-20
-30
-40
-60
-80
-100
-1900
-2000
-2100
-2200
-2300
-2400
-2500
-2600
-2700
-2800
-2900
-3000
-4000
PA
NJ
WV
MD
DE
VA
NC
SC
N
Legend
VACAPES OPAREA
Surface Grid
3 nm State Limit
12 nm Territorial Limit
Bathymetry
Shelf Break (180m Isobath)
< 180m Isobaths (10m Intervals)
> 180m Isobaths (100m Intervals)
0
12.5
25
50
75
100
Nautical Miles
Source data: NOAA (1999)
Figure 3.1-1
Bathymetry
VACAPES Range Complex
Coordinate System: GCS WGS 1984

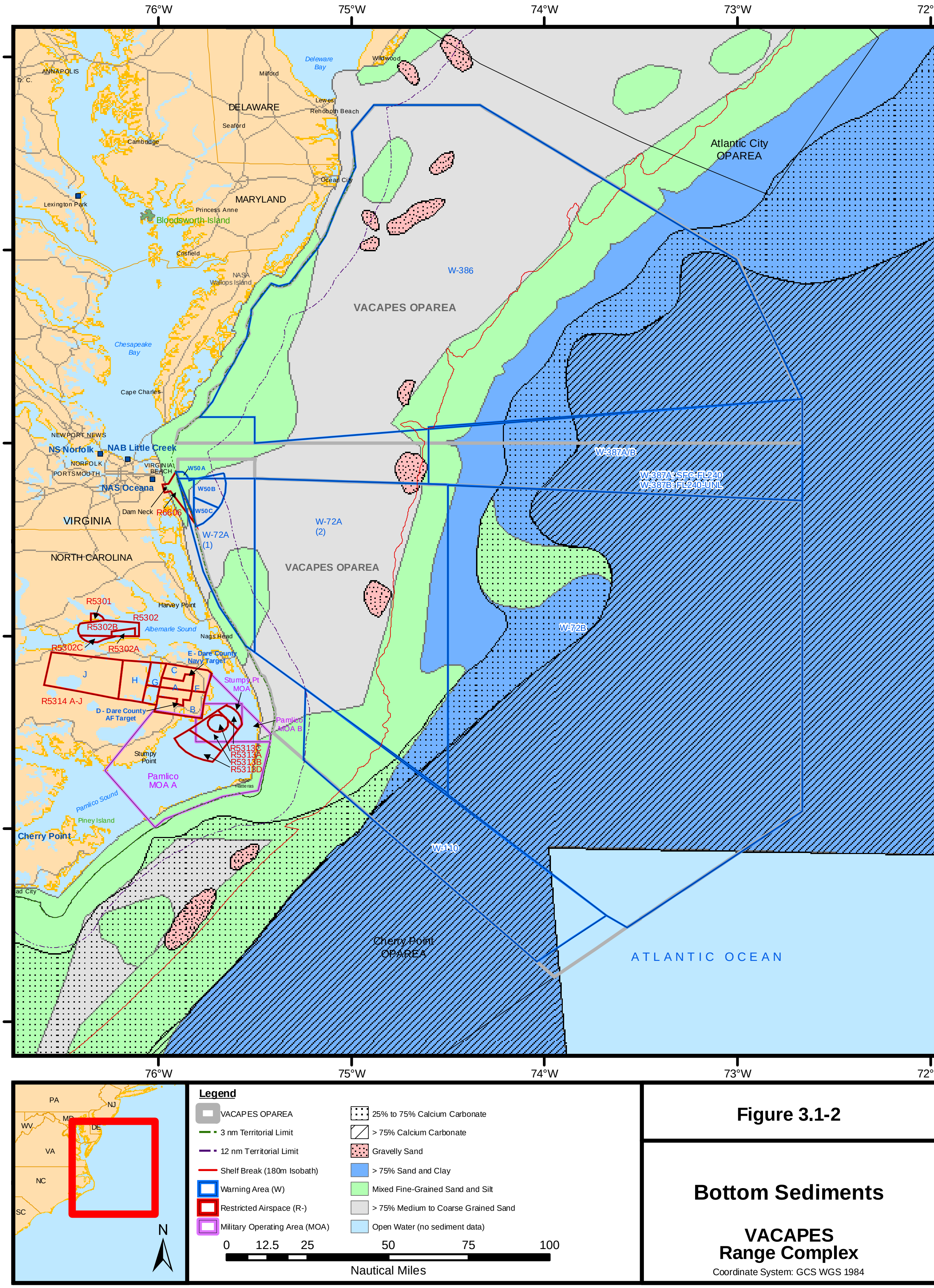


Figure 3.1-2

Bottom Sediments

VACAPES Range Complex

3.1.3 Environmental Consequences

The primary effect of the Navy's training activities in the VACAPES Study Area would be explosions in the water and the deposition of expended training materials on the ocean bottom and their accumulation over time. The numbers and sizes of explosions that are summarized in Table 2.2-7 were used to evaluate effects from explosions. Data from Tables 2.2-4, 2.2-5, 2.2-6, and 3.1-2 were used to determine the total amount training materials deposited annually per square nautical mile of each training area and the entire study area.

This section considers only the physical effects of these materials on bathymetry and sediments. The effects associated with the chemical properties of expended training materials are discussed in Section 3.2.2. Effects of explosions and debris deposition on benthic organisms are addressed in Section 3.6, Marine Communities.

3.1.3.1 No Action Alternative

Explosions in the Water

As shown in Figures 2.2-1 and 2.2-5 through 2.2-10 and listed in Table 2.2-7, the No Action Alternative would result in 1,411 explosions in the water each year from training in the VACAPES study area. Explosives would range from the 8-lb net explosive weight (NEW) charges in Hellfire missiles to the 944.7-lb NEW charges in the nine MK-84 bombs that would be dropped annually in bombing exercises.

All of the high-explosive MK-20, MK-82, MK-83, and MK-84 bombs that would be dropped at sea would be used in areas of deep waters and would explode before reaching a depth that could damage the ocean floor or disturb deep sediments. Therefore, explosions in deep marine waters of the VACAPES Study Area would not affect the bathymetry or sediments of the study area.

Each year, 12 explosions of charges up to 20 lbs NEW would be conducted on the ocean bottom in shallow waters as part of mine neutralizations training exercises. Each charge would create a shallow depression in bottom sediments, and would suspend a substantial volume of sediment in the water column, causing a localized increase in turbidity. The turbidity increase would be short-lived, because larger particles would rapidly drop to the bottom and smaller particles would be dispersed by currents. Although the depressions would last longer, they would act as sediment traps, would soon be filled in, and would not have a lasting effect on bathymetry or sediments.

Deposition of Expended Training Materials

Tables 2.2-4, 2.2-5, and 2.2-6 provide details on the numbers and sizes of the training materials expended in each training area. The effects of expended materials from training activities on ocean bottom sediments were assessed as the number of items deposited per unit area of bottom surface. About 1,816,383 training items would be expended annually under the No Action Alternative (see Table 3.1-2). Based on the VACAPES Range Complex sea space area of 27,661 nm^2, this would be about 65.7 items per nm^2. The density would range from less than one item annually per nm^2 in several of the training areas to 16,629 items annually per nm^2 in W-50C.

Of the 1,816,383 training items, approximately 1,773,019 or 98 percent would be cannon shells (20, 25, 30 or 40-mm) or small-arms munitions (.50-caliber or 7.62-mm bullets). These munitions (including the case) are small, ranging from 2.75 to 5.5 inches long. Because of the small size and low density of military expended materials, sediment stability on the ocean bottom would not be affected by small-arms munitions.

Other military expended materials may be larger. However, two or more larger pieces would not likely settle in the same vicinity, because training activities would seldom occur in the exact location, and ocean currents would move the materials from where they entered the water to where they settled on the bottom.

As a result, sediment stability on the ocean floor would not be affected by larger pieces of materials expended during training.

Training materials would accumulate in ocean sediments over the entire period of military training, so a one-year analysis does not capture the magnitude of the environmental effects. If the same amounts of training materials were used annually for 20 years, the aggregate density of military expended materials on the ocean floor would be about 1,313 items per nm^2. In W-50C, about 332,585 items would accumulate over 20 years, or an average of one item per 111 square feet (approximately equal to a square that is 10 feet per side). Some of the materials deposited would be completely degraded after 20 years, especially metals with a high corrosion potential. Twenty years was chosen to calculate aggregate densities to give an approximation to the number of materials present, based on the added assumption that operations and locations change over time. Eventually, deposited materials would be covered with sediment and incorporated into the ocean floor. This process would occur more quickly for small items, such as bullets, than for large items.

Another concern for training material deposition, is the deposition of materials in areas where sand resources, such as sand shoals, usable for beach replenishments are located. Sand shoals are typically found in shallower areas and those of the most value are close to shore. With the exception of Norfolk, VA the Navy is unlikely to operate in very shallow water areas or to use ordnance in the nearshore public areas. Water areas close to shore typically are crowded with commercial or private vessels that would interfere with training, therefore those areas are avoided, especially if ordnance is used. The water areas with the most concentrated Navy ordnance activity, are specifically designated training areas, such as the hotbox (see Figures 2.2-3 through 2.2-10), and are not near any shoal areas. Therefore, although there may be training materials in sand resource areas, the amounts present would not be so prevalent that they would foul the sand resources.

Most of the military expended materials would be non-explosive and thus, harmless, but some of the materials would consist of metals such as lead. In 2005, the Canadian Forces Maritime Experimental and Test Ranges (CFMETR) near Nanoose, British Columbia were analyzed for chemical effects associated with expendable components from activities involving sonobuoys, torpedoes, expendable mobile ASW training targets (EMATT), and auxiliary dry cargo carriers (ESG, 2005). These expended materials contain many of the same constituents as training materials used in the VACAPES OPAREA. In the CFMETR study, the analysis focused on lead, copper, lithium, and torpedo fuel. The types of materials expended in the CFMETR were similar to the military expended materials deposited in the VACAPES OPAREA.

The study found that metal constituents were most likely to concentrate in fine-grained particulate matter, especially when the particulate matter was smaller than 63 micrometers. The findings demonstrated that CFMETR operations did not cause a measurable effect on sediment quality (ESG, 2005). Assuming the VACAPES military expended materials react to the sediments in VACAPES in a similar manner as CFMETR materials react to CFMETR sediments there would be no measurable effect on VACAPES sediment quality. In addition, based on a density of expended components in the VACAPES Study Area that would be lower than those in the CFMETR, military expended materials would have a lower impact on sediment quality.

In accordance with the NEPA, Navy training activities in territorial waters under the No Action Alternative would have no significant impact to bathymetry and sediment. In accordance with Executive Order (EO) 12114, Navy training activities in non-territorial waters would not cause harm to bathymetry or sediment.

3.1.3.2 Alternative 1

Explosions in the Water

As shown in Table 3.1-2, Alternative 1 would result in 1,453 explosions in the water each year from training in the VACAPES Study Area. As with the No Action Alternative, explosives would range from the 8-lb NEW charges in Hellfire missiles to 944.7-lb NEW charges in MK-84 bombs.

Impacts from explosions in the water would be the same as those described for the No Action Alternative. All large, high-explosives bombs would be detonated near the surface over deep water, and would not damage the ocean floor or disturb deep sediments. Increased numbers of explosions would occur for Hellfire missiles and underwater detonations using 20-lb NEW charges but, as described for the No Action Alternative, all effects from these explosions would be localized and short-term.

Deposition of Expended Training Materials

The effects of expended materials from training activities on ocean bottom sediments in the VACAPES Study Area were assessed as the number of items deposited per unit area of bottom surface. About 2,249,138 training items would be expended under Alternative 1 (see Table 3.1-2). Based on the VACAPES Range Complex sea space area of 27,661 nm^2, this would be about 81.3 items per nm^2. The density would range from less than one item annually per nm^2 in several of the training areas to 20,838 items annually per nm^2 in W-50C.

Of the 2,249,138 training items, approximately 2,196,730 or 98 percent would be cannon shells (25 or 30 mm) or small-arms munitions (.50-caliber or 7.62-mm bullets). After 20 years, the greatest density, which would be in W-50C, would be about 416,770 items, or an average of one item per 88 square feet (approximately equal to a square that is 9 feet per side). Throughout the VACAPES Study Area, the density would be much lower, about 1,626 items per nm^2.

In addition to the materials described in the tables, Alternative 1 would include the installation of a mine neutralization training area in the W-50C area. This would consist of two relatively small (about 1 square mile) training minefields, for use with AMNS, RAMICS, and MK-103. There will be 20-40 shapes in the water of 40-60 feet in depth, both moored and bottom shapes. Concrete anchors would hold the mine shapes in place, one for each mine shape. Each anchor would measure 2.0 to 2.5 feet on each side. Sediment disturbance would occur during anchor placement and could recur with subsequent anchor maintenance activities or during mine shape deployment or recovery. However, all such disturbances would be highly localized and short-term, and would not have any lasting effects on bathymetry or sediments.

As described in the No Action Alternative, neither bullets and shells nor larger pieces from other military expended materials would affect sediment stability, and they eventually would be covered with sediment and incorporated into the ocean floor. Based on the studies at the CFMETR, the volume of military expended materials that would result from Alternative 1 would not measurably affect sediment quality.

In accordance with the NEPA, Navy training activities in territorial waters under Alternative 1 would have no significant impact to bathymetry or sediment. In accordance with Executive Order (EO) 12114, Navy training activities in non-territorial waters would not cause harm to bathymetry or sediment.

TABLE 3.1-2
TRAINING MATERIALS IN VACAPES TRAINING AREAS

Training Areas and Number of Training Items	No Action	Alternative 1	Alternative 2
Entire Study Area (27,661 square nautical miles)			
Number of items expended annually	1,816,383	2,249,138	2,298,753
Number of items annually per square nautical mile	65.7	81.3	83.1
20-year aggregate density per square nautical mile	1,313	1,626	1,662
R-6606 (33 square nautical miles)			
Number of items expended annually	40,054	44,060	44,060
Number of items annually per square nautical mile	1,214	1,335	1,335
20-year aggregate density per square nautical mile	24,280	26,700	26,700
W-50C (33 square nautical miles)			
Number of items expended annually	548,766	687,670	687,730
Number of items annually per square nautical mile	16,629	20,838	20,840
20-year aggregate density per square nautical mile	332,580	416,760	416,800
W-72 (15,274 square nautical miles)			
Number of items expended annually	169,564	188,492	188,492
Number of items annually per square nautical mile	11	12	12
20-year aggregate density per square nautical mile	220	240	240
W-72A (Air-3B) (808 square nautical miles)			
Number of items expended annually	121	121	0
Number of items annually per square nautical mile	0.15	0.15	0
20-year aggregate density per square nautical mile	3	3	0
W-72A (Air-1A) (458 square nautical miles)			
Number of items expended annually	483,840	792,000	792,000
Number of items annually per square nautical mile	1,056	1,729	1,729
20-year aggregate density per square nautical mile	21,120	34,580	34,580
W-72 (1C1 and 1C2) (360 square nautical miles)			
Number of items expended annually	511	511	511
Number of items annually per square nautical mile	1.4	1.4	1.4
20-year aggregate density per square nautical mile	28	28	28
W-72A/B (14,643 square nautical miles)			
Number of items expended annually	225	248	248
Number of items annually per square nautical mile	0.015	0.017	0.017
20-year aggregate density per square nautical mile	0.300	0.340	0.340

TABLE 3.1-2 (Continued)
TRAINING MATERIALS IN VACAPES TRAINING AREAS

Training Areas and Number of Training Items	No Action	Alternative 1	Alternative 2
W-386 (9,765 square nautical miles)			
Number of items expended annually	528,226	582,210	582,210
Number of items annually per square nautical mile	54	60	60
20-year aggregate density per square nautical mile	1,080	1,200	1,200
W-386 (Air-E, F, I, J) (4,683 square nautical miles)			
Number of items expended annually	26	26	26
Number of items annually per square nautical mile	0.006	0.006	0.006
20-year aggregate density per square nautical mile	0.120	0.120	0.120
W-386 (Air-D, G, H, K) (3,307 square nautical miles)			
Number of items expended annually	30	33	33
Number of items annually per square nautical mile	0.010	0.011	0.011
20-year aggregate density per square nautical mile	0.200	0.220	0.220
W-386 (Air-K) (592 square nautical miles)			
Number of items expended annually	6,477	10,284	9,960
Number of items annually per square nautical mile	11	17.4	16.8
20-year aggregate density per square nautical mile	220	348	336
W-386 (5C/5D) (464 square nautical miles)			
Number of items expended annually	511	511	511
Number of items annually per square nautical mile	1.1	1.1	0.7
20-year aggregate density per square nautical mile	22	22	22
W-386 (7C/7D and 8C/8D) (720 square nautical miles)			
Number of items expended annually	511	511	511
Number of items annually per square nautical mile	0.7	0.7	0.7
20-year aggregate density per square nautical mile	14	14	14

3.1.3.3 Alternative 2 (Preferred Alternative)

Explosions in the Water

As shown in Table 3.1-2, Alternative 2 would result in 1,088 explosions in the water each year from training in the VACAPES Study Area. Explosives would range from 0.002-lb NEW charges that are associated with the cable cutters of the MK-103 mine sweeping system to 415.8-lb NEW charges in the MK-83 bombs that would be used in bombing exercises.

As shown in Table 2.2-7, Alternative 2 would eliminate the use of MK-84 bombs (944.8 lbs NEW), MK-82 bombs (192.2-lbs NEW), and MK-20 bombs (109.7-lbs NEW), and would substantially reduce the numbers of MK-83 bombs (415.8-lbs NEW) used in bombing exercises. However, these changes would not have any effect on bathymetry or sediments compared to the No Action Alternative. This would result because all detonations of large, high-explosives bombs would continue to occur near the surface over deep water where they would not damage the ocean floor or disturb deep sediments; this absence of damage would not change with reductions in the numbers and sizes of explosions.

Alternative 2 would increase the number of explosions used for mine countermeasure and mine neutralization training about eight-fold compared to the No Action Alternative. More than half of the additional explosions would be from 0.002-lb NEW charges in the cable cutters of the MK-103 mine sweeping system. These very small explosions would occur in the water column and would be unlikely to affect bathymetry or sediment.

The remaining additional explosions would result from increased use of Hellfire missiles (8-lbs NEW) and underwater detonations using 20-lb NEW charges, and from new use of the Airborne Mine Neutralization System (AMNS) (3.24-lbs NEW) in the study area. As described for the No Action Alternative, all effects from these explosions would be localized and short-term.

Deposition of Expended Training Materials

The effects of expended materials from training activities on ocean bottom sediments in the VACAPES Study Area were assessed as the number of items deposited per unit area of bottom surface. About 2,298,753 training items would be expended under Alternative 2 (see Table 3.1-2). Based on the VACAPES Range Complex sea space area of 27,661 nm^2, this would be about 83.1 items per nm^2. The density would range from less than one item annually per nm^2 in several of the training areas to 20,840 items annually per nm^2 in W-50C.

Of the 2,298,753 training items, approximately 2,246,466 or 98 percent would be cannon shells (25 or 30 mm) or small-arms munitions (.50-caliber or 7.62-mm bullets). After 20 years, the greatest density, which would occur in W-50C, would be about 416,806 items, or an average of one item per 88 square feet (approximately equal to a square that is 9 feet per side). Throughout the VACAPES Range Complex, the density would be much lower, about 1,662 items per nm^2.

In Alternative 2, the Navy would install the mine neutralization training areas as depicted in Figures 2.2-1, 2.2-2, 2.2-3, and 2.2-4. Each training area would accommodate one to four individual minefields with non-explosive training mines attached to concrete anchors, each of which would measure 2.0 to 2.5 feet on each side. There will be 20-40 non-explosive mine shapes per training area.

As described for Alternative 1, sediment disturbance would occur during anchor placement, and could recur with subsequent anchor maintenance activities or during mine shape deployment or recovery. However, all such disturbances would be highly localized and short-term, and would not have any lasting effects on bathymetry or sediments.

As described in the No Action Alternative, neither bullets and shells nor larger pieces from other military expended materials would affect sediment stability, and they eventually would be covered with sediment and incorporated into the ocean floor. Based on the studies at the CFMETR, the volume of military expended materials that would result from Alternative 2 would not measurably affect sediment quality.

In accordance with the NEPA, Navy training activities in territorial waters under Alternative 2 would have no significant impact to bathymetry or sediment. In accordance with Executive Order (EO) 12114, Navy training activities in non-territorial waters would not cause harm to bathymetry or sediment.

3.1.4 Unavoidable Significant Environmental Effects

There would not be any unavoidable significant environmental effects as a result of implementation of the No Action Alternative, Alternative 1, or Alternative 2.

3.1.5 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.1-3, No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on bathymetry and sediments. Furthermore, the No Action Alternative, Alternative 1, and Alternative 2 would not cause harm to bathymetry and sediments in non-territorial waters.

TABLE 3.1-3
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON BATHYMETRY AND SEDIMENTS IN THE VACAPES STUDY AREA

Alternative and Stressor	NEPA (U.S. Territory)	EO 12114 (Non-Territorial Waters, >12 nm)
No Action		
Mine warfare deployment and recovery Non-explosive practice munitions Underwater detonations and high-explosive ordnance Military expended materials	Explosions in shallow water would result in localized, short-term impacts. No effects from explosions in deep water. No effects from deposition of expended training materials on the ocean floor.	Explosions in shallow water would result in localized, short-term impacts. No effects from explosions in deep water. No effects from deposition of expended training materials on the ocean floor.
Impact conclusion	No significant impact to bathymetry or sediments.	No harm to bathymetry or sediments.
Alternative 1		
Mine warfare deployment and recovery Non-explosive practice munitions Underwater detonations and high-explosive ordnance Military expended materials	Explosions in shallow water would result in localized, short-term impacts. No effects from explosions in deep water. No effects from deposition of expended training materials on the ocean floor.	Explosions in shallow water would result in localized, short-term impacts. No effects from explosions in deep water. No effects from deposition of expended training materials on the ocean floor.
Impact conclusion	No significant impact to bathymetry or sediments.	No harm to bathymetry or sediments.
Alternative 2		
Mine warfare deployment and recovery Non-explosive practice munitions Underwater detonations and high-explosive ordnance Military expended materials	Explosions in shallow water would result in localized, short-term impacts. No effects from explosions in deep water. No effects from deposition of expended training materials on the ocean floor.	Explosions in shallow water would result in localized, short-term impacts. No effects from explosions in deep water. No effects from deposition of expended training materials on the ocean floor.
Impact conclusion	No significant impact to bathymetry or sediments.	No harm to bathymetry or sediments.

3.2 HAZARDOUS MATERIALS AND HAZARDOUS WASTE

3.2.1 Introduction and Methods

3.2.1.1 Introduction

This section addresses hazardous and non-hazardous components of the training operations described in this EIS/OEIS. Some items such as fuels, adhesives, and solvents required for maintenance and operation of vessels, machinery, and equipment are used by the Navy as well as by other organizations and individuals. Other items such as missiles and chaff are only used in military activities. Terms used to describe items throughout this section are discussed below:

Military Expended Material (MEM) – Military expended material (MEM) refers to those munitions, items, devices, equipment and materials which are uniquely military in nature, and are used and expended in the conduct of the military training and testing mission, such as: sonobuoys, flares, chaff, drones, targets, bathymetry measuring devices and other instrumentation, communications devices, and items used as training substitutes. This definition may also include materials expended (such as propellants, weights, guidance wires) from items typically recovered, such as aerial target drones and practice torpedoes.

According to a 2008 report compiled by the Interagency Marine Debris Coordination Committee (IMDCC), MEM from Navy training and testing missions is not considered a significant source of marine debris (IMDCC, 2008). In addition, an annual report from the Ocean Conservancy further details the main sources of marine debris resulting from the 2007 International Coastal Cleanup effort, with shoreline/recreational activities and smoking-related activities accounting for more than 90% of marine pollution worldwide (Ocean Conservancy, 2007). More specifically, the report states that on average, land based activities in Maryland, Delaware, Virginia, and North Carolina, including picnics, festivals, sporting events, beach outings, and litter runoff from parking lots, streets, and storm drains account for more than 63% of marine pollution. On average, smoking–related products accounted for an additional 29% of all marine debris collected in these states. In summary, neither of these studies point to the Navy as a primary contributor to the marine debris problem.

In addition to recovering spent training and testing materials whenever possible, proactive Best Management Practices (BMPs) instituted by the Navy play a crucial role in reducing or eliminating the amount of expended materials introduced into the environment. The Navy P2 Afloat Program details many pollution prevention practices, including shipboard recycling programs, use of non-polluting technologies and materials, reducing excess packaging materials, and eliminating discarded plastics through the use of shipboard Plastic Waste Processors (http://205.153.241.230/p2_documents/navy.html). In summary, this study does not point to the Navy as a primary contributor to the marine debris problem.

Military Expended Material Constituent (MEMC) – Any constituent released into the environment from the use of MEM is considered a military expended material constituent (MEMC). MEMC includes constituents from explosive and non-explosive materials and the emission, degradation, or breakdown products from MEM.

Non-hazardous Components – Parts of a device made of nonreactive materials, including parts made of metals such as steel or aluminum; polymers such as nylon, rubber, vinyl, and plastics; glass; fiber; and concrete. While these items represent persistent seabed litter, their strong resistance to degradation and their chemical composition mean they do not chemically contaminate the surrounding environment by leaching heavy metals or organic compounds.

Hazardous Material – Hazardous materials are chemical substances that pose a risk to human health or the environment. In general, these materials pose hazards because of their quantity, concentration, physical, chemical, or infectious characteristics. Hazardous materials include, but are not limited to, petroleum products, coolants, paints, adhesives, solvents, corrosion inhibitors, cleaning compounds, photographic materials, and chemicals. Hazardous materials are also used in, munitions and targets because they are strong, lightweight, reliable, long-lasting, or low-cost.

Munitions Constituents – Materials originating from unexploded ordnance (UXO), discarded military munitions, or other military munitions, including explosive and non-explosive materials and emission, degradation, or breakdown products of such ordnance and munitions, are called munitions constituents. When missiles, munitions, and targets are used for their intended purpose, component hazardous materials are considered munitions constituents. Components that contain hazardous constituents include propellants, batteries, flares, telemetry, igniters, jet fuel, diesel fuel, hydraulic fluid, and explosive warheads. Each constituent has the potential to affect human health and the environment through direct contact with individuals, water, soil, or air.

Hazardous Constituents – Hazardous constituents can generally be defined as hazardous materials present at low concentrations in a generally non-hazardous matrix, such that their hazardous properties do not produce acute effects. The USEPA and the DoD have identified numerous waste streams from Navy vessels that do or may contain hazardous constituents. Waste streams from Navy vessels that may contain hazardous constituents include hull coating leachate, bilgewater/oil water separator discharges, gray water, cooling water, weather deck runoff, chain locker effluent, elevator pit effluent, and photographic laboratory drains. Small boat engines discharge petroleum products in their wet exhaust.

Hazardous Waste – A hazardous waste may cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or pose a present or potential risk to human health or the environment when improperly treated, stored, transported, disposed, or otherwise managed. The Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Part 6901, *et seq*. regulates management of solid and hazardous waste.

Military Munitions Rule – This rule clarifies when conventional and chemical military munitions become a solid waste, which then may be regulated as hazardous waste under the RCRA. Military munitions are not considered hazardous waste under two conditions stated in the USEPA Military Munitions Rule and the DoD Interim Policy on Military Munitions (1997). These conditions cover virtually all the uses of missiles, munitions, and targets at the VACAPES Study Area. Specifically, munitions are not considered hazardous waste when they are:

- Used for their intended purpose, including training of military personnel and explosive emergency response specialists or for research and development activities, and when they are recovered, collected, and destroyed during range clearance events.
- Unused and being repaired, reused, recycled, reclaimed, disassembled, reconfigured, or subjected to other material recovery activities.

Used hazardous materials and chemical byproducts generated at sea are not considered hazardous waste until offloaded at port. Environmental compliance policies and procedures applicable to shipboard operations afloat are defined in applicable naval operations instruction manuals. These instructions reinforce the Clean Water Act's prohibition against discharge of harmful quantities of hazardous substances into or on U.S. waters out to 200 nm. Navy ships are required to conduct operations at sea in such a manner as to minimize or eliminate any adverse impacts on marine environment. This includes conforming to stringent requirements for hazardous waste discharge, storage, dumping, and pollution prevention.

Hazardous material and waste generated afloat are stored in approved containers and offloaded for proper disposal within five working days of arrival at a Navy port. All commands (ship or shore) can return excess and unused hazardous materials to the Hazardous Material Minimization Center (HAZMINCEN) located at their assigned naval station (DoN, 2005a). The Consolidated Hazardous Materials Reutilization and Inventory Management Program (CHRIMP) provides assistance in the development and implementation of local hazardous material management. It is available online at http://www.naspensacola.navy.mil/logistics/chrimp.pdf. The 2005 Hazardous Materials Minimization, Hazardous Waste Reutilization and Disposal Guide, which is available on the Internet at http://www.cnrma.navy.mil/environmental/ hazardous_waste.htm, provides points of contact and detailed information regarding shipboard hazardous waste and hazardous material turn-in. These documents provide a comprehensive compilation of procedures and requirements mandated by law, directive, or regulation. They have a compliance orientation to ensure safe and efficient control, use, transport, and disposal of hazardous waste.

3.2.1.2 Assessment Methods and Data Used

General Approach to Analysis

Each alternative analyzed in this EIS/OEIS includes several Primary Mission Areas (for example, Mine Warfare, Air Warfare, and Surface Warfare), and most warfare areas include multiple types of training operations, such as surface-to-air gunnery exercise and surface-to-air missile exercise. Likewise, several activities, such as weapons firing, target deployment, are accomplished under each operation. Some types of MEM, such as bombs, missiles, small-caliber ammunition, and marine markers, are common to multiple activities.

To address potential impacts, the approach to analysis includes characterizing the yearly test and training operations that may contribute MEM and MEMC to the VACAPES Study Area ocean environment. This section of the EIS/OEIS reviews the MEM and MEMC associated with training on the ocean range. Specific MEM categories analyzed include bombs, missiles, targets and countermeasures, marine markers (smoke floats), naval gun ammunition, smalls-arms and close-in weapons system ammunition, chaff, flares, and underwater detonations. For each category, a general characterization and quantity used is presented, followed by a description of the anticipated fate and transport of the MEM and MEMC once it has introduced into the environment. Potential impacts on environmental resources are addressed in other sections of this chapter as appropriate.

Study Area

The study area for MEM and MEMC is the same as the VACAPES EIS/OEIS Study Area that is described in Section 1.5 and is shown in Figure 1.5-1

Data Sources

Prior EAs, EISs, marine resource assessments (MRAs), studies, databases, and websites were reviewed. Numerous federal, state, and local regulations governing the handling, storage, and disposal of waste and hazardous materials (see Appendix K) were also researched.

Primary Mission Areas and Associated Environmental Stressors

Aspects of the proposed actions that are likely to act as stressors were identified by conducting an analysis of the PMARs, operations, and specific activities included in the alternatives. Appendix D provides detailed descriptions of the VACAPES Study Area operations. Table 3.2-1 presents identified MEM stressors and their association with specific operations that would occur within the VACAPES Study Area. Checkmarked cells in Table 3.2-1 indicate that MEM is associated with the operation and that the activities and associated training item(s) are carried forward for detailed analysis in this EIS/OEIS.

TABLE 3.2-1
POTENTIAL STRESSORS ASSOCIATED WITH MILITARY EXPENDED MATERIAL

Primary Mission Area and Operation	Training Areas	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High-Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)					
Mine countermeasures exercise (MCM)	Lower Chesapeake Bay	✓	✓		
Mine countermeasures exercise (MCM)	W-50A/C, W-386, W-72	✓	✓		
Mine neutralization	W-50C	✓	✓	✓	✓
Surface Warfare (SUW)					
Bombing exercise (BOMBEX) (air-to-surface) (at sea)	W-386 (Air-K), W-72A (Air-3B), W-72A/B		✓	✓	✓
Missile exercise (MISSILEX) (air-to-surface)	W-386 (Air-K) W-72A		✓	✓	✓
Gunnery exercise (GUNEX) (air-to-surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C		✓	✓	✓
GUNEX (surface-to-surface) - boat	W-50C, R-6606		✓	✓	✓
GUNEX (surface-to-surface) - ship	W-386, W-72		✓	✓	✓
Laser targeting	W-386 (Air-K)				
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA				
VBSS/MIO- Helo	VACAPES OPAREA				
Air Warfare (AW)					
Air combat maneuver (ACM)	W-72A (Air-2A/B, 3A/B)				
GUNEX (air-to-air)	W-72A				✓
MISSILEX (air-to-air)	W-386 (Air D, G, H, K), W-72A		✓	✓	✓
GUNEX (surface-to-air)	W-386, W-72		✓		✓
MISSILEX (surface-to-air)	W-386, (Air D, G, H, K)		✓		✓
Air intercept control (AIC)	W-386, W-72				
Detect to engage (DTE)	W-386, W-72				

TABLE 3.2-1
POTENTIAL STRESSORS ASSOCIATED WITH MILITARY EXPENDED MATERIAL (Continued)

Primary Mission Area and Operation	Training Areas	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High-Explosive Ordnance	Military Expended Materials
Strike Warfare (STW)					
HARM missile exercise	W-386 (Air E, F, I, and J)		✓	✓	✓
Amphibious Warfare (AMW)					
Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)		✓	✓	✓
Electronic Combat (EC)					
Chaff exercise - aircraft	W-386, W-386 (Air-K), W-72				✓
Chaff exercise - ship	W-386 and W-72				✓
Flare exercise - aircraft	W-386, W-386 (Air-K), W-72				✓
Electronic Combat (EC) operations - aircraft	W-386 (Air-K)				
EC operations- ship	VACAPES OPAREA				
Test and Evaluation					
Shipboard Electronic Systems Evaluation Facility (SESEF) utilization	VACAPES OPAREA				

3.2.2 Affected Environment

Open ocean areas are typically considered relatively unpolluted with regard to hazardous materials and hazardous waste. However, hazardous materials are present on the ocean as cargo and as fuel, lubricants, and cleaning and maintenance materials for marine vessels and aircraft. Infrequently, large hazardous materials leaks and spills, especially of petroleum products, affect the marine environment and adversely affect marine life. Quantitative information is not available on the types and quantities of hazardous materials present on the sea ranges at a given time, or on their distribution among the various categories of vessels.

Navy vessels within the VACAPES Study Area represent a small fraction of the commercial and recreational boat traffic and, correspondingly, account for only a small fraction of the hazardous materials present. Navy training activities in open ocean areas involve the use of fuel, lubricants, explosives, propellants, batteries, oxidizers, and other hazardous substances.

Hazardous waste is present within the VACAPES Study Area, both on surface vessels and in bottom sediments. Commercial, scientific, and military vessels generate small quantities of hazardous waste during their operations. These materials typically are accumulated while at sea, and then offloaded and transported to land disposal facilities when in port. Quantitative information is not available on the types and quantities of hazardous waste present on the sea ranges at a given time, or on their distribution among the various categories of vessels.

As a result of the past practice of ocean disposal of hazardous waste, isolated deposits of hazardous waste may be found on the ocean floor. Although no such sites have been identified within the Navy's sea ranges, the potential exists for one or more hazardous waste deposits to be present.

3.2.3 Environmental Consequences

Navy ships may not discharge overboard untreated used or excess hazardous material generated onboard the ship within 200 nm of shore. Ships retain used and excess hazardous material on board for shore disposal. Ships offload used hazardous material within five working days of arrival at a Navy port. The 2005 Hazardous Materials Minimization, Hazardous Waste Reutilization and Disposal Guide, available online at http://www.cnrma.navy.mil/environmental/hazardous_waste.htm, provides points of contact and detailed information regarding shipboard hazardous waste and material turn-in.

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) prohibits certain discharges of oil, garbage, and other substances from vessels. The MARPOL Convention and its annexes are implemented by national legislation, including the Act to Prevent Pollution from Ships (APPS) (33 U.S.C. 1901 to 1915) and Federal Water Pollution Control Act (FWPCA) (33 U.S.C. 1321 to 1322), commonly known as the Clean Water Act (CWA). These statutes are further implemented and amplified by Department of the Navy (DoN) and Office of the Chief of Naval Operations Environmental and Natural Resources Program Manual, which establishes Navy policy, guidance, and requirements for the operation of Navy vessels. The vessels operating in the VACAPES Study Area would comply with the discharge requirements, minimizing or eliminating potential impacts from discharges from ships.

If a fuel spill occurred, the effects would be mitigated through compliance with standard spill-control responses and wildlife rescue procedures.

Navy ships may not discharge overboard untreated used or excess hazardous material generated onboard the ship within 200 nm of shore. Ships retain used and excess hazardous material on board for shore disposal. Ships offload used hazardous material within five working days of arrival at a Navy port. The 2005 Hazardous Materials Minimization, Hazardous Waste Reutilization and Disposal Guide, available online at http://www.cnrma.navy.mil/environmental/hazardous_waste.htm, provides points of contact and detailed information regarding shipboard hazardous waste and material turn-in.

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Fuel dumping by aircraft rarely occurs. Navy aircrews are prohibited from dumping fuel below 6,000 feet, except in an emergency situation. Above 6,000 feet, the fuel has enough time to completely vaporize and dissipate and would, therefore, have a negligible effect on the water below. A study performed by the Air Force (USAF, 2002) indicated that 735 gallons of fuel released from an aircraft at 5,000 feet altitude resulted in approximately 99 percent evaporation before the fuel hit the surface.

Additionally, jet fuel generally evaporates from the surface of water within 24 hours and, consequently, does not persist in the marine environment.

The Navy has recently implemented the Water Range Sustainability Environmental Program Assessment (WRSEPA) Policy (29 August 2008) to ensure the long-term viability of our operational ranges while protecting human health and the environment (Chief of Naval Operations, 2008). The impact of training materials expended in the marine environment will be a focus of the WRSEPA Policy. Protective measures will be considered and implemented if practicable to sustain range operations, maintain environmental compliance, and address unacceptable risks associated with munitions constituents and MEMCs. Protective measures are actions or best management practices designed and implemented to abate, prevent, minimize, stabilize, or eliminate the release or the threat of release of munitions constituents and MEMCs and risks to human health or the environment.

Tables 2.2-4 and 2.2-5 list quantities of MEM used by Navy range operation and training activities during exercises at the VACAPES Study Area for each alternative. Appendix D contains detailed weapons system descriptions. MEM and associated MEMC can leak or leach small amounts of toxic substances into the water as they degrade and decompose (see Table 3.2-2). These items decompose very slowly, so the volume of MEM that decomposes within the training areas, and the amounts of toxic substances being released to the environment, gradually increase over the period of military use. Concentrations of some substances in sediments surrounding the expended material may increase over time. Sediment movements in response to tidal surge and longshore currents, and sediment disturbance from ship traffic and other sources can disperse these contaminants so they will be present at very low concentrations. Thus, they are anticipated to have minimal effect on the environment (Environmental Sciences Group, 2005).

Bioaccumulation, or the building up of a substance in the systems of living organisms (and thus, a food chain) due to ready solubility in living tissues, is not anticipated to be an issue when MEM or MEMC are introduced into the water. Although aquatic food chains are capable of accumulating certain environmental contaminants to toxic concentrations, MEM and MEMC from Navy activities are not expected to contribute to bioaccumulation in the Study Area. In general, at least three properties are required for a contaminant to bioaccumulate in an aquatic food chain: 1) a high octanol-water partition coefficient, 2) chemical and metabolic stability in water and in organisms in the food chain, and 3) a low toxicity to organisms in the chain so that the chain is not broken by loss of an intermediate species. Most chemicals and metals introduced to the aquatic environment by environmental contamination (including Navy MEM and MEMC) fail to meet these requirements (Clarkson, 1995). Further, due to the expansive area of seaspace in the VACAPES OPAREA, tidal surge and longshore currents, and sediment disturbance from ship traffic and other sources, MEM and MEMC would not provide a measurable contribution to bioaccumulation within the food chain of species found in the OPAREA. Consequently, the process of bioaccumulation or its effects are not further analyzed in this EIS/OEIS.

This EIS/OEIS does not contain MEM associated with sonar training. The Navy is currently preparing the Atlantic Fleet Active Sonar Training (AFAST) EIS/OEIS for the use of multiple sonar types in the east coast and Gulf of Mexico OPAREAs of the United States. A summary of the AFAST EIS/OEIS is provided in Section 3.19, Summary of Sonar Effects.

3.2.3.1 No Action Alternative

Navy training operations conducted under the No Action Alternative use a variety of materials. Materials required in the VACAPES Study Area are broadly classified as shipboard materials necessary for normal operations and maintenance, such as fuel and paint and MEM. MEM includes both high explosives and non-explosive practice munitions.

Some MEM, including gun ammunition, bombs, missiles, targets, chaff, and flares, are expended on the range and not recovered. A small percentage of training items containing military explosives may fail to function properly, and, if not recovered, may remain on the range as UXO.

TABLE 3.2-2
MUNITIONS CONSTITUENTS OF POTENTIAL CONCERN

Training Application/ Munitions Element	Munitions Constituents
Pyrotechnics Tracers Spotting charges	**Munitions Constituent**
Oxidizers	Lead oxide
Delay elements	Barium chromate Potassium perchlorate Lead chromate
Propellants	Ammonium perchlorate
Fuses	Potassium perchlorate
Detonators	Fulminate of mercury Potassium perchlorate
Primers	Lead azide
Other explosives [a/]	2-Amino-4,6-dinitrotoluene (2-A-4,6-DNT) 4-Amino-2,6-dinitrotoluene (4-A-2,6-DNT) 1,3-Dinitrobenzene (1,3-DNB) 2,4-Dinitrotoluene (DNT) 2,6-DNT Hexahydro-1,3,5-trinitro-1,3,5-triazine (Rapid-Detonating Explosive or RDX) Methyl-2,4,6-trinitrophenylnitramine (Tetryl) Nitrobenzene Nitroglycerin 2-Nitrotoluene 3-Nitrotoluene 4-Nitrotoluene Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (Octogen or HMX) Perchlorate 1,3,5-Trinitrobenzene (1,3,5-TNB) 2,4,6-Trinitrotoluene (TNT) Metals (such as aluminum, arsenic, lead, and mercury)

a/ Source: U.S. Navy Range Sustainability Environmental Program Assessment Policy Implementation Manual, November 2006

The following paragraphs discuss the characteristics and the fate and transport of training items used within the VACAPES Training Complex.

Bombs

Characteristics and Numbers of Bombs

Typically, bombing exercises (BOMBEX) at sea involve one or more aircraft bombing a target simulating a hostile surface vessel. Bomb bodies are steel and the bomb fins are either steel or aluminum. Based on the American Society for Testing and Materials (ASTM) standards specified for bomb construction, each of the iron bomb bodies or steel fins may also contain small percentages (typically less than 1%) of any of the following: carbon, manganese, phosphorus, sulfur, copper, nickel, chromium, molybdenum, vanadium, columbium, or titanium. The aluminum fins, in addition to the aluminum, may also contain zinc, magnesium, copper, chromium, manganese, silicon, or titanium (DoN, 2005d). Refer to Section 3.3, Water Resources, for effects on water quality.

Practice bombs are also called bomb dummy units (BDU). They are bomb bodies filled with an non-explosive material, such as concrete). A BDU mimics the weight, size, center of gravity, and ballistics of a high-explosive bomb. Non-explosive practice mine shapes are similar in composition to BDUs, and consist of pieces of concrete or steel cases formed in the shape of a mine and filled with concrete. Both could be used within the VACAPES Study Area. These practice munitions may contain spotting charges and/or signal cartridges that produce a visual indication of impact.

Several types of bombs would be used at the VACAPES Study Area sea range during the No Action Alternative. Their approximate weights, lengths, and diameters are provided in Table 3.2-3.

TABLE 3.2-3
BOMBS DEPLOYED UNDER THE NO ACTION ALTERNATIVE ON THE VACAPES STUDY AREA SEA RANGE

Bomb Type	Type	~Weight (pounds)	~Length (inches)	~Diameter (inches)
MK-82/GBU-30/38	High explosive	500	90	11
MK-83/GBU-32	High explosive	1,000	119	14
MK-84	High explosive	2,000	154	18
MK-20 Cluster Each dispenses 247 bomblets	High explosive	1.32 per bomblet	6.5	2
MK-20 Cluster Each dispenses 247 bomblet	Non-explosive, practice	1.32 per bomblet	6.5	2
MK-76 (mine shape)	Non-explosive, practice (also used as mine shape)	25	25	4
BDU-45 (mine shape)	Non-explosive, practice (also used as mine shape)	500	66	11
BDU-33, GBU-12, JDAM, JSOW, MK-76, MK-82, MK-84	Non-explosive, practice	See above	See above	See above

Sixty one percent (61%) of the bombs used in the No Action Alternative VACAPES Study Area exercises would be practice bombs without explosive warheads. Thirty nine percent (39%) of the 1,203 bombs dropped annually in No Action Alternative exercises at the VACAPES Study Area sea range would contain high explosives. Bombs with high-explosive ordnance would be fused to detonate on contact with the water, and it is estimated that 99% of them would explode within 5 feet of the ocean surface (DoN, 2005b). Propelled fragments would be produced by exploding bombs.

Bombs Fate and Transport

Small fragments of detonated bombs would settle to the sea floor. Unrecovered ordnance would also sink to the bottom where solid metal components would be corroded by seawater at slow rates. Over time, natural encrustation of exposed surfaces would occur, reducing the rate at which corrosion occurred. Rates of deterioration would vary, depending on the material and conditions in the immediate marine and benthic environment. Because of the large ocean area of the VACAPES Study Area, expended ordnance scattered on the ocean floor would be widespread and would have a minimal impact on the benthic environment. Initial chemical by-product concentrations released during bomb detonation would disperse rapidly in water and would be considered negligible (DoN, 2005b).

Practice bombs entering the water would consist of materials like concrete, steel, and iron, and would not contain the combustion chemicals found in the warheads of explosive bombs. These components are consistent with the primary building blocks of artificial reef structures. The steel and iron, although durable, would corrode over time, with no noticeable environmental impacts. The concrete is also durable and would offer a beneficial substrate for benthic organisms. After sinking to the bottom, the physical structure of bombs would be incorporated into the marine environment by natural encrustation and/or sedimentation (DoN, 2006b).

Refer to Section 3.3, Water Resources, for information regarding water quality.

Missiles

Characteristics and Numbers of Missiles

Missiles would be fired by aircraft, ships, and Naval Special Warfare (NSW) operatives at a variety of airborne and surface targets on the VACAPES Study Area. In general, the single largest hazardous constituent of missiles is solid propellant, which is primarily composed of rubber (polybutadiene) mixed with ammonium perchlorate (for example, solid double-base propellant, aluminum and ammonia propellant grain, and arcite propellant grain). Hazardous constituents are also used in igniters, explosive bolts, batteries (potassium hydroxide and lithium chloride), and warheads (for example, PBX-N high-explosive components; PBXN-106 explosive; and PBX (AF)-108 explosive). Chromium or cadmium may also be found in anti-corrosion compounds coating exterior missile surfaces.

In the event of an ignition failure or other launch mishap, the rocket motor or portions of the unburned propellant may cause environmental effects. Experience with Hellfire missiles has shown that if the rocket motor generates sufficient thrust to overcome the launcher hold-back, all of the rocket propellant is consumed. In the rare cases where the rocket does not generate sufficient thrust to overcome the hold-back (hang fire or miss fire), some propellant may remain unburned but the missile remains on the launcher. Jettisoning the launcher is a possibility for hang fire or miss fire situations, but in most cases the aircraft returns to base where the malfunctioning missile is handled by EOD personnel.

Table 3.2-4 provides the approximate dimensions, weights, numbers, and types of missiles that would be fired during operations in No Action Alternative missile exercises at the VACAPES Study Area sea range. Approximately 27% of the 300 missiles that would be fired on the VACAPES Study Area sea range each year would carry non-explosive practice warheads with no hazardous constituents.

TABLE 3.2-4
MISSILES FIRED UNDER THE NO ACTION ALTERNATIVE AT THE VACAPES STUDY AREA SEA RANGE

Missile Name	Designation	Type		~Launch Weight (pounds)	~Length (feet)	~Diameter (inches)
Sparrow	AIM-7	Air-to-air	HE & NEPM [a/]	500	12	8
Sidewinder	AIM-9	Air-to-air	HE & NEPM	190	9.4	5
AMRAAM Slammer	AIM-120	Air-to-air	HE & NEPM	350	12	7
ASRAAM	AIM-132	Air-to-air	NEPM	220	9	7

TABLE 3.2-4 (Continued)
MISSILES FIRED UNDER THE NO ACTION ALTERNATIVE
AT THE VACAPES STUDY AREA SEA RANGE

Missile Name	Designation	Type		~Launch Weight (pounds)	~Length (feet)	~Diameter (inches)
Maverick	AGM-65	Air-to-surface	HE & NEPM	460-670	8.5	12
Harpoon	AGM-84	Air-to-surface	NEPM	1,800	17	13.5
High-speed Anti-radiation Missile (HARM)	AGM-88	Air-to-surface	HE & NEPM	800	13.6	10
Hellfire	AGM-114	Air-to-surface	HE & NEPM	100	5.6	7
Sea Sparrow	RIM-7	Surface-to-air	NEPM	500	12	8
Standard Missile (SM2)	RIM-66C	Surface-to-air	NEPM	1,350	14.5	13.5
Rolling Airframe	RIM-116	Surface-to-air	NEPM	162	9	5

a/ HE = High explosive. NEPM = Non-explosive practice munitions.

Missiles Fate and Transport

Non-explosive practice missiles do not explode upon contact with the target or sea surface. The main environmental effect would be the physical structure of the missile entering the water. Practice missiles do not use rocket motors and, therefore, do not have potentially hazardous rocket fuel.

Exploding warheads may be used in air-to-air missile exercises, but to avoid damaging the aerial target, the missile explodes at an offset to the target in the air, disintegrates, and falls into the ocean. High-explosive missiles used in air-to-surface exercises explode near the water surface (DoN, 2006a).

The principal source of potential impacts to water and sediment quality would be unburned solid propellant residue. Solid propellant fragments would sink to the ocean floor and undergo changes in the presence of seawater. The concentration would decrease over time as the leaching rate decreased and further dilution occurred. The aluminum would remain in the propellant binder and eventually would be oxidized by seawater to aluminum oxide. The remaining binder material and aluminum oxide would pose no threat to the marine environment (DoN, 1996). Section 3.3, Water Resources, discusses missile propellant in the marine environment.

Targets

Characteristics and Numbers of Targets and Countermeasures

At-sea targets are usually remotely operated airborne, surface, or subsurface traveling units, most of which are designed to be recovered for reuse. Aerial and surface targets would be deployed annually on the VACAPES Study Area under operations in the No Action Alternative. Small concentrations of fuel and ionic metals would be released during battery operation.

A typical aerial target drone is powered by a jet fuel engine, generates radio frequency (RF) signals for tracking purposes, and is equipped with a parachute to allow recovery. Drones also contain oils, hydraulic fluid, batteries, and explosive cartridges as part of their operating systems. There are also recoverable, remotely controlled target boats and underwater targets designed to simulate submarines. If severely damaged or displaced, targets may sink before they can be retrieved. Aerial targets on the VACAPES Study Area would include AST/ALQ/ESM pods, Banner drones, BQM-74E drones, Cheyenne, Lear Jets, and Tactical Air-Launched Decoys (TALDs). The only expended target is the TALD. The TALD is a non-powered, air-launched, aerodynamic vehicle. It provides false imagery to defense acquisition systems by using chaff/electromagnetic and radar signature augmentation. It is approximately 7.6 feet long, 10 inches high, and 10 inches wide. It weighs about 400 pounds and is constructed of extruded aluminum.

Surface targets would include Integrated Maritime Portable Acoustic Scoring and Simulator Systems (IMPASS), Improved Surface Tow Targets (ISTT), QST-35 Seaborne Powered Targets (SEPTAR), and expendable marine markers (smoke floats). Expended surface targets commonly used in addition to marine markers include cardboard boxes, 55-gallon steel drums, and a 10-foot-diameter red balloon tethered by a sea anchor (also known as a “killer tomato”). Floating debris, such as Styrofoam, may be lost from target boats.

An estimated 360 expended targets would be used each year within the VACAPES Study Area for the No Action Alternative.

Target Fate and Transport

Most target fragments would sink quickly in the sea. Expended material that sinks to the sea floor would gradually degrade, be overgrown by marine life, and/or be incorporated into the sediments. Floating non-hazardous expended material may be lost from target boats and would either degrade over time or wash ashore as flotsam.

Non-hazardous expended materials are defined as the parts of a device made of non-reactive material. Typical non-reactive material includes metals such as steel and aluminum; polymers, including nylon, rubber, vinyl, and plastics; glass; fiber; and concrete. While these items represent persistent seabed litter, their strong resistance to degradation and their chemical composition mean they do not chemically contaminate the surrounding environment by leaching heavy metals or organic compounds.

An extensive study conducted in Canada (Environmental Sciences Group, 2005) at Canadian Forces Maritime Experimental and Test Ranges near Nanoose, British Columbia, concluded that, in general, the direct impact of debris accumulation on the sea floor appeared to be minimal and had no detectable effects on wildlife or sediment quality.

Marine Markers (Smoke Floats)

Characteristics and Numbers of Marine Markers

Marine markers are pyrotechnic devices dropped on the water’s surface. They are used in training exercises to mark a surface position on the ocean. The chemical flame of a marine marker burns like a flare, but also produces smoke.

The MK-25 marker consists of a cylindrical, outer tube about 18.5 inches long and 3 inches in diameter. It weighs 3.7 pounds and produces a yellow flame and white smoke for 10 to 20 minutes. It contains red phosphorus and a seawater-activated battery (The Ordnance Shop, 2007a). Seawater batteries use magnesium anodes, seawater as the electrolyte, and oxygen dissolved in the seawater as oxidant.

The MK-58 is composed of tin and contains two red phosphorus pyrotechnic candles and a seawater-activated battery. The MK-58 marine marker is about 22 inches long and 5 inches in diameter, weighs 12.8 pounds, and produces a yellow flame and white smoke for between 40 and 60 minutes (The Ordnance Shop, 2007b).

Marine markers would be used during exercises within the VACAPES Study Area for the No Action Alternative. Approximately 300 marine markers (smoke floats) would be expended annually during the No Action Alternative.

Marine Markers Fate and Transport

Smoke from marine markers would be rapidly diffused by air movement. The marker is not designed to be recovered and would sink to the bottom and become encrusted and/or incorporated into the sediments.

Unburned phosphorus contained in the marker would settle to the sea floor where it would react with the water to produce phosphoric acid, until all phosphorus was consumed by the reaction. Combustion of red phosphorus would produce phosphorus oxides, which have a low toxicity to aquatic organisms. The red phosphorus is not anticipated to have a significant effect on the marine environment (DoN, 2006b). Refer to Section 3.3, Water Resources, for details regarding water quality.

Seawater-activated batteries would be expended during their normal service life and would not present a significant impact to the environment (Environmental Sciences Group, 2005).

Naval Gun Ammunition

Naval Gun Ammunition Characteristics and Numbers

Naval gun fire within the VACAPES Study Area would use non-explosive and explosive 5-inch and 76-millimeter (mm) rounds, and non-explosive, practice, 2.75-inch rockets. An estimated 4,422 rounds would be fired annually during VACAPES Study Area exercises. More than 80 percent of the 5-inch and 76-mm rounds training rounds and all of the rockets would be non-explosive and contain an iron shell and sand, iron grit, or cement filler. Rapid-detonating explosive (RDX) is used in explosive rounds.

Unexploded shells and non-explosive practice munitions would not be recovered and would sink to the ocean floor. Solid metal components (mainly iron) of UXO and non-explosive practice munitions would also sink.

Naval Gun Ammunition Fate and Transport

High-explosive, 5-inch shells are typically fuzed to detonate within 3 feet of the water surface. Shell fragments rapidly decelerate through contact with the surrounding water and settle to the sea floor. Un-recovered ordnance also sinks to the bottom.

Iron shells and fragments would be corroded by seawater at slow rates, with comparably slow release rates. Over time, natural encrustation of exposed surfaces would occur, reducing the rate at which corrosion occurred. Rates of deterioration would vary, depending on the material and conditions in the immediate marine and benthic environment. However, the release of contaminants from UXO, non-explosive practice munitions, and fragments would not result in measurable degradation of marine water quality. Refer to Section 3.3, Water Resources for details regarding water quality.

The RDX material of UXO would not typically be exposed to the marine environment. Should the RDX be exposed on the ocean floor, it would break down within a few hours (DoN, 2001). Over time, the RDX residue would be covered by ocean sediments or diluted by ocean water.

Small-Arms and Close-In Weapons System Ammunition

Characteristics and Numbers of Small-Arms and Close-In Weapons System Ammunition

The cartridges used in .50-caliber and 7.62-mm small arms often contain lead cores. The 20-mm and 25-mm cannon shells used in Small Arms and Close-In Weapons Systems (CIWS) training are primarily steel; 20 mm projectiles used in CIWS training are typically inert tungsten. Depleted Uranium, is being phased out of the inventory, and is not used in training events. A total of 808,160 small-arms rounds and 201,700 cannon shells would be fired annually in the No Action Alternative.

An estimated 540 non-explosive, practice, 40-mm grenades would be used each year. A grenade is about the same size and shape as a chicken egg, contains high explosives in an inert dye in a metal shell, and uses a variety of fuzes.

Small-Arms and Close-In Weapons System Ammunition Fate and Transport

Expended .50-caliber and 7.62-mm bullets may release small amounts of iron, aluminum, copper, and tungsten into sediments and the overlying water column as bullets corrode. All of these are elements that exist naturally in the environment. Their presence in water is mainly the result of erosion of soils and rocks. Increased concentrations of metals in sediments would be restricted to a small zone around the bullet, and releases to the overlying water column would be quickly diluted (DoN, 2005c). Refer to Section 3.3, Water Resources, for details regarding water quality.

Chaff

Characteristics and Numbers of Chaff

Radio frequency chaff (chaff) is an electronic countermeasure designed to reflect radar waves and obscure aircraft, ships, and other equipment from radar-tracking sources. Chaff is non-hazardous and consists of aluminum-coated glass fibers (about 60% silica and 40% aluminum by weight) ranging in lengths from 0.3 to 3 inches with a diameter of about 40 micrometers. Chaff is released or dispensed from military vehicles in cartridges or projectiles that contain millions of chaff fibers.

For each chaff cartridge used, a plastic end-cap and Plexiglas piston is released into the environment in addition to the chaff fibers. The end-cap and piston are both round and are 1.3 inches in diameter and 0.13 inches thick (Spargo, 2007).

Chaff would be used during chaff exercises throughout the VACAPES Study Area. Under the No Action Alternative, it is estimated that 1,821 chaff exercises would be held per year, releasing about 18,198 rounds (150-gram cartridges) of chaff in the VACAPES Study Area.

Chaff Fate and Transport

When deployed, a diffuse cloud of fibers undetectable to the human eye is formed. Chaff is a very light material that can remain suspended in air anywhere from 10 minutes to 10 hours. It can travel considerable distances from its release point, depending on prevailing atmospheric conditions (Arfsten *et al.* 2002).

Based on the dispersion characteristics of chaff, large areas of open water within the VACAPES Study Area would be exposed to chaff, but the chaff concentrations would be low. For example, Hullar *et al.* (1999) calculated that a 4.97-mile by 7.46-mile area (37.1 square miles or 28 square nautical miles) would be affected by deployment of a single cartridge containing 150 grams of chaff. The resulting chaff concentration would be about 5.4 grams per square nautical mile. This corresponds to fewer than 179,000 fibers per square nautical mile or fewer than 0.005 fibers per square foot, assuming that each canister contains five million fibers.

The fine, neutrally buoyant chaff streamers act like particulates in the water, temporarily increasing the turbidity of the ocean's surface. However, they are quickly dispersed and turbidity readings return to normal.

The end-caps and pistons would sink; however, some may remain at or near the surface if it were to fall directly on a dense *Sargassum* mat. The expended material could also be transported long distances before becoming incorporated into the bottom sediments.

Flares

Characteristics and Numbers of Flares

Infrared defensive flares are used at the VACAPES Study Area to attract heat-seeking missiles. Infrared defensive flares are also called self-protection flares or decoy flares. They consist of an aluminum case approximately 8 inches long with a 1.0- to 1.5-inch diameter.

The type of metal burned in the flare determines the color of the flame; most flares burn magnesium to produce a white flame. Traces of orange indicate the burning of the aluminum casing. Solid flare and pyrotechnic residues may contain, depending on their purpose and color, aluminum, magnesium, zinc, strontium, barium, boron, chromium, cadmium, and nickel, as well as perchlorates. Hazardous constituents in pyrotechnic residues are typically present in small amounts or low concentrations, and are bound in relatively insoluble compounds. As inert, incombustible solids with low concentrations of leachable metals, these materials typically do not meet the RCRA criteria for characteristic hazardous waste. The perchlorate compounds present in the residues are persistent and do not break down readily into other compounds in the environment. Because they are relatively soluble, they disperse quickly in the water (DoN, 2008).

Under normal operations, the only defensive flare waste material that would enter the water would be ash and a small, round, plastic end-cap about 1.4 inches in diameter. In rare instances, an unburned, dud flare could enter the water. While no data specifying absolute flare reliability rates are available, the dud rate is estimated at less than 1 percent, based on studies conducted by the Air Force (USAF, 1997).

Decoy flares are used during air combat maneuver training, chaff exercises, electronic combat operations, and firing exercises (IMPASS). Each year, 465 flares would be used under the No Action Alternative.

Flares Fate and Transport

Because flares are designed to burn completely, only a small amount of waste falls to the sea surface. Similar to the chaff cartridge end-caps and pistons discussed above, plastic flare end-caps would be released into the marine environment where they would persist for long periods. Although the end-caps would typically sink, some could remain at or near the surface if they fell directly on a dense *Sargassum* mat. The expended material could also be transported long distances before becoming incorporated into the bottom sediments.

Laboratory leaching tests of flare pellets and residual ash using synthetic seawater found barium in the pellet tests, while boron and chromium were found in the ash tests. The pH of the test water was raised in both tests. Ash from flares is dispersed over the water surface and then settles out. Chemical leaching occurs throughout the settling period through the water column, and any leachates after the particles reach the bottom are dispersed by currents. Although the compounds in the residues are persistent (that is, they do not break down readily into other compounds), they are relatively soluble and should disperse quickly (DoN, 2008). Refer to Section 3.3, Water Resources for details regarding water quality.

Dud flares would sink to the bottom and slowly degrade. Based on studies conducted by the Air Force, flare dud degradation products in saltwater would include magnesium and barium (USAF, 1997). Incidental flare duds falling into marine environments would not generate adverse effects because of the small amount of chemicals released (USAF, 1997), the small number of dud flares, and the large dilution capacity of the receiving waters of the VACAPES Study Area.

Underwater Detonations

Characteristics and Numbers of Underwater Detonations

Most underwater detonations during VACAPES Study Area operations would be associated with mine neutralization exercises. Explosive ordnance disposal (EOD) detachments place explosive charges next to or on non-explosive practice mines. Charges used by EOD divers consist of 20-lb explosives. These charge sizes reflect the size of charges EOD divers use to detonate mines in combat or real-world conditions.

The combustion products from the detonation of high explosives are commonly found in seawater and include carbon monoxide (CO), carbon dioxide (CO_2), hydrogen gas (H_2), water (H_2O), nitrogen gas (N_2), and ammonia (NH_3). The primary contaminants that would be released from explosives used in mine warfare training are nitroaromatic compounds such as TNT, RDX, and HMX (URS *et al.* 2000). Refer to Section 3.3, Water Resources, for details regarding water quality.

Under the No Action Alternative, 12 20-lb charges would be used per year.

Underwater Detonations Fate and Transport

Initial concentrations of explosion by-products are not expected to be hazardous to marine life (DoN, 2001) and would not accumulate in the training area because exercises are spread out over time and chemicals rapidly disperse in the ocean. Therefore, no adverse effects from chemical by-products would be expected. Refer to Section 3.3, Water Resources, for details regarding water quality.

3.2.3.2 Alternative 1

Under Alternative 1, VACAPES Study Area training operations would increase from current levels in support of the Fleet Readiness Training Plan (FRTP). While the number of training operations would increase, no new training activities, such as weapons firing or target deployment, would be introduced. Under Alternative 1, as compared to the No Action Alternative, MEM use of:

- High-explosive bombs would remain the same;
- Non-explosive practice bombs would increase 4 percent;
- Air-to-surface high-explosive missiles would increase 39 percent;
- Air-to-air high-explosive missiles would increase 12 percent;
- Non-explosive practice missiles would increase 10 percent;
- Expended targets would increase 10 percent;
- Marine markers (smoke floats) would increase 65 percent;
- High-explosive ammunition would remain the same;
- Non-explosive practice naval gun ammunition would increase by 8 percent;
- Small-arms ammunition would increase 32 percent;
- CIWS ammunition would increase 11 percent;
- Grenades would increase 11 percent;
- Chaff rounds would increase 12 percent;
- Defensive/decoy flares would increase 77 percent; and
- 20-lb charges would increase 100 percent.

Amounts of MEM would increase in rough proportion to the increases in training operations shown in Tables 2.2-4 and 2.2-5. A summary of ordnance use and increase by training area is provided in Table 2.2-6.

Vessels, aircraft, and other military assets employed in training operations would carry and use hazardous materials for routine operation and maintenance. Increases in hazardous materials transport, storage, and use to support increased training operations under Alternative 1 would be managed in compliance with applicable laws and regulations. No new types of hazardous materials would be required, and existing hazardous materials storage and handling facilities, equipment, supplies, and procedures would continue to provide for adequate management of these materials. No significant harm or effect on the environment is anticipated.

The amounts of hazardous waste generated by normal vessel and aircraft operations and maintenance during training under Alternative 1 would be about the same as those generated under the No Action Alternative. The amounts of hazardous waste generated by training operations under Alternative 1 would be incrementally greater than those under the No Action Alternative. All hazardous waste would continue to be managed in compliance with applicable laws and regulations. No changes in hazardous waste management are anticipated for operating Navy assets under Alternative 1.

Proposed Increases in Training Operations

Amounts of MEM would increase in rough proportion to the changes in training operations. Navy vessels, aircraft, and other military assets engaged in these operations would use minor quantities of hazardous materials and generate minor quantities of used hazardous materials during routine ship operations. These materials would be managed in accordance with applicable laws and regulations. Hazardous materials inventories would be replenished, and used hazardous materials would be offloaded for appropriate treatment and/or disposal while the vessels were in port.

Expand Warfare Missions: Conduct Maritime Security Surface Strike Group Training

Maritime Security (MS) Surface Strike Group (SSG) training under Alternative 1 would not be measurably different from training which would occur within the VACAPES Study Area under the No Action Alternative. Changes primarily would consist of repackaging cruiser/destroyer training operations such that a three-ship SSG would practice operating as an autonomous entity. MS SSG training does not involve the expenditure of ordnance. None of the MS SSG training would have a substantial effect on MEM, hazardous materials use, or hazardous waste generation under Alternative 1.

Accommodate Mission Requirements Associated with Force Structure Changes

Conduct MH-60R and MH-60S Helicopter Training. See Section 1.7, Related Environmental Documents, for a summary of the 2002 environmental assessment prepared for the proposed homebasing and operations of new MH-60R/S helicopters and MH-60R helicopters on the east coast of the United States (DoN, 2002). In relation to the VACAPES Study Area, the finding of no significant impact (FONSI) identified NS Norfolk as the homebase for all or most of the MH-60R/S helicopters. MH-60R/S training would not have a substantial effect on hazardous materials use or hazardous waste generation under Alternative 1.

Organic Mine Countermeasures. Navy vessels, aircraft, and other military assets engaged in these operations would use minor quantities of hazardous materials and generate minor quantities of used hazardous materials during routine operations. These materials would be managed in accordance with applicable laws and regulations. Although underwater detonations would increase, no adverse effects from chemical by-products would be expected.

3.2.3.3 Alternative 2

VACAPES Study Area training operations involving hazardous materials would increase from current levels in support of the FRTP. While the number of training operations would increase, no new training activities, such as weapons firing or target deployment, would be introduced. MEM use under Alternative 2 (Preferred Alternative) would be the same as Alternative 1 except that the use of high-explosive bombs would decrease by 96 percent below the No Action Alternative level.

Amounts of MEM would increase and decrease in rough proportion to the increases and decreases in training operations shown in Tables 2.2-4 and 2.2-5. A summary of ordnance use by training area is provided in Table 2.2-6.

Vessels, aircraft, and other military assets employed in training operations would carry and use hazardous materials for routine operation and maintenance. Increases in hazardous materials transport, storage, and use to support increased training operations under Alternative 2 would be managed in compliance with applicable laws and regulations. No new types of hazardous materials would be required. Existing hazardous materials storage and handling facilities, equipment, supplies, and procedures would continue to provide for adequate management of these materials. No releases of hazardous materials to the environment and no unplanned exposures of personnel to hazardous materials are anticipated under this alternative.

The amounts of hazardous waste generated by normal vessel and aircraft operation and maintenance during training under Alternative 2 would be about the same as those generated under the No Action Alternative. The amounts of hazardous waste generated by training operations under Alternative 2 would be incrementally greater than those under the No Action Alternative. All hazardous waste would continue to be managed in compliance with applicable laws and regulations. No changes in hazardous materials management practices are anticipated under Alternative 2.

3.2.3.4 Unavoidable Significant Environmental Effects

The analysis presented above indicates that Alternatives 1 and 2 would not result in unavoidable significant adverse effects.

3.2.3.5 Summary of Environmental Effects (NEPA and EO 12114)

Hazardous material, waste, and MEM used and generated during VACAPES Study Area operations would be managed in accordance with applicable federal and state regulations and DoD service guidelines. Any spills or mishaps would be handled pursuant to all applicable federal and state laws and DoD regulations.

Military munitions are not considered hazardous waste when used for their intended purposes, which include training of military personnel and research and development activities. This includes almost all missiles, munitions, and targets used at the VACAPES Study Area. A review of the use of munitions and targets was conducted and their hazardous constituents' disposition was analyzed. The components that contain hazardous constituents include propellants, batteries, flares, telemetry, igniters, jet fuel, diesel fuel, hydraulic fluid, and explosive warheads.

Non-hazardous expended material is defined as all parts of a device made of nonreactive materials, including parts made of metals such as steel or aluminum; polymers such as nylon, rubber, vinyl, and plastics; glass; fiber; and concrete. While these items represent persistent seabed litter, their strong resistance to degradation and their chemical composition mean that they do not chemically contaminate the surrounding environment by leaching heavy metals or organic compounds. Expended material that sinks to the sea floor would gradually degrade, be overgrown by marine life, and/or be incorporated into the sediments. Floating non-hazardous expended material may be lost from target boats and would either degrade over time or wash ashore as flotsam.

MEM would introduce small amounts of potentially hazardous chemicals into the marine environment. The water quality analysis of all current and proposed operations indicates that concentrations of constituents of concern associated with material expended in the VACAPES Range Complex under all three alternatives would be well below water quality criteria established to protect aquatic life (see Section 3.3, Water Resources).

The combustion products from the detonation of high explosives are commonly found in seawater and include carbon monoxide (CO), carbon dioxide (CO_2), hydrogen gas (H_2), water (H_2O), nitrogen gas (N_2), and ammonia (NH_3). The primary contaminant that would be released from explosives used in mine warfare training would include nitroaromatic compounds such as TNT, RDX, and HMX (URS *et al.* 2000). Initial concentrations of explosion by-products resulting from training operations associated with any of the alternatives would not be hazardous to marine life (DoN, 2001) and would not accumulate in the area because exercises would be spread out over time and the chemicals would rapidly disperse in the ocean. Therefore, no adverse effects from chemical by-products would be expected.

As summarized in Table 3.2-5, less than significant impacts from hazardous materials or waste management are anticipated under the No Action Alternative, Alternative 1, or Alternative 2 (Preferred Alternative). Discarded training materials would be deposited in offshore areas, become buried in the sea floor sediments, and have no measurable environmental effects. The volume of expended training items would increase in Alternative 1 and Alternative 2 (Preferred Alternative) in correlation to changes in operations.

TABLE 3.2-5
SUMMARY OF ENVIRONMENTAL EFFECTS
OF THE ALTERNATIVES IN THE VACAPES EIS/OEIS STUDY AREA

Alternative and Stressor	Summary of Effects and Impact Conclusion	
	NEPA (U.S. Territorial Waters, 0 to 12 nm)	Executive Order 12114 (Non-Territorial Waters, >12 nm)
No Action Alternative		
Military expended materials (MEM)	Long-term, minor, and localized accumulation of MEM on the ocean floor, *Sargassum* mats, and beaches.	Long-term, minor, and localized accumulation of MEM on the ocean floor and *Sargassum* mats.
Underwater detonations and high-explosive ordnance	Negligible effects.	Negligible effects.
Non-explosive practice munitions	Long-term, minor, and localized accumulation of MEM on the ocean floor, *Sargassum* mats, and beaches.	Long-term, minor, and localized accumulation of MEM on the ocean floor and *Sargassum* mats.
Mine warfare deployment/recovery	Negligible effects.	Negligible effects.
Impact conclusion	Less than significant impact.	Less than significant harm.
Alternative 1		
MEM	Long-term, minor, and localized accumulation of MEM on the ocean floor, *Sargassum* mats, and beaches. Slight increase compared to No Action.	Long-term, minor, and localized accumulation of MEM on the ocean floor and *Sargassum* mats. Slight increase compared to No Action.
Underwater detonations and high-explosive ordnance	Negligible effects.	Negligible effects.
Non-explosive practice munitions	Long-term, minor, and localized accumulation of MEM on the ocean floor, *Sargassum* mats, and beaches. Slight increase compared to No Action.	Long-term, minor, and localized accumulation of MEM on the ocean floor and *Sargassum* mats. Slight increase compared to No Action.
Mine warfare deployment/recovery	Negligible effects.	Negligible effects.
Impact conclusion	Less than significant impact.	Less than significant harm.

TABLE 3.2-5
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES IN THE VACAPES EIS/OEIS STUDY AREA (Continued)

Alternative and Stressor	Summary of Effects and Impact Conclusion	
	NEPA (U.S. Territorial Waters, 0 to 12 nm)	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Alternative 2 (Preferred Alternative)		
MEM	Long-term, minor, and localized accumulation of MEM on the ocean floor, *Sargassum* mats, and beaches. Slight increase compared to No Action.	Long-term, minor, and localized accumulation of MEM on the ocean floor and *Sargassum* mats. Slight increase compared to No Action.
Underwater detonations and high-explosive ordnance	Negligible effects.	Negligible effects.
Non-explosive practice munitions	Long-term, minor, and localized accumulation of MEM on the ocean floor, *Sargassum* mats, and beaches. Slight increase compared to No Action.	Long-term, minor, and localized accumulation of MEM on the ocean floor and *Sargassum* mats. Slight increase compared to No Action.
Mine warfare deployment/recovery	Negligible effects.	Negligible effects.
Impact conclusion	Less than significant impact.	Less than significant harm.

3.3 WATER RESOURCES

3.3.1 Introduction and Methods

Water resources on land include surface and subsurface water bodies. Since land ranges in the VACAPES Range Complex are not being evaluated as part of this EIS/OEIS, water resources such as lakes, ponds, rivers, streams, groundwater, and aquifers are not discussed unless they specifically pertain to an activity in the proposed action or are linked to the marine environment. The marine environment refers to offshore, high salinity waters, and is further defined by prevailing currents, harbor flushing hydraulics, and tidal variations.

Water quality describes the chemical and physical composition of water as affected by natural conditions and human activities. For the purposes of this analysis, water quality is evaluated with respect to possible release of pollutants from those aircraft and vessels using the VACAPES Range Complex.

After the existing water quality conditions are described, the potential future water quality impacts of the project alternatives are compared to the existing water quality conditions to identify the differences in environmental impacts that might be expected if one of the project alternatives were selected. In other words, environmental impacts are currently taking place from current natural and human activities, including those of the Navy.

3.3.1.1 Assessment Methods and Data Used

Each alternative analyzed in this EIS/OEIS includes several warfare areas (*e.g.,* Mine Warfare, Air Warfare, *etc.*) and most warfare areas include multiple types of training operations (*e.g.,* Mine Neutralization, Air-to-Surface Missile Exercise, *etc.*). Likewise, several activities (*e.g.,* vessel maneuver, target deployment, weapons firing, *etc.*) are accomplished under each operation. Most of the specific activities accomplished under a given operation are not unique to that operation. For example, many of the operations included in the alternatives involve Navy vessel maneuvers and aircraft overflights. Accordingly, the analysis for water resources is organized by specific activity rather than warfare area or operations.

For the purposes of this analysis, water quality is evaluated with respect to possible release of expended materials from aircraft and surface and subsurface vessels. To address potential impacts, the approach to analysis includes characterizing the yearly test and training operations that may contribute expended materials to the VACAPES Range Complex ocean environment. These include missile flights; target expenditures; ship, boat, and aircraft operations; weapons firing; and expended materials from various training operations. This section of the EIS/OEIS reviews the water resources and impacts to water quality associated with training in the VACAPES Range Complex. Potential impacts to other environmental resources are addressed in the respective sections of this chapter as appropriate. A full discussion of hazardous materials and hazardous waste (primarily military expended materials) is presented in Section 3.2.

<u>EIS Study Area</u>

In this EIS/OEIS, the water resources/water quality Study Area for the VACAPES Range Complex includes the Navy's sea ranges, lower Chesapeake Bay, and adjacent waters (waters from the shoreline seaward).

The VACAPES OPAREA includes offshore surface and subsurface extending southward generally from the Delaware-Maryland border along the coast of Maryland, Virginia, and North Carolina to the latitude of approximately Cape Fear, North Carolina, for an estimated distance of 270 miles and seaward (east) to 3 nm off the coast, for a distance of approximately 155 nm (see Figure 1.5-1).

Data Sources

State and federal regulations, as well as each state's water resource/water quality programs were reviewed. Available reference materials, including the Marine Resource Assessment for the VACAPES Study Area, as well as prior EAs and EISs, were reviewed and are cited as appropriate.

Significance Criteria and Impact Thresholds

Numerous federal, state, and local regulations govern the protection of water resources; these regulations are summarized in Appendix K. The primary objective of these regulations is to protect public health and the environment, as well as biological resources.

3.3.1.2 Warfare Areas and Associated Environmental Stressors

Aspects of the proposed actions likely to act as stressors to water resources were identified by conducting an analysis of the warfare areas, operations, and specific activities included in the alternatives. Table 3.3-1 summarizes this analysis and shows the primary stressors associated with each operation (see Appendix D for detailed descriptions of operations). After the primary stressors were identified, training items associated with warfare areas and operations were identified.

TABLE 3.3-1
POTENTIAL STRESSORS ASSOCIATED WITH WATER QUALITY

Warfare Area and Operation	Training Areas	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)					
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay	✓	✓		
Mine Countermeasures Exercise (MCM)	W-50A/C W-386, W-72	✓	✓		
Mine Neutralization	W-50C	✓	✓	✓	✓
Surface Warfare (SUW)					
Bombing Exercise (Air-to-Surface) (at sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B		✓	✓	✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A		✓	✓	✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C		✓		✓
GUNEX (Surface-to-Surface) - Boat	W-50C, R-6606		✓		✓
GUNEX (Surface-to-Surface) - Ship	W-386, W-72		✓		✓
Laser Targeting	W-386 (Air-K)				

TABLE 3.3-1
POTENTIAL STRESSORS ASSOCIATED WITH WATER QUALITY (Continued)

Warfare Area and Operation	Training Areas	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA				
VBSS/MIO- Helo	VACAPES OPAREA				
Air Warfare (AW)					
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)				
GUNEX (Air-to-Air)	W-72A				✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A		✓		✓
GUNEX (Surface-to-Air)	W-386, W-72		✓		✓
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)		✓		✓
Air Intercept Control (AIC)	W-386, W-72				
Detect to Engage (DTE)	W-386, W-72				
Strike Warfare (STW)					
HARM Missile Exercise	W-386 (Air E, F, I, and J)		✓	✓	✓
Amphibious Warfare (AMW)					
FIREX with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)		✓	✓	✓
Electronic Combat (EC)					
Chaff Exercise - Aircraft	W-386, W-386 (Air-K), and W-72				✓
Chaff Exercise - Ship	W-386 and W-72				✓
Flare Exercise - Aircraft	W-386, W-386 (Air-K), and W-72				✓

TABLE 3.3-1
POTENTIAL STRESSORS ASSOCIATED WITH WATER QUALITY (Continued)

Warfare Area and Operation	Training Areas	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Electronic Combat (EC) Operations - Aircraft	W-386 (Air-K)				
EC Operations- ship	VACAPES OPAREA				
Test and Evaluation					
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA				

Table 3.3-2 identifies the training item source associated with the expended materials for each operation and the location relative to the shoreline where the operation would occur.

TABLE 3.3-2
EXPENDABLE OR HAZARDOUS TRAINING ITEM ASSOCIATED WITH THE VACAPES RANGE COMPLEX OPERATIONS

Warfare Area and Operation	Training Area Proximity	Expended Training Item
Mine Countermeasures Exercise (MCM)	3-12 nm	• MK-103 (Alternative 2 only) 0.002-lb Net Explosive Weight (NEW)
Mine Neutralization	3-12 nm	• 20-lb NEW charges • AMNS (3.24 -lb NEW)
Bombing Exercise (BOMBEX) (Air-to-Surface)	Outside 12 nm	• MK-82/GBU-30/38 (500-lb High Explosive (HE) • MK-83/GBU-32 (1,000-lb HE • MK-84 (2,000-lb HE) • MK-20 (cluster bomb HE) • MK-20 non-explosive practice munitions (NEPM) • MK-76 (NEPM) • BDU-45 (NEPM) • BDU-33, GBU-12, JDAM, JSOW, MK-76, MK-82, MK-84 (all NEPM)
Missile Exercise (MISSILEX) (Air-to-Surface)	Outside 12 nm 75% 3-12 nm 25%	• AGM-114 Hellfire (HE) • AGM-65 E/F (Maverick HE) • AGM-88 (HARM) • AGM-65 LSR (Maverick) • AGM-84 (Harpoon)

TABLE 3.3-2
EXPENDABLE OR HAZARDOUS TRAINING ITEM ASSOCIATED WITH THE VACAPES RANGE COMPLEX OPERATIONS (Continued)

Warfare Area and Operation	Training Area Proximity	Expended Training Item
Gunnery Exercise (GUNEX) (Air-to-Surface)	Outside 12 nm 75% 3-12 nm 25%	• .50-caliber projectile • 2.75-inch rockets • M-240 (7.62 mm projectile) • 20-mm projectile (NEPM)
GUNEX (Surface-to-Surface) (Boat)	Inside 3 nm 10% 3-12 nm 90%	• .50-caliber projectile • 7.62-mm projectile • 40-mm grenades
GUNEX (Surface-to-Surface) (Ship)	Outside 12 nm	• 5-inch projectile • 7- mm projectile • .50-caliber projectile • 25-mm projectile
GUNEX (Air-to-Air)	Outside 12 nm	• 20-mm projectile
MISSILEX (Air-to-Air)	Outside 12 nm	• AIM-7 (HE and NEPM) • AIM-9 (HE and NEPM) • AIM-120 (HE and NEPM) • AIM-132
GUNEX (Surface-to-Air)	Outside 12 nm	• 5-inch projectile • 76-mm projectile • 20-mm projectile
MISSILEX (Surface-to-Air)	Outside 12 nm	• NATO Sea Sparrow • Evolved NATO Sea Sparrow • Rolling Airframe Missile • SM-2
HARM Missile Exercise	Outside 12 nm	• AGM-88 (HARM)
Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	Outside 12 nm	• 5-inch projectile (NEPM and 8-lb NEW HE)
Chaff Exercise	Outside 12 nm	• RR-144A/AL • MK-214 • MK-216
Flare Exercise	Outside 12 nm	• Defensive Flares

3.3.2 Affected Environment

The affected environment for purposes of water quality includes the VACAPES Study Area and lower Chesapeake Bay (shoreline from NS Norfolk north 25 nm) and referred to as the VACAPES Study Area. As mentioned in Chapters 1 and 2, the VACAPES Range Complex includes land areas, but these areas are not analyzed in this EIS/OEIS. The area of the VACAPES Range Complex assessed in this EIS/OEIS is almost entirely offshore training sea space, undersea space, and special use airspace. For water quality purposes, the majority of area assessed is the 27,661 nm^2 of sea space, which begins 3 nm from shore where state waters end; however, the nearshore environment is also included in this analysis.

The physical oceanography of the Study Area can be characterized in terms of its bathymetry, or bottom topography, and its circulation. Sediment transport and deposition and bottom composition also are elements of physical oceanography. Bathymetry and bottom composition are addressed in Section 3.1, Bathymetry and Sediments. Water characteristics, sediment transport, deposition and circulation are discussed below, along with marine water quality. Fate and transport of expended materials in the marine environment is discussed in Section 3.2.

3.3.2.1 Marine Water Quality

The VACAPES Study Area is located in the coastal and offshore waters of the western North Atlantic ocean adjacent to the States of Delaware, Maryland, Virginia, and North Carolina and extends seaward into waters more than 4,000 m deep (see Figures 1.1-1 and 2.1-1). Cape Hatteras, North Carolina is generally considered to be a transition zone between the warm, tropical waters found to the south and the cool, temperate waters to the north. Cape Hatteras separates the oceanic provinces of the South-Atlantic Bight (SAB) from those of the Mid-Atlantic Bight (MAB). The SAB encompasses the area from the Florida Straights to Cape Hatteras, while the MAB extends from Cape Hatteras to the southwestern flank of Georges Bank (DoN, 2001a; DoN, 2008). The majority of the VACAPES Study Area is located in the MAB, but the southernmost section of the OPAREA is located in the northernmost limit of the SAB province. Thus, both oceanic provinces influence the physical environment of the OPAREA.

Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes operating continuously in the ocean system. This dynamic equilibrium is expressed by a variety of indicators, including temperature, salinity, dissolved oxygen, and nutrient levels. Water pollutants alter the basic chemistry of sea water in various ways. The following discussion characterizes in general terms the major determinants of marine water quality in the VACAPES Study Area.

Currents

Prevailing winds and centripetal force cause surface waters to move in a gyre or circular fashion in ocean basins. In the North Atlantic Ocean, this gyre system is composed of the Gulf Stream, North Atlantic, Canary, and Equatorial Currents. Additional surface water masses found in the VACAPES Study Area are Chesapeake Bay plume water, Delaware Bay plume water, and mid-Atlantic shelf water (or Virginia Coastal Water) (DoN, 2008).

The Gulf Stream exerts a considerable influence on the oceanographic conditions in the VACAPES Study Area. In general, the Gulf Stream flows roughly parallel to the coastline from the Florida Straits to Cape Hatteras, where it is deflected from the North American continent and flows northeastward past the Grand Banks (Figure 3.3-1). After the Gulf Stream separates from the east coast in North Carolina, the current passes through the southeastern portion of the VACAPES Study Area (DoN, 2008). In this area, the Gulf Stream is approximately 27 nm wide and 3,281 feet deep. Surface velocity ranges from two to five knots and temperature from 77 to 82^{o}F.

Relatively fresh or brackish water from the Chesapeake and Delaware Bays flows out of these estuaries in the form of plume water. The Coriolis force causes this less dense (because it is lower in salinity) water to turn south, resulting in southward-flowing, coastally trapped currents. An increase in river flow and ebbing tides force more water out of the respective bays; thus, the seaward front of the plume extends across the shelf. During the summer months predominant southwesterly winds cause a seaward expansion of the plume over the continental shelf, creating a well-stratified, two-layer system. The warm surface waters are replaced by deeper, more saline, nutrient-rich water (DoN, 2008).

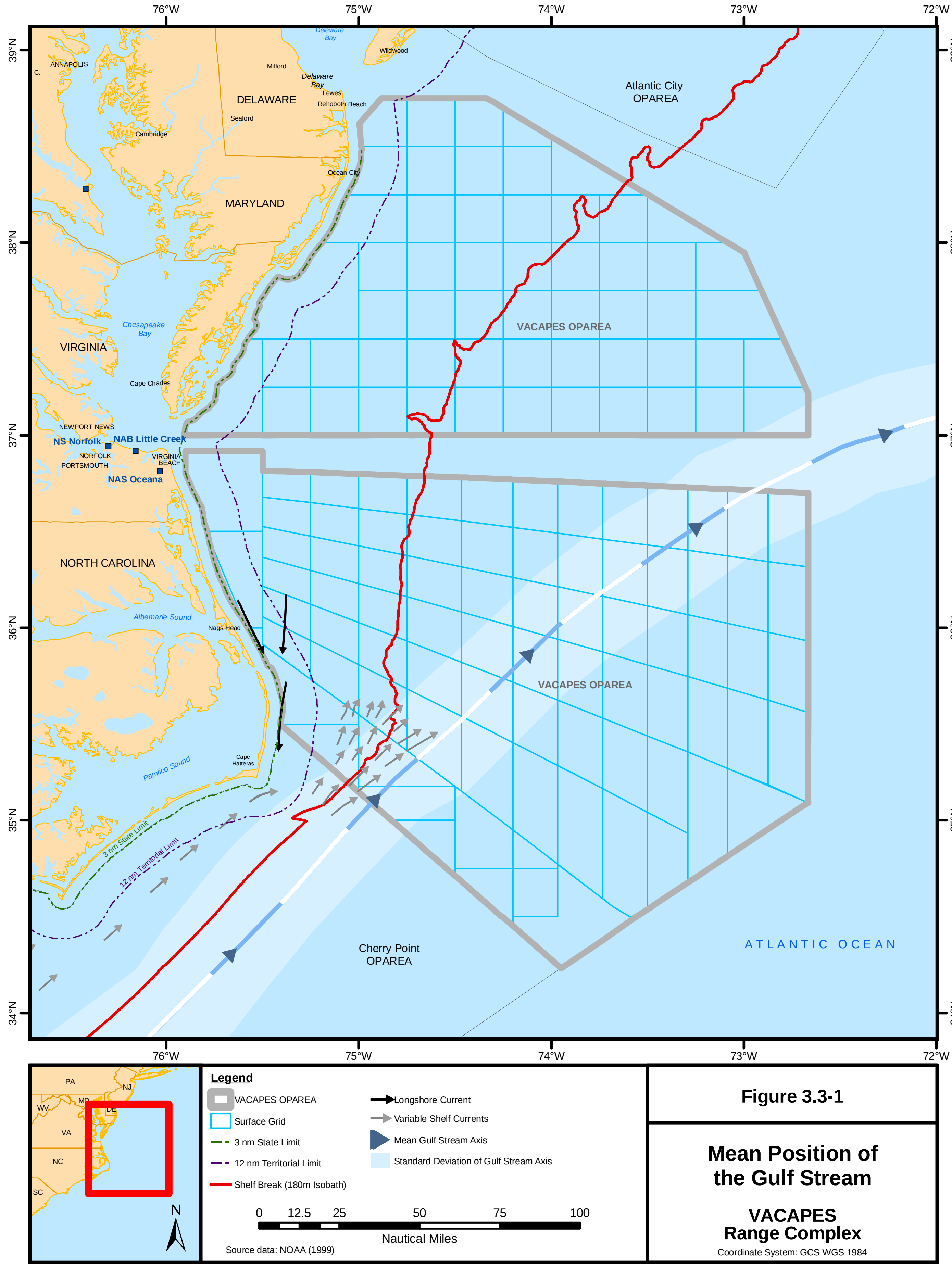


Figure 3.3-1

Mean Position of the Gulf Stream

VACAPES Range Complex

Coordinate System: GCS WGS 1984

Temperature and Salinity

Temperature stratification varies greatly between summer and winter in the waters of the VACAPES Study Area. The water column is vertically well-mixed, with water temperatures of 14°C (57°F) at the surface and 11°C (52°F) at depth in the winter; the water column is vertically stratified, with 25°C (77°F) water near the surface and 10°C (50°F) water at depths greater than 656 feet during the summer (Paquette *et al*., 1995).

The marine environment has a high buffering capacity (*i.e.,* the pH of seawater is relatively stable) due to the presence of dissolved elements, particularly carbon and hydrogen. Most of the carbon in the sea is present as dissolved inorganic carbon that originates from the complex equilibrium reaction of dissolved carbon dioxide (CO_2) and water. This CO_2-carbonate equilibrium system is the major buffering system in seawater, maintaining a pH between 7.5 and 8.5.

The major chemical parameters of marine water quality include pH, dissolved oxygen, and nutrient concentrations. The major ions present in seawater are sodium, chloride, potassium, calcium, magnesium, and sulfate.

Salinity ranges from 28 to 36 parts per thousand (ppt) over the continental shelf. Lower salinities are found near the coast and the highest salinities found near the continental shelf break, with highest salinities during the winter and lowest in the spring. The intrusion of saltier water (greater than 35 ppt) from the continental slope waters and freshwater input from coastal sources causes the variability in this area. A fairly uniform salinity range (32 to 36 ppt) is maintained throughout the year in continental slope waters in the VACAPES Study Area, with pockets of high-salinity water (38 ppt) near the Gulf Stream in the fall (DoN, 2008).

Sediment Transport and Deposition

The continental shelf and slope of the MAB are covered with unconsolidated terrigenous sediments, primarily sand, silt, clay, and some gravel. A small amount of carbonate is found in the bottom sediments north of Cape Hatteras, although sediments south of the Cape contain as much as 50 percent. The continental shelf of the MAB is primarily covered by medium-grained sands composed primarily of quartzite and feldspar with less than five percent calcium carbonate while the continental shelf off Cape Hatteras is covered by a mixture of sand, silt, and clay (DoN, 2008).

Rivers draining eastern North America presently carry little sediment to the continental shelf as most is trapped in estuaries or coastal marshes. The fine-grained materials found in the bottom sediments have been winnowed out and transported either shoreward into estuaries or off the shelf via the canyons onto the continental slope. The continental slope sediments in the mid-Atlantic area are primarily silt and clay, but seaward of the 3,000 m isobath, fine-grained biogenic calcareous sediments predominate (DoN, 2008).

Water Pollutants

The heavy concentration of activity in coastal areas, combined with pollutants flowing from streams far inland and others carried through the air great distances from their source, are the primary causes of nutrient enrichment, hypoxia, harmful algal blooms, toxic contamination, sedimentation, and other problems that plague coastal waters (U.S. Commission on Ocean Policy [USCOP], 2004). Not only do degraded waters cause significant ecological damage, they also lead to economic impacts due to beach closures, curtailed recreational activities, and additional health care costs. Reducing water pollution will result in cleaner coastal waters, healthy habitats that support aquatic life, and a suite of economic benefits.

Water quality in the VACAPES Study Area is affected by human activities in the heavily developed mid-Atlantic coastal areas. These continental shelf waters are located in the MAB that extends from

Nantucket Shoals, Massachusetts, to Cape Hatteras, North Carolina. The Hudson River, Delaware Bay, and Chesapeake Bay are among the large rivers and estuaries that discharge fresh water into the MAB (NASA, 2005). Water quality in Delaware Bay and Chesapeake Bay are discussed in subsequent sections.

The USEPA's 2002 National Water Quality Inventory found that just over half of the estuarine areas assessed were polluted to the extent that their use was compromised, either for aquatic life, drinking water, swimming, boating, or fish consumption. Estuarine waters can directly or indirectly affect marine water quality of coastal waters. The interagency 2004 Draft National Coastal Condition Report II rated coastal waters along the southeast United States as being in fair condition (USCOP, 2004).

Point source pollution comes from identifiable sources. The major point sources of pollution to the nation's waterways include wastewater treatment plants, sewer system overflows, septic systems, industrial facilities, and animal feeding operations. Nutrient pollution has had a major impact on coastal waters, contributing to toxic algal blooms, loss of seagrass habitat and coral reefs, and oxygen depletion (USCOP, 2004).

Nonpoint source pollution arises when rainfall and snowmelt carry contaminants over land, into streams and groundwater, and down to coastal waters. Nonpoint source pollutants include: fertilizers and pesticides from rural farms and urban lawns; bacteria and viruses from livestock and pet waste; sediments from improperly managed construction sites and timber harvesting; oil and chemicals flowing over streets, parking lots, and industrial facilities; and a variety of pollutants being blown along airborne pathways. Ninety percent of impaired water bodies do not meet water quality standards at least in part because of nonpoint source pollution. The majority of nonpoint source pollution entering rivers, estuaries, coastal waters, and ultimately the oceans is from agricultural and storm water runoff (USCOP, 2004).

Shipboard waste-handling procedures governing the discharge of non-hazardous waste streams were established for commercial and Navy vessels (DoN, 1996). These categories of waste include: (a) Liquids: "black water" (sewage); "gray water" (water from deck drains, showers, dishwashers, laundries, *etc*.); and oily waste (oil water mixtures); and (b) Solids (garbage). Table 3.3-3 summarizes the waste stream discharge restrictions for Navy vessels at sea.

TABLE 3.3-3
WASTE DISCHARGE RESTRICTIONS FOR NAVY SHIPS

Zone (nm from shore)	Type of Waste	
	Black Water (Sewage)	**Gray Water**
U.S. Waters (0-3 nm)	No discharge.	If vessel is equipped to collect gray water, pump out when in port. If no collection capability exists, direct discharge permitted.
U.S. Contiguous Zone (3-12 nm)	Direct discharge permitted.	Direct discharge permitted.
>12 nm from shore	Direct discharge permitted.	Direct discharge permitted.
Zone	**Oily Waste**	**Garbage (Non-plastic)**
U.S. Waters (0-3 nm)	Discharge allowed if waste has no visible sheen. If equipped with Oil Content Monitor (OCM), discharge <15 ppm oil.	No discharge.
U.S. Contiguous Zone (3-12 nm)	Same as 0-3 nm.	Pulped garbage may be discharged.

TABLE 3.3-3
WASTE DISCHARGE RESTRICTIONS FOR NAVY SHIPS (Continued)

Zone (nm from shore)	Type of Waste	
	Black Water (Sewage)	**Gray Water**
>12 nm from shore	If equipped with OCM, discharge <15 ppm oil. Ships with Oil/Water Separator but no OCM must process all bilge water through the oil-water separator.	Direct discharge permitted.
Zone	**Garbage (Plastic) (Non-food-contaminated)**	**Garbage (Plastic) (food-contaminated)**
U.S. Waters (0-3 nm)	No discharge.	No discharge.
U.S. Contiguous Zone (3-12 nm)	No discharge.	No discharge.
12-50 nm from shore	No discharge.	No discharge.
>50 nm from shore	Retain last 20 days before return to port. Discharge if necessary.	Retain last three days before return to port. Discharge if necessary.

Source: Northern Division 1996; Office of the Chief of Naval Operations 1994

A No Discharge Zone (NDZ) is an area of a waterbody or an entire waterbody into which the discharge of sewage (whether treated or untreated) from all vessels is completely prohibited. There are two NDZs in Maryland and two inVirginia; however, only one in Virginia is relevant to the Study Area. Maryland's NDZs include Herring Bay and the Northern Coastal Bays. The Herring Bay NDZ is a 3,145-acre area of water located along the western shore of the Chesapeake Bay in southern Anne Arundel County. The Northern Coastal Bays NDZ is 12,780 acres of water that include all tidal waters north of the Ocean City Inlet to the Delaware State line (USEPA, 2007b).

Virginia's NDZ, as applicable to the Study Area, is for the Lynnhaven River Watershed and encompasses an area of land and water approximately 64 square miles with nearly 150 miles of shoreline located in the northern part of the City of Virginia Beach. The Lynnhaven River flows to the Chesapeake Bay through Lynnhaven Inlet and upstream portions of the Lynnhaven River system flow either north to the Chesapeake Bay or south to the North Carolina sounds depending on wind and tidal patterns. These zones are designed to give states an additional tool to address water quality issues associated with sewage contamination (USEPA, 2007b).

3.3.2.2 Delaware Water Quality

Delaware's Atlantic coastline consists of a series of barrier beaches and dunes from Cape Henlopen to Fenwick Island, open only by one large inlet at the Indian River Bay. The Delaware Coastal Programs differentiate between the coastal zone and the coastal strip of the state. The entire state is included in the coastal zone, which is managed by the Delaware Coastal Management Program through several state laws and authorities, including the federal Coastal Zone Management Act (DNREC, 2002).

The coastal strip is an approximately 4-mile wide band of land that parallels the entire Delaware coastline. It was defined by the Delaware State Coastal Zone Act of 1971, which is the primary authority for regulating heavy industry, manufacturing, and bulk transfer facilities in the coastal strip. Nearly

25 miles of beaches border the Atlantic Ocean; almost half are in state parks (NOAA, 2007a; DNREC, 2002).

The Delaware Estuary is one of the largest in the east, at 685 square miles of water surface, exceeded only by the Chesapeake Bay, Long Island Sound, and the combined Pamlico-Albemarle Sounds (Frithsen *et al.,* 1991). The Delaware Estuary includes 5,985 square miles of drainage area, which is approximately 47 percent of the Delaware River Basin. The Delaware River provides the estuary with 58 percent of its freshwater input. Delaware Bay lies between the shorelines of Delaware and New Jersey. The average depth of Delaware Bay (in the zone nearest the ocean) is 31.5 feet. Maximum depth, which is in the shipping lane near the Harbor of Refuge in Lewes, Delaware, is 151 feet (Sutton *et al.*, 1996).

There are four regions of the Delaware Estuary; however, only three are discussed here (Lower Estuary, Upper Estuary, and Delaware Bay regions), as they are most proximal to coastal waters. The Upper Estuary region stretches from Trenton, New Jersey southwestward to the Pennsylvania/ Delaware border, and consists of 1,743 square miles of small sub-watersheds in Pennsylvania and New Jersey. Riverfront industry and development, as well as several major ports, make the Delaware River a critical economic resource to both states in this region. Contaminants from an industrial legacy and water withdrawals serving the needs of industry and urban populations are the major sources of concern here, in addition to wastewater and combined sewer overflows and storm water runoff (Partnership for the Delaware Estuary, 2006).

The Lower Estuary region stretches south from the Delaware/Pennsylvania border, to the point where the Delaware River opens to become the Delaware Bay. This region, encompassing 1,020 square miles, includes the Christina River Basin in Delaware and the Salem River Watershed in New Jersey, as well as several smaller watersheds. Riverfront industry and the Port of Wilmington make this area a significant economic resource and, thus, present many of the same opportunities and challenges as in the Upper Estuary region. The mixing of salt and fresh water in this portion of the Delaware River makes turbidity and its effects on legacy pollutants a major concern. The importance of maintaining wetlands here for water quality and flood control also involves sediment budgeting (Partnership for the Delaware Estuary, 2006).

The Delaware Bay region stretches southeast from the widening of the Delaware River to the Atlantic Ocean. This region of 1,539 square miles includes the Maurice River Watershed in New Jersey and the Mispillion River Watershed in Delaware, as well as smaller sub-watersheds along both sides of the Delaware Bay. Recreational boating, fishing, and tourism are major economic influences in this region. Runoff from agriculture and storm water from increasing development (on shallow soil) are major concerns (Partnership for the Delaware Estuary, 2006).

The Delaware Estuary has one of the highest nutrient inputs of any major estuary in North America (Sutton *et al.*, 1996). Urban wastewater is the major source of both nitrogen and phosphorus in the estuarine system. On average, total phosphorus dropped dramatically in the early 1970s, but stayed relatively constant since that time. Ammonium concentrations have been steadily declining, with proportionate increases in nitrogen concentrations (Partnership for the Delaware Estuary, 2006).

The Delaware Estuary is negatively impacted to varying degrees by toxic substances released to its waters through human activities. Elevated levels of heavy metals and organic contaminants such as pesticides and polychlorinated biphenyls (PCB) were detected in the sediment, water column, and in organisms of the estuary. While there are few exceedances of USEPA's water quality criteria for toxic substances in the Delaware Estuary, there are concerns about long-term, chronic impacts. The highest concentrations of toxic substances occur in the urban area, such as those in the water column or those in bottom sediments. There may be some point sources for metals, but organic contaminants appear to be primarily from nonpoint sources (Delaware Estuary Program, 1998).

Metal concentrations tend to decline from the transition zone to the ocean, probably as a result of increasing dilution by seawater and fewer dischargers. Storms, dredging, and to some degree shipping and boating activities, re-suspend sediments and potentially remobilize these metals. Total loadings of arsenic, chromium, copper, and lead to the Delaware Estuary are approximately 110 tons. A significant portion of these loadings originate from point sources discharging directly into the estuary; however, nonpoint sources also contribute to the loadings. Urban runoff contributes significant metals to the estuary. Agricultural runoff adds a significant source of arsenic to the estuary because of long-term use of inorganic pesticides. Atmospheric deposition contributes a small proportion of the total loadings of arsenic, chromium, and lead. Urban runoff, point sources, atmospheric deposition, and groundwater all contribute significant amounts of mercury to the estuary. The total yearly loading of mercury is approximately 11 tons (Delaware Estuary Program, 1998).

The highest level of organic toxic substances are associated with urban areas. Chlorinated hydrocarbons are of particular concern because they biomagnify in biota. Some of these compounds can be formed as a result of water treatment by chlorination. Most contributions of chlorinated pesticides to the estuary are from agricultural runoff, amounting to approximately 11 tons per year (Delaware Estuary Program, 1998).

DNREC adopted a watershed approach to determine the most effective and efficient methods for protecting water quality or abating existing problems. Five basins and 41 watersheds were delineated. Under the watershed approach, DNREC will evaluate all sources of pollution that may impact a waterway and target the most significant sources for management (USEPA, 2000).

<u>Summary of Delaware Water Quality</u>

- The entire State of Delaware is in the coastal zone.
- The water resources related to the Study Area include the coastal zone, Delaware Estuary and Delaware Bay.
- The primary water quality concerns in the Delaware Estuary include nutrients (nitrogen and phosphorus) and urban wastewater is the major source.
- Other water quality concerns include toxics (*i.e.*, metals, arsenic, chromium, lead, chlorinated hydrocarbons) and organic contaminants; however, the highest concentrations are primarily found in the water column in urban areas or bottom sediments from urban and agricultural runoff, and atmospheric deposition.
- Metal concentrations decline as the progression is made from the transition zone to the ocean due to dilution by seawater and fewer dischargers.

3.3.2.3 Maryland Water Quality

Maryland's coastal zone includes 16 counties and Baltimore City, encompasses two-thirds of the State's land, and is home to 67.83 percent of its residents. Maryland has 4,360 miles of coastline along the Chesapeake Bay, Coastal Bays, and Atlantic Ocean, and almost 95 percent drains to the Chesapeake Bay (Maryland Department of Natural Resources, 2007). Most of the ocean shoreline supports aquatic life (USEPA, 2000).

The Maryland coastal zone is composed of the land, water, and subaqueous land between the territorial limits of Maryland in the Chesapeake Bay, coastal bays, and Atlantic Ocean, as well as the towns, cities, and counties that contain the coastline. It falls into two distinct regions: the Atlantic Coast, including the Atlantic Coastal Bays (Coastal Bays), and the Chesapeake Bay, which together equal 7,719 miles of shoreline. The Maryland Coastal Zone extends from 3 miles out in the Atlantic Ocean to the inland boundaries of the 16 counties bordering the Atlantic Ocean, Chesapeake Bay, and the Potomac River up to the District of Columbia. The State has a National Estuarine Research Reserve funded by NOAA and

Maryland. The Chesapeake Bay, Maryland Reserve has three components located in Harford, Anne Arundel, Prince George's, and Somerset Counties (NOAA, 2007b).

Maryland's Coastal Bays, provide habitat for a wide range of aquatic life. The main threats to these bays include development, nutrients, sediments, and other anthropogenic sources. Water quality conditions in Maryland's Coastal Bays range from generally degraded conditions within or close to tributaries to better conditions in the bay regions. High nitrate levels are found in the freshwater reaches of streams, including excess algae, chronic brown tide blooms, algal blooms, and incidents of low dissolved oxygen due to nutrient enrichment (Wazniak *et al*., 2004).

Nutrient overenrichment from nitrogen and phosphorus is a threat to the Coastal Bays, leading to degraded water quality and ecosystem health. Symptoms of ecosystem degradation include increased phytoplankton blooms (measured as water column chlorophyll *a*) and related swings in dissolved oxygen. The upper tributaries, such as the northern Coastal Bays and Newport Bay, are severely enriched in nitrogen; the southern Coastal Bays, including Sinepuxent and Chincoteague, have the lowest total nitrogen concentrations. Phosphorus enrichment is more widespread than nitrogen enrichment. Chlorophyll values were generally low in the open bays (Wazniak *et al*., 2004).

Although the Coastal Bays are shallow lagoons that typically do not stratify, oxygen values are frequently low in some areas. The Water Quality Index synthesizes the status of the four water quality indicators: chlorophyll *a* (algae), total nitrogen, total phosphorus, and dissolved oxygen into a single indicator of water quality and compares measured variables to values known to maintain fisheries and seagrasses (Wazniak *et al*., 2004). Currently, tributaries generally show poor to very degraded water quality, primarily due to high nutrient inputs, while the open bays have good to excellent water quality. Also, the northern bays are generally in poorer condition than the southern bays. More highly flushed regions such as Sinepuxent Bay and south Chincoteague Bay have excellent water quality; however, south Chincoteague has many sites with high phosphorus concentrations (Wazniak *et al.*, 2004).

Nutrient concentrations are variable between the two regions and many sites throughout the system are displaying subsequent ecosystem effects of high phytoplankton and reduced dissolved oxygen. Since this has an impact on aquatic communities, some regions within the Coastal Bays do not provide suitable habitat for seagrasses or fish (Wazniak *et al*., 2004).

Potomac River

The Potomac River watershed comprises about 22 percent of the land area, and 30 percent of the population of the Chesapeake Bay watershed (Interstate Commission on the Potomac River Basin, 2007). As a result, pollution loads from the Potomac River have a significant impact on the health of the bay.

The District of Columbia, Maryland, and Virginia have placed portions of the tidal Potomac River on their 303(d) impaired waters lists for PCB contamination. Fish consumption advisories were issued due to elevated PCB concentrations in fish tissue and PCB concentrations in water have exceeded state standards in some cases. The TMDL analysis for each jurisdiction must include a determination of the sources that contribute to the impairment and by what amount those sources must be reduced so that PCB levels in fish and in water meet or fall below state standards. A single TMDL was developed for the three jurisdictions; USEPA, Region III, issued a Decision Rational for approval of the TDML on 31 October 2007 (Interstate Commission on the Potomac River Basin, 2007).

Summary of Maryland Water Quality

- Maryland has 4,360 miles of coastline along the Chesapeake Bay, Coastal Bays, and Atlantic Ocean, and almost 95 percent drains to the Chesapeake Bay.

- The water resources in Maryland most relevant to the Study Area include the coastal zone, Chesapeake Bay, Coastal Bays, and the Potomac River.
- Nutrient enrichment (both nitrogen and phosphorus) is the main threat to water quality in the Coastal Bays, with higher concentrations in the northern coastal bays.
- Pollution from the Potomac River has an impact on the Chesapeake Bay. Portions of the Potomac River were placed on the 303(d) impaired waters list. A TMDL for PCBs was jointly developed by the District of Columbia, Maryland, and Virginia and subsequently approved by USEPA, on 31 October 2007.

3.3.2.4 Virginia Water Quality

Virginia's coastal zone covers 8,950 square miles, or approximately one quarter of the state, and is defined by the boundaries of counties, cities, and towns adjacent to tidal waters. Open waters in the southern (lower) half of Chesapeake Bay, and the tidal waters of the James, York, and Rappahannock Rivers occupy almost 2,400 square miles of that area. According to recent measurements, the interface between open water and land in the coastal zone extends along more than 10,000 miles of tidal shoreline (NOAA, 2007c; VA DEQ, 2001).

Water quality parameters are measured at over 4,000 stations in Virginia's coastal zone (VA DEQ, 2001). The monitoring data indicate that 316 coastal water bodies are impaired, meaning they do not meet standards for their designated uses (supporting aquatic life, shellfish harvesting, swimming, or supplying drinking water).

The majority of areas in the coastal zone that fail to meet standards are impaired for use as shellfish harvesting waters due to bacteria. Approximately 142 square miles of Virginia tidal waters are closed to harvesting of shellfish; TMDLs for these areas will be developed by 2010. The Virginia Department of Health (VDH) Division of Health Hazard Controls has six health advisories in effect to restrict and one advisory to prohibit fish consumption (USEPA, 2000). Fishing is allowed in all Virginia tidal waters; however, several health advisories exist for waters in basins within the Study Area, including the James River Basin (kepone, an insecticide, and PCBs), York River Basin (PCBs and mercury), Rappahannock River Basin (PCBs), and the Chesapeake Bay/Atlantic Ocean and Small Coastal Basin (PCBs and mercury) (VA DEQ, 2006).

Virginia's Coastal Program links state agencies and programs that manage diverse coastal resources along the Chesapeake Bay; the Atlantic Ocean; the Rappahannock, York, and James Rivers; and portions of the tidal Potomac River. Key issues for the Commonwealth include restoration of the oyster fishery, water quality in the Chesapeake Bay, and management of a growing aquaculture industry (VA DEQ, 2001).

Rappahannock River

The Rappahannock River Basin is located in the northeastern portion of Virginia and covers 2,715 square miles (approximately 6.8% of Virginia's total area). The Rappahannock River Basin is bordered by the Potomac-Shenandoah Basin to the north and the York River Basin and Coastal Basin to the south. The headwaters lie in Fauquier and Rappahannock Counties and flow in a southeasterly direction to its mouth, where it enters the Chesapeake Bay (VA DEQ, 2006).

Agriculture, atmospheric deposition of nitrogen, industrial and municipal point sources, internal nutrient recycling, loss of riparian habitat, and sources outside the jurisdiction are the main contributors to water quality contamination in estuarine waters of the Rappahannock River Basin. There are 18 approved TMDLs for this basin, 12 for fecal coliform and six for *Escherichia coli* (*E. coli*) (VA DEQ, 2006).

York River

The York River Basin lies in the central and eastern section of Virginia and covers 2,662 square miles (approximately 7% of the Virginia's total area). It is defined by hydrologic boundaries. The basin is bounded by the Rappahannock River Basin to the north and east and the James River Basin to the south and west. The headwaters of the York River begin in Orange County and flow in a southeasterly direction for approximately 220 miles to its mouth at the Chesapeake Bay (VA DEQ, 2006).

The sources of water quality contamination in estuarine waters of the York River Basin include industrial point sources, municipal point sources, agriculture, atmospheric deposition of nitrogen, sedimentation, internal nutrient recycling, sources outside of the jurisdiction and unknown sources. There are five approved TMDLs for this basin, one for fecal coliform and four for *E. coli* (VA DEQ, 2006).

James River

The James River Basin occupies the central portion of Virginia and covers 10,206 square miles or approximately 25 percent of the Commonwealth's total land area. It is Virginia's largest river basin and is made up of the Upper, Middle, and Lower James River Subbasin and the Appomattox River Subbasin. The James River Basin begins in the Alleghany Mountains, and the river flows in a southeasterly direction to Hampton Roads where it enters the Chesapeake Bay. The James is formed by the confluence of the Jackson and Cowpasture Rivers and flows 228 miles to the Fall Line at Richmond and another 111 miles to the Chesapeake Bay. The population for the James River Basin is concentrated in Tidewater, with over one million people, and the Greater Richmond/Petersburg area with over 750,000 (VA DEQ, 2006).

The lower James River subbasin is most proximal to the EIS Study Area. Industrial and municipal point sources, agriculture, atmospheric deposition of nitrogen, internal nutrient recycling, loss of riparian habitat, and sources outside the jurisdiction are the main contributors to water quality contamination in estuarine waters of the James River Basin. There are four TMDLs in the lower James River Basin; two are for *E. coli*, one is for enterococci and fecal coliform, and the fourth is for phosphorus (VA DEQ, 2007).

Nearly all of Virginia's estuarine waters flow into the Chesapeake Bay (VA DEQ, 2006). The control of nonpoint source pollution and implementation of best management practices comprise much of the effort to improve water quality in the Chesapeake Bay and its tributaries. Water quality monitoring data, land use inventories, animal density data, and other information is used to assess watersheds for nonpoint source pollution control efforts. At present, most of the coastal zone outside of the undeveloped portions of the upper York River watershed are ranked as high or medium priorities for nonpoint source pollution control. This reflects the potential for pollution created by development and the prevalence of agricultural nutrient use on the Middle Peninsula, Northern Neck, and Eastern Shore.

Summary of Virginia Water Quality

- Virginia's coastal zone covers 8,950 square miles, or approximately one quarter of the state
- The water resources in Virginia most relevant to the Study Area include the coastal zone, Chesapeake Bay, and the James, York and Rappahannock Rivers.
- Industrial and municipal point sources, agriculture, atmospheric deposition of nitrogen, internal nutrient recycling, loss of riparian habitat, and sources outside the jurisdiction are the main threats to estuarine water quality.
- The VDH has issued 52 fish consumption advisories in the state (12 for mercury, 39 for PCBs and one for kepone). The advisories in the Study Area include the James River Basin for kepone (an insecticide), mercury, and PCBs; York River Basin for PCBs and mercury; Rappahannock River Basin for PCBs; and the Chesapeake Bay/Atlantic Ocean and Small Coastal Basin for PCBs and mercury.

Chesapeake Bay

The Chesapeake Bay Program is a regional partnership that directs and conducts restoration of the Chesapeake Bay (Chesapeake Bay Program, 2007). Chesapeake 2000 is the most recent agreement by the partners in the Chesapeake Bay Program and is intended to guide restoration activities throughout the Bay watershed through 2010.

The Chesapeake Bay is the largest of 130 estuaries in the United States, with a watershed that includes parts of six states (Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia) and all of the District of Columbia (Chesapeake Bay Program, 2007). The Bay is about 200 miles long, stretching from Havre de Grace, Maryland to Norfolk, Virginia (Figure 3.3-2). The Bay's width ranges from 3.4 miles near Aberdeen, Maryland, to 35 miles near the mouth of the Potomac River. The Bay receives about half of its water volume from the Atlantic Ocean; the rest drains into the Bay from a 64,000 square mile drainage basin or watershed.

The Chesapeake Bay holds more than 18 trillion gallons of water. There are approximately 150 major rivers and streams in the Chesapeake drainage basin (Chesapeake Bay Program, 2007). The Susquehanna River in south central Pennsylvania provides about 50 percent of the freshwater coming into the Bay - an average of 19 million gallons of water per minute. The water in the Chesapeake Bay is shallow; although the Bay covers a large surface area, its average depth, including all tidal tributaries, is about 21 feet. The Bay's salinity ranges from freshwater (0-0.5 ppt) near the Susquehanna River to water of nearly oceanic salinity (30-35 ppt) at the mouth of the Bay. The Bay has two of the five major North Atlantic ports in the United States, including Baltimore and Hampton Roads.

Water Quality in the Chesapeake Bay is influenced by natural conditions as well as anthropogenic sources. The weather plays a large role in conditions in the Bay and a typical year is as follows. Rain in the spring washes pollutant loads into the Bay, and lowers salinities to the minimum for the year. Summer weather plays a role as surface water temperature increases with air temperature increases. Salinity rises during the summer due to less rainfall and increased evaporation, and stratification occurs between surface and bottom water. Dissolved Oxygen (DO) levels are also at their lowest (often anoxic), especially in the deeper tributaries such as the Potomac and Baltimore Harbor. Fall brings about improved water clarity, decreased water temperature and increased salinity. Due to colder temperatures in winter, the water is well mixed, which causes temperature, salinity and oxygen levels to be similar throughout the water column. DO levels are at also their highest during the winter; however, biological activity is reduced (Maryland DNR, 2007).

The Chesapeake Bay was listed as an impaired water body under the Clean Water Act (CWA) due to excess nutrients and sediment (USGS, 2007). Improvements in water quality conditions must be made by 2010, or regulatory approaches to achieve these standards will be implemented. A summary the key water quality issues in the Chesapeake Bay is presented below.

Summary of Key Water Quality Issues in the Chesapeake Bay

The February 2004 Biennial Report of The Secretary of Natural Resources to The Virginia General Assembly (Virginia Secretary of Natural Resources, 2004) summarized several key water quality issues in the Chesapeake Bay, including excessive levels of nutrients and their impact on living resources and impacts from toxic chemicals in regions with existing or potential problems. The following discussion of trends is specific to the Chesapeake Bay and its tributaries.

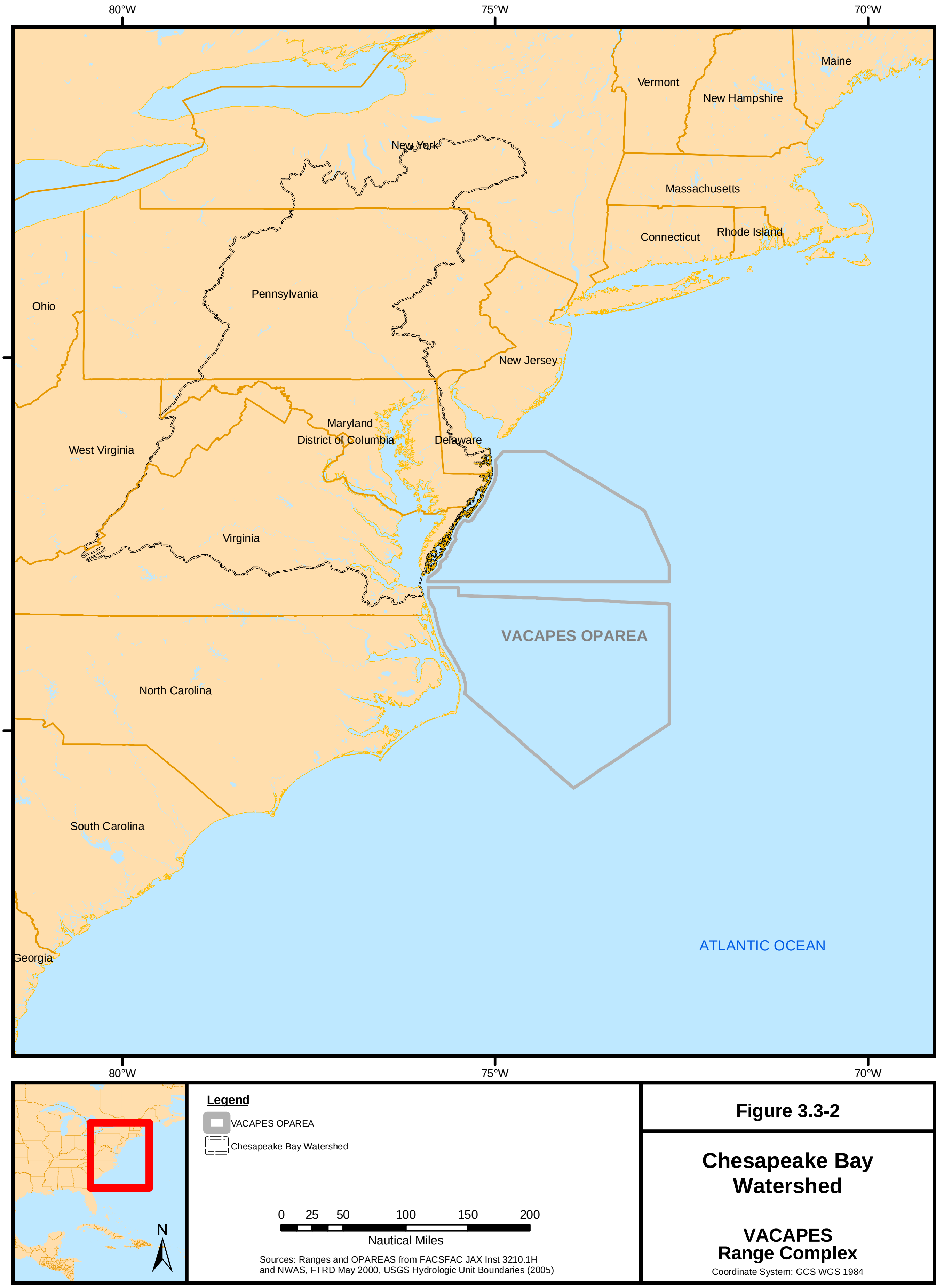


Figure 3.3-2

Chesapeake Bay Watershed

Nutrient loadings from watershed input monitoring stations were affected by the reduced point and nonpoint inputs but are highly dependent on river flow patterns as well. There were decreased loadings of nitrogen, phosphorus, and sediments due to decreased flow; however, some decreased loadings are due to management actions (Virginia Secretary of Natural Resources, 2004).

Phosphorus levels in water entering from the Bay watershed reflected both point and nonpoint source nutrient source reductions by the evidence of improving concentration trends in some rivers. Overall, there were eight areas showing improving trends and five areas showing degrading trends for phosphorus (Virginia Secretary of Natural Resources, 2004).

For nitrogen, the Potomac River and James River showed improving trends in water entering from the watershed. Nitrogen levels also showed improving trends in much of the tidal Potomac and James Rivers. Improving trends were also found for the first time in the mainstem Virginia Chesapeake Bay. Degrading trends are a concern in the upper Rappahannock River (Virginia Secretary of Natural Resources, 2004).

According to the 2006 Chesapeake Bay Report Card, the overall health of the bay as related to water quality was poor, due to very poor water clarity, poor chlorophyll a, and good dissolved oxygen (except in deep water channels). The poor rating for water clarity is attributed to an extremely turbid year during 2006, which was the worst water clarity assessment since monitoring began in 1985. The lower Bay, which is most applicable to the Study Area, received ratings of very poor water clarity and chlorophyll *a*; however, had the second best biotic index due to good benthic and moderate phytoplankton communities scores, which gave a total ranking of average to the lower Bay. The causes for turbidity during 2006 have not been determined (EcoCheck, 2007).

In summary, conditions for nitrogen and dissolved oxygen are generally improving; conversely, trends are generally declining for phosphorus, chlorophyll, suspended solids, and water clarity. These patterns are a combined result of both management controls of nutrient inputs and the natural effects of rainfall (*i.e.*, the drought that ended in 2003) (Virginia Secretary of Natural Resources, 2004).

3.3.2.5 North Carolina Quality

North Carolina has 3,375 miles of coastline. Some of the greatest challenges facing North Carolina's coastal zone are the impacts from population growth and coastal development, including loss of sensitive coastal habitats (NOAA, 2007d). Storm water runoff is a leading cause of water quality problems along the North Carolina coast, and mercury was identified as a major contaminant in fish tissue in all coastal river basins (North Carolina DENR/DWQ, 2002a).

Albemarle- Pamlico Estuarine Complex

The Albemarle-Pamlico Estuarine Complex (Complex) drains approximately 30,000 square miles of watershed and is the largest lagoonal estuarine system in the United States. This National Estuary Program (NEP) has a 23,000-square mile study area that extends south from Prince George County, Virginia, to Carteret County, North Carolina, and includes seven sounds (Albemarle, Bogue, Core, Croatan, Currituck, Pamlico, and Roanoke) (APNEP, 2006).

A chain of islands forms a barrier with the Atlantic Ocean on the eastern side of the Complex. The Complex is characterized by random wind-driven tides, which result in less predictable variations in water circulation and salinity patterns (Focazio, 2006).

The Albemarle-Pamlico National Estuary Program (APNEP) was among the first NEPs established by USEPA in 1987. The issues of environmental concern for the APNEP are water quality, habitat quality, and fishery resources. Impairment of waters in the Albemarle-Pamlico Estuarine Complex are primarily attributed to nonpoint sources of pollution; agricultural and urban runoff being the most prevalent. A smaller, but still significant amount of water quality impairment in the system is attributed to point-source discharges along the rivers flowing into the Complex (USEPA, 2007b).

The overall condition of the Albemarle-Pamlico Estuarine Complex is rated good to fair based on the four indices of estuarine condition used by the National Coastal Assessment (NCA). The water quality index for the Complex is rated good, the sediment quality and fish tissue contaminants indices are rated good to fair, and the benthic index is rated fair. This index was developed using NCA data on five component indicators: dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), chlorophyll *a*, water clarity, and DO. Only four percent of the Complex's estuarine area was rated poor for water quality; 35 percent was rated fair (USEPA, 2007b).

The Albemarle-Pamlico Estuarine Complex is rated good for DIN and DIP concentrations. DIP represents about 97 percent of the total phosphorus measurement for estuaries of the Southeast Coast region (USEPA, 2007a). The Complex is rated fair for chlorophyll *a* concentrations, good for water clarity (water clarity was rated poor at a sampling site if light penetration at 1 meter was less than 10% of surface illumination), and fair for dissolved oxygen concentrations (USEPA, 2007b).

Although trends in nutrient concentrations in the Complex appear to be very site-specific, the waters of these estuaries are generally rich in phosphorus and relatively nitrogen-limited (Harned and Davenport, 1990; APNEP, 2006). Water quality measurements and trend analysis conducted across the entire Albemarle-Pamlico Estuarine Complex demonstrated some noticeable long-term patterns between 1945 and 1988, including the following:

- Increased dissolved oxygen levels (in general);
- Increased pH (in general);
- Decreased levels of suspended solids; and
- Increased chlorophyll *a* levels (Harned and Davenport, 1990).

A major source of nutrient loading to the waters of the Albemarle-Pamlico Estuarine Complex is runoff from agricultural activities (Harned and Davenport, 1990; North Carolina DEHNR, 1997). Enhanced runoff of nutrients in the spring season was a major contributor to nuisance harmful algal blooms during the summer months. Atmospheric deposition accounts for an average of 27 percent of total nitrogen inputs and 22 percent of total phosphorus inputs to the drainage basin of the Albemarle-Pamlico Estuarine Complex (McMahon and Woodside, 1997).

Freshwater inputs to the system are provided by five major rivers — the Pasquotank, Chowan, and Roanoke Rivers that flow into Albemarle Sound, and the Tar-Pamlico and Neuse rivers that flow into Pamlico Sound. TMDLs were finalized for the Roanoke River (DO and dioxine), Tar River (nutrients and DO), and the Neuse River Estuary (total nitrogen) (North Carolina DENR/DWQ, 2007b).

The Pasquotank River Water Quality Monitoring Program was established in 1998 and monitored water quality parameters including pH, nitrates, phosphates, DO, temperature, total dissolved solids, conductivity, and microbiology for one year to assess the health of the river. Pollution from nonpoint sources is the main concern. The most likely sources include agricultural runoff, of which pig farming operations are the largest contributor, faulty septic tank systems, wastewater treatment plant effluent, runoff from lawns, and storm water runoff from Elizabeth City, the largest populated area on the River (North Carolina DENR/DWQ, 1997). A summary of data from the water quality monitoring program indicate the river has good water quality during the winter months, with the exception of high levels of coliforms and *E. coli*, which are expected to increase during the summer and warmer periods. It was suggested that further research be conducted to identify and locate the sources of contamination (Elizabeth City State University, 2007).

The Chowan River watershed lies in portions of Virginia and North Carolina. The majority of the Chowan River's watershed is in Virginia and is managed as the Chowan River and Dismal Swamp basin. This portion of the watershed covers 4,061 square miles of the Chowan River and Chowan River basin's headwaters (Virginia Department of Conservation and Recreation, 2007). The Chowan River basin in North Carolina is composed of the Chowan River and Meherrin River drainages. Water quality information for the North Carolina portion of the Chowan River basin is scarce; however, the basin is monitored for benthic macroinvertebrates, fish assessments, aquatic toxicity and ambient monitoring. Ambient monitoring data shows that dissolved oxygen levels are naturally low since they are influenced by swamp and wetland conditions, which can lower dissolved oxygen concentrations and decrease pH. Turbidity, total suspended solids, and copper were generally low. Most ambient water quality concerns in the Chowan River basin are attributed to nonpoint sources. The data available indicate that water quality is generally good and all waters in the basin are designated as Nutrient Sensitive Waters (NSW) (North Carolina DENR/DWQ, 2002a). The NSW designation is assigned to waters that have problems due to increased nitrogen and phosphorus loading to the system and may require the development and implementation of a strategy, such as a TMDL, to manage both point and nonpoint nutrient sources to meet water quality goals.

Elevated concentrations of mercury were found in fish tissue (largemouth bass and bowfin, both long-lived fish species, which indicates bioaccumulation) in both the Pasquotank and Chowan River basins; however, atmospheric deposition was found to be the significant contributor of mercury contamination. There are no basin-specific fish consumption advisories for the Chowan or Pasquotank River basins; however, there is a statewide advisory for bowfish, which is found in all river basins (North Carolina DENR/DWQ, 2002b).

Summary of North Carolina Water Quality

- North Carolina's coastal zone covers 3,375 miles.
- The water resources in North Carolina most relevant to the Study Area include the coastal zone and the Albemarle-Pamlico Estuarine Complex.
- Storm water runoff is a leading cause of water quality problems along the North Carolina coast
- Impairment of waters in the Albemarle-Pamlico Estuarine Complex is primarily attributed to nonpoint sources of pollution (the most prevalent being agricultural and urban runoff) and point-source discharges along the rivers flowing into the Complex to a lesser degree.
- The overall condition of the Albemarle-Pamlico Estuarine Complex is rated good to fair based on the four indices of estuarine condition used by the National Coastal Assessment.
- TMDLs were finalized for the Roanoke River (DO and dioxin), Tar River (nutrients and DO), and the Neuse River Estuary (total nitrogen).
- Primary sources of pollution to the Pasquotank River are agricultural runoff, of which pig farming operations are the largest contributor, faulty septic tank systems, wastewater treatment plant effluent, runoff from lawns, and storm water runoff. Overall, the water quality is good, with the exception of fecal coliform bacteria and *E. coli*.
- Water quality in the Chowan River Basin is generally good; however, all waters in the basin are designated as Nutrient Sensitive Waters. Most ambient water quality concerns in the Chowan River basin are attributed to nonpoint sources.

3.3.3 Environmental Consequences:

3.3.3.1 No Action Alternative

VACAPES OPAREA

Bombs

Bombs with live ordnance are fused to detonate on contact with the water, and it is estimated that 99 percent of them would explode within 5 feet of the ocean surface (DoN, 2005a). Propelled fragments would be produced by an exploding bomb. Sixty one percent of the bombs used under the No Action Alternative would be practice bombs without explosive warheads. Thirty nine percent of the 1,203 bombs deployed under the No Action Alternative for the VACAPES Range Complex sea range are high explosive.

Typically, bombing exercises (BOMBEX) at sea involve one or more aircraft bombing a target simulating a hostile surface vessel. Practice bombs are also called bomb dummy units (BDU) and are considered non-explosive practice munitions (NEPM). They are bomb bodies filled with an inert material (*e.g.,* concrete) and configured with either low-drag conical tail fins or high-drag tail fins for retarded weapon delivery. A BDU mimics the weight, size, center of gravity, and ballistics of a high explosive bomb. BDUs would be used within the VACAPES Range Complex. These practice munitions may contain spotting charges/signal cartridges that produce a visual indication of impact.

Chemical effects to the marine environment and water quality are considered to be negligible from a BOMBEX (DoN, 2005a). Initial concentrations of the chemical by-products of ordnance detonations are not hazardous to marine life and are rapidly dispersed in the ocean. Small and mostly metallic pieces of the bomb will quickly come to rest on the seafloor with each detonation. Numerous steel non-explosive practice bombs will likewise find their way to the seafloor. All these materials will slowly deteriorate with time and, given that they will be spread out over a relatively large area, their potential impact on the environment is considered to be negligible.

Bombs used at the VACAPES Range Complex under the No Action Alternative are listed in Chapter 2, and their approximate weight, length, and diameter are provided in Section 3.2.

Missiles

Missiles would be fired by aircraft and ships at a variety of airborne and surface targets on the VACAPES Range Complex. The principal source of potential impacts to water and sediment quality would be the unburned solid propellant residue, as well as other hazardous materials used in igniters, explosive bolts, batteries, and warheads. However, the rocket motor is typically fully expended prior to the missile reaching the target. Further, if it is a high explosive missile, the warhead is detonated prior to hitting the water as well. Approximately 27 percent of the 300 missiles fired on the VACAPES Range Complex carry non-explosive practice warheads with no hazardous constituents.

Testing demonstrated that water penetrates only 0.06 inches into the propellant during the first 24 hours of immersion, and that fragments would very slowly release ammonium and perchlorate ions (Aerospace Corporation, 1998 in DoN, 2007). These ions would be expected to be rapidly diluted and disperse in the surrounding water so that local concentrations would be extremely low. However, assuming all propellant on the ocean floor will be in the form of 4-inch cubes, only 0.42 percent of it will be wetted during the first 24 hours. If all the ammonium perchlorate leaches out of the wetted propellant, then approximately 0.01 lb would enter the surrounding seawater. The concentration would decrease over time as the leaching rate decreases and further dilution occurs. The aluminum would remain in the propellant binder and eventually be oxidized by seawater to aluminum oxide. The remaining binder material and aluminum oxide would not pose a threat to the marine environment. Therefore, effects from missile propellant may have temporary, minimal impacts on water quality.

The effects of hydrocarbon releases on water quality were analyzed using the federal criteria in the National Ambient Water Quality Criteria (NAWQC), which includes maximum concentration levels for the protection of aquatic life from contaminants in water. Saltwater criteria exist for benzene and toluene, and three polycyclic aromatic hydrocarbon (PAH) compounds: naphthalene, acenaphthene, and fluoranthene. However, both benzene and toluene are very volatile and are unlikely to be present after a short period, and fluoranthene is generally not present or is found in such low amounts (<0.1%) in refined petroleum that these constituents were not considered in this analysis (National Research Council, 1985).

Currently, ingestion of drinking water is the only viable exposure route for humans to perchlorate. Although the USEPA has published a reference dose in the Integrated Risk Information System (IRIS) specifically for the drinking water exposure route for humans, the environmental effects of perchlorate in the marine environment remain largely unknown and un-regulated. Navy training at sea with munitions containing perchlorate would not present a significant source of perchlorate to the marine environment, and therefore not have a significant effect on the environment as: 1) most, if not all, of the propellant would be consumed during use; 2) all perchlorate salts are readily soluble so any residual perchlorate remaining in the spent missile, or on fragments, would rapidly disperse through dilution; and 3) the most currently accepted, peer-reviewed screening value for aquatic, ecological receptors is significantly higher than the human health DWEL (Dean *et. al*, 2004).

Because perchlorate historically has not been considered a common contaminant, USEPA has not set perchlorate standards; however, the agency's range of concern is 4 to 18 ppb (Arlington, Virginia Dept. of Environmental Services, 2007). This action level would not be applicable to this analysis involving missile testing over the ocean. Therefore, ecological or human exposure to concentrations of perchlorate in aquatic environments that could be deemed a potential risk is highly unlikely

Short-Term Effects. Once concentrations are determined for each activity, comparisons with the NAWQC are possible. The NAWQC provide both acute and chronic concentrations. Acute values are levels producing short-term effects (*i.e.,* lethality), while chronic values produce long-term or sub-lethal effects.

Long-Term Effects. The combined concentrations from multiple exercises throughout a year cannot be compared with the NAWQC because of assumptions underlying the criteria. The criteria apply to instantaneous or short-term concentrations, not to loading or long-term effects. Even if two events were to occur simultaneously, it would be extremely unlikely for the two events to affect the same volume of water. Hence, the calculations for water quality analysis reflect each current and proposed activity independently.

Targets and Countermeasures

Under the No Action Alternative, an estimated 360 expended targets would be used within the VACAPES Study Area. At-sea targets are usually remotely operated airborne, surface, or subsurface traveling units, most of which are designed to be recovered for reuse. Aerial and surface targets would be deployed annually on the VACAPES Range Complex under operations in the No Action Alternative. Small concentrations of fuel and ionic metals released during battery operation could enter the water and contaminate limited areas; however, they do not represent a source of substantial environmental degradation.

A typical aerial target drone is powered by a jet fuel engine, generates radio frequency signals for tracking purposes, and is equipped with a parachute to allow recovery. They also contain oils, hydraulic fluid, batteries, and explosive cartridges as part of their operating systems. There are also recoverable, remotely controlled target boats and underwater targets designed to simulate submarines. If severely damaged or displaced, targets may sink before they can be retrieved. Aerial targets on the VACAPES Range Complex would include AST/ALQ/ESM pods; Banner drones; BQM-74E drones; Cheyenne; Lear Jets; and Tactical Air-Launched Decoys (TALD). The only expendable target is the TALD; all other aerial targets are non-expendable.

Target Assumptions. Potentially hazardous materials in targets (*e.g.,* BQM-74) include fuel and batteries. A BQM-74 starts operation with 107-lbs of liquid fuel, and it was assumed that 20 percent of the fuel (*i.e.,* 21.5 lbs) would remain at the completion of each mission. It was also conservatively assumed that five percent of the fuel comprised PAHs (PAHs such as acenaphthene generally make up less than 4% of fuel oil, and naphthalene is generally less than 1% [National Research Council, 1985]). This analysis also assumed a worst-case scenario in which the target would be destroyed on impact with the water rather than recovered intact. The majority of targets are recovered by use of an engine cut-off switch and a parachute. The target is retrieved from the water by helicopter.

In the case of a severe malfunction and a crash, water surface impacts would occur at a speed of at least 500 knots (600 mph) and could realistically affect an area up to 10 times the size of the target (taking into consideration water displacement). A typical target (BQM-74) is approximately 12.9 feet long, 2.3 feet high, with a wingspan of approximately 5.8 feet. Therefore, the analysis assumed a circle with a diameter of 58 feet would encompass the affected area. Given the low density of the hazardous constituents (*e.g.,* fuel, oil) relative to seawater, the analysis also assumed that only the top 3 feet of the water column would be affected. Based on these assumptions, the affected surface area would be about 10,600 ft^2 and the affected volume of seawater would be 2.5 x 10^5 gallons. The resulting concentration of PAHs would be 503 µg/L for each operation. This concentration is below the threshold established in the NAWQC for naphthalene (acute = 2,350 µg/L) and acenaphthene (acute = 970 µg/L; chronic = 710 µg/L). Note: 1 µg/L = 1 ppb.

Naval Gun Fire

Naval gun fire exercises at the VACAPES Range Complex would use non-explosive and explosive 5-inch and 76-mm rounds, and non-explosive practice 2.75-inch rockets containing an iron shell and sand, iron grit , or cement filler. Eighty one percent of the 5-inch and 76-mm rounds are non-explosive. The surface area of the ocean affected by the impact of a non-explosive 5-inch and 76-mm round is 20 in^2 and 12 in^2, respectively. An estimated 4,422 5-inch rounds and 72 76-mm rounds are fired annually under the No Action Alternative during the VACAPES Range Complex exercises that use 5-inch guns. When added together, this creates an estimated impact area accumulating to 0.00002 nm^2, which when compared to the total VACAPES Range area (27,661 nm^2), becomes negligible.

Unexploded 5-inch shells and non-explosive practice munitions would not be recovered and would sink to the ocean floor. Solid metal components of unexploded ordnance and non-explosive practice munitions would also sink.

Any changes in water quality would be negligible based on the dispersed nature of the expended rounds, slow breakdown rates, and enormous dilution capacity of the surrounding sea water. Therefore, indirect effects resulting from changes in water quality would not occur.

Small Arms and Close-In Weapons System Fire

The projectiles for .50-caliber and 7.62-mm gun ammunition typically contain lead cores. The 20-mm and 25-mm projectiles used in Close-In Weapons Systems training are typically inert tungsten. An estimated 540 grenades would also be used. Expended bullets may release small amounts of iron, aluminum, copper and tungsten into the sediments and the overlying water column as bullets corrode. Although elevated levels of these elements can cause toxic reactions in exposed animals, high concentrations in sediments would be restricted to a small zone around the bullet, and releases to the overlying water column would be quickly diluted (DoN, 2005b).

An estimated total of 808,160 small arms rounds; 201,700 cannon shells; and 540 non-explosive practice 40-mm grenades would be used under the No Action Alternative.

As with naval gun fire, any changes in water quality would be negligible based on the dispersed nature of the expended rounds, slow breakdown rates, and enormous dilution capacity of the surrounding sea water. Therefore, indirect effects resulting from changes in water quality would not occur.

Chaff

Chaff would be used during Chaff Exercises throughout the VACAPES Range Complex. Under the No Action Alternative, it is estimated that 1,821 Chaff Exercises would be held per year, releasing about 18,198 canisters of chaff in the VACAPES Range Complex. The amount of chaff used on any given day varies based on scheduled training events. Radiofrequency chaff (chaff) is an electronic countermeasure designed to reflect radar waves and obscure aircraft, ships, and other equipment from radar tracking sources. All components of the aluminum coating are present in seawater in trace amounts, except magnesium, which is present at 0.1 percent. The stearic acid coating is biodegradable and nontoxic. The potential for chaff to have a long-term adverse impact on water quality is very unlikely, and chemicals leached from the chaff will also be diluted by the surrounding seawater, thus reducing the potential for concentrations to build up to levels that can have effects on sediment quality and benthic habitats.

Even though chaff dipoles contain aluminum and other trace metals that can ultimately be leached from the chaff, the amount of chaff needed to raise environmental concentrations of these metals above background levels far exceeds the number than can be realistically deposited in a given area of land or body of water. As such, chaff releases are not expected to have any significant effect on ecosystem functioning in either terrestrial or aquatic environments (Farrell and Siciliano, 2007)

For each chaff cartridge used, a plastic end-cap and Plexiglas piston is released into the environment in addition to the chaff fibers. The end-cap and piston are both round and are 1.3 inches in diameter and 0.13 inches thick (Farrell and Siciliano, 2007).

A typical bundle of training chaff contains approximately five million fibers, each composed of glass silicate with an aluminum coating. Aluminum and silicon comprise the most common minerals in the earth's crust, aluminum oxide (Al_2O_3) and silicon dioxide (SiO_2). Since ocean waters are in constant exposure to crustal materials, there is little reason to believe that the addition of small amounts of chaff would have any effect on either water or sediment composition (Hullar *et al*., 1999). Chaff is generally resistant to chemical weathering and likely remains in the environment for long periods of time. As it is much like aluminosilicate minerals, the influence on the physical environment will be small, and likely limited to settling with bottom geology (DoN, 2007).

The physical environment may be affected by the leaching of metals from the chaff particles. However, the concentration of chaff needed to cause any kind of significant environmental impact far exceeds the amount that actually enters the water during air combat maneuvers. Sediment in the bottom of the ocean is composed of silicate minerals arising from various geomorphic processes. Minerals such as aluminum also enter the water through hydrothermal vents and the geologic processes themselves. The ions that can be leached from the chaff particles render such a small concentration in the at-sea environment (because of the large volume of water in comparison the actual number of chaff particles is so great) that the influence of aluminum ions entering the water is of smaller quantity than the processes that introduce metallic ions in the water naturally (DoN, 2007).

The amount of chaff necessary to impact the environment is not realistically deposited during normal naval training activities.

Flares

Flares are used to attract heat-seeking missiles and thus called self-protection flares. Self-protection flares consist of a magnesium/Teflon formulation that, when ignited and released from an aircraft, burn for a short period of time (less than 10 seconds) at very high temperatures. Flares release heat and light to disrupt tracking of Navy aircraft by enemy infrared tracking devices or weapons. Flares are designed to burn completely. Under normal operations, the only material that would enter the water would be a small, round plastic end-cap (approximately 1.4 inch diameter). The plastic end-caps would be distributed throughout the OPAREA (W-72 and W-386), therefore the amount of debris is negligible and would not substantially affect water quality resources..

Marine Markers (Smoke Floats)

Marine markers are pyrotechnic devices dropped on the water's surface. They are used in training exercises to mark a surface position on the ocean (refer to Section 3.2 for details). The chemical flame of a marine marker burns like a flare but also produces smoke. Approximately 300 marine markers (smoke floats) would be expended during the No Action Alternative.

Marine markers are composed of tin and contain red phosphorus pyrotechnic candles and seawater-activated batteries (The Ordnance Shop, 2007). In the aquatic environment, phosphorus will settle to the sea floor where it will react with the water to produce phosphoric acid, until all phosphorus is consumed by the reaction. Combustion of red phosphorus produces phosphorus oxides, which have a low toxicity to aquatic organisms. Due to the low usage of marine markers, the red phosphorus would have no effect on the marine environment (DoN, 2006b).

The Navy is currently preparing the Atlantic Fleet Active Sonar Training EIS/OEIS for the use of multiple sonar types in the East Coast and Gulf OPAREAs of the United States. Additional assessment regarding the use of marine markers (smoke floats) in the VACAPES Range Complex is included in the AFAST EIS/OEIS. A summary of the AFAST EIS/OEIS is provided in Section 3.19, Summary of Sonar Effects.

Underwater Detonations

Most underwater detonations during VACAPES Range Complex operations would be associated with mine neutralization exercises. Explosive ordnance disposal (EOD) detachments place explosive charges next to or on non-explosive practice mines. Charges used by EOD divers in the VACAPES Range Complex consist of 20-lb explosives, and reflect the size of charges EOD divers use to detonate mines in combat or real-world conditions. Underwater explosions would also occur during SEAL platoon training exercises. Navy SEAL underwater demolitions and EOD operations would be conducted in the Surface Danger Zone, W-50C.

Approximately 12 underwater detonations using 20-lb explosives would be conducted under the No Action Alternative.

The combustion products from the detonation of high explosives are commonly found in sea water – carbon monoxide, carbon dioxide, hydrogen, water, nitrogen, and ammonia. The primary contaminants that would be released from explosives used in mine warfare training are nitroaromatic compounds such as trinitrotoluene (TNT), cyclonite (Royal Demolition Explosive or RDX), and octogen (High Melting Explosive or HMX) (URS *et al*., 2000)

Initial concentrations of explosion by-products are not expected to be hazardous to marine life (DoN, 2001b) and would not accumulate in the training area because exercises are spread out over time and chemicals rapidly disperse in the ocean. Therefore, no adverse effects from chemical by-products would be expected.

The chemical products of underwater detonations are initially confined to a thin, circular area called the surface pool. After the turbulence of the explosion has dispersed, the pool stabilizes and the chemical products are diluted and become undetectable. The USEPA considers the contaminant levels released during the sinking of a target to be within the standards of the Marine Protection, Research and Sanctuaries Act (USEPA, 2007a).

Small-scale underwater detonations, including development tests of underwater weapons, underwater explosive research testing, and shock survivability tests of shipboard equipment showed no significant environmental effects to the benthic environment, water quality, or marine biota of the global commons (DoN, 1992). Testing occurred 18 nm offshore from Key West, Florida, where the depth of the water column ranged from approximately 1200 to 4,800 feet.

Military training activities in the VACAPES Study Area, especially the use of live ordnance, are potential sources of water quality pollutants. Some detonations occur within the 12 nm limit in W-50C where live fire is authorized; however, most of the underwater detonation operations in the VACAPES Study Area occur outside the 12 nm limit, and any potential impacts to water quality from combustion products are localized, temporary, and do not substantially affect water quality or resources in the Study Area. Therefore, the impact on water resources and water quality is less than significant in the No Action Alternative.

Water Quality in Chesapeake Bay

Impacts to water quality in the lower Chesapeake Bay would be attributable to using the MK-104, MK-105, and SPU-1W minesweeping systems in the nearshore environment resulting from mine countermeasure training. Mine Countermeasure exercises train forces to detect, identify, classify, mark, avoid, and disable (or verify destruction of) underwater mines using a variety of methods, including air, surface, sub-surface, and ground assets. A total of approximately 272 mine countermeasure exercises (sorties) would be conducted annually in the lower Chesapeake Bay under No Action Alternative.

The MK-104 is a minesweeping system to counter acoustic influencing mines. It simulates the acoustic signature of a targeted vessel and causes the mine to self-detonate. The SPU-1W is a 30-foot magnetized pipe used for mine sweeping in shallow water for magnetic influenced mines. The 1,000-lb pipe is transported by hanging from an MH-53E to and from the training area. Once at the training area, the aircrew deploy the system into the water to simulate a targeted vessel.

The MK-105 is a minesweeping sled used to counter magnetic influencing mines. The sled is towed behind an MH-53E. Behind the hydrofoil sled is a 450-foot buoyant magnetic cable with 150 feet of electrodes on either end of the cable. The electrodes create a magnetic field that causes magnetic influenced mines to self detonate.

Use of the MK-104, MK-105, or the SPU-1W minesweeping systems could alter conditions in bottom sediment of the lower Chesapeake Bay when the water column is shallow. As stated previously, the Chesapeake Bay was listed as an impaired water body under the CWA due to excess sediment. Proposed operations could have an impact due to towing the minesweeping systems through the water, which could cause a temporary increase in turbidity and total suspended solids in the water column during and temporarily after a training exercise.

Although the portion of the Chesapeake Bay where these operations would occur lies within Virginia state territorial waters, the potential sediment disturbance would not exceed state or federal water quality standards; thus, no significant impact on water quality is anticipated in the No Action Alternative.

3.3.3.2 Alternative 1

VACAPES OPAREA

VACAPES Range Complex training operations involving hazardous materials that have the potential to affect water resources and water quality would increase by varying degrees from current levels under Alternative 1. Amounts of expended training materials would increase and decrease in rough proportion to the overall increases and decreases in these training operations.

Under Alternative 1, annual use of materials in the VACAPES Study Area would increase over the No Action Alternative approximately as follows:

- MK-103 sorties would increase from 176 to 200;
- AQS-24A sorties would increase from 480 to 530;
- AQS-20A sorties would increase from 430 to 660;

Explosive Ordnance Explosive events would increase from 12 to 24.Under Alternative 1, new or modified mine warfare systems and ordnance would be introduced for the VACAPES Study Area, including:

- ALMDS, 100 sorties;
- AQS-20A 12 sorties associated with the DDG 91+ remote mine hunting system);
- AMNS 70 sorties, and 140 AMNS sorties with HE (30 rounds); and
- RAMICS, 100 sorties.

RAMICS is a targeting, fire control, and gun system which fires inert, non-explosive rounds at a mine moored near the surface of the water. The associated system, ALMDS, uses the LIDAR laser system from the MH-60S to identify the mine and direct RAMICS gun fire to destroy the mine. ALMDS/RAMICS systems would be deployed in W-50C.

AMNS is a mine neutralization system deployed from an MH-53E (70 sorties) or MH-60S (140 sorties using approximately 30 rounds of 3.24 Lbs NEW HE) to neutralize mines identified by minehunting systems. The AMNS operator, controlling the system from the helicopter, uses the vehicle's sonar to reacquire the target. Once acquired, the operator uses video to guide the target into a position for firing a self-contained shaped charge that neutralizes the mine. This system would be used in W-50C.

Potential effects associated with the active sonar components of mine warfare activities are analyzed separately in the AFAST EIS and summarized in Section 3.19 of this document. Military training activities in the VACAPES Study Area, especially the use of HE ordnance, are potential sources of water quality pollutants. Most of the underwater detonation operations in the VACAPES Study Area occur outside the 12 nm limit, with the exception of training in W-50C. Any potential impacts to water quality from combustion products are localized, temporary, and do not substantially affect water quality or resources in the Study Area. Therefore, the impact on water resources and water quality is less than significant under Alternative 1.

Water Quality in Chesapeake Bay

As described for the No Action Alternative, impacts to water quality in the lower Chesapeake Bay would be attributable to using the MK-104, MK-105, and SPU-1W minesweeping systems in the nearshore environment resulting from mine countermeasure training. For these systems, a total of approximately 310 mine countermeasure exercises (sorties) would be conducted in Alternative 1 (compared to 272 for the No Action Alternative).

- SPU-1W sorties would increase from 64 to 70;
- MK-104 sorties would increase from 104 to 120; and
- MK-105 sorties would increase from 104 to 120.

Under Alternative 1, an additional system would be introduced: 360 OASIS mine sweeping exercises (sorties). OASIS is a self-contained, high speed, shallow water magnetic and acoustic influence sweeping device. OASIS would be towed by an MH-60S helicopter. The mine sweeping system emulates the magnetic and acoustic signatures of transit platforms. Once in the training area, aircrew deploys the system into the water to simulate a targeted vessel. OASIS would not affect water quality via chemical constituents; however, could disturb the sediment since it is towed through the water. Use of the mine sweeping systems could alter conditions in bottom sediment of the lower Chesapeake Bay when the water column is shallow. As stated previously, the Chesapeake Bay was listed as an impaired water body under the CWA due to excess sediment. Proposed operations could have an impact due to any of these systems streamed through the water, which could cause a temporary increase in turbidity and total suspended solids in the water column during and temporarily after a training exercise.

Although the portion of the Chesapeake Bay where these operations would occur lies within Virginia state territorial waters, the potential sediment disturbance would not exceed state or federal water quality standards; thus, no significant impact on water quality is anticipated under Alternative 1.

3.3.3.3 Alternative 2

VACAPES Range Complex training operations with potential impacts to water quality would increase by varying degrees from current levels under Alternative 2. Amounts of expended training materials would increase and decrease in rough proportion to the overall increases and decreases in these training operations.

As with Alternative 1, various new or modified mine countermeasure training areas are proposed as part of the Preferred Alternative (Alternative 2). These include ALMDS, AQS-20A (platform changed from MH-60S to remote mine hunting system), AMNS (and AMNS with HE), and RAMICS, and are the same types of new training introduced in Alternative 1.

Under Alternative 2, use of materials in the VACAPES Study Area would be the same as Alternative 1 except for the following:

- MK-103 sorties would be the same but would employ HE (0.002 Lbs NEW) under Alternative 2;
- AQS-24A sorties would increase from 480 sorties (No Action Alternative) to 550 sorties under Alternative 2;
- AQS-20A sorties would increase from 430 sorties (No Action Alternative) to 670 sorties under Alternative 2;
- ALMDS sorties would increase from 100 sorties (Alternative 1) to 110 sorties (Alternative 2);
- RAMICS sorties would increase from 100 sorties (Alternative 1) to 110 sorties (Alternative 2); and
- High Explosive bombs would be decreased from 344 bombs (No Action Alternative and Alternative 1) to 20 in W-386 and 121 bombs (No Action Alternative and Alternative 1) to zero bombs (Alternative 2) in W-72.

Military training activities in the VACAPES Study Area, especially the use of live ordnance, are potential sources of water quality pollutants. Any potential impacts to water quality from combustion products are localized, temporary, and do not substantially affect water quality or resources in the Study Area. Based on the analysis presented above, these pollutants would be released in quantities and at rates that would not exceed any water quality standard or criteria, even given the reduction in at-sea BOMBEX events using explosive ordnance proposed under this Alternative. Therefore, the impact on water resources and water quality is less than significant, individually and in the aggregate, under the Preferred Alternative (Alternative 2).

Water Quality in Chesapeake Bay

Impacts to water quality in the lower Chesapeake Bay would be attributable to using the MK-104, MK-105, SPU-1W, and OASIS minesweeping systems resulting from mine countermeasure training and the deployment and retrieval of simulated mines. A total of 680 mine countermeasure exercises (sorties) would be conducted in the lower Chesapeake Bay under Alternative 2.

Under Alternative 2, the MK-105/SPU-1W training area would contain two 1 nm by 4 nm areas populated with Versatile Exercise Mines (VEM). VEM units would be deployed on Chesapeake Bay bottom surface, which would be pre-surveyed to avoid shipping lanes, shipwrecks, artificial reefs and hard bottom surfaces. Twenty VEM systems would be deployed during mine countermeasure exercises within the VACAPES Study Area (lower Chesapeake Bay) for Alternative 2. VEM units would be retrieved approximately every 90 days to service the units and download data. VEM units simulate mine shapes and no detonations would occur during this training.

Use of the MK-104, MK-105, and SPU-1W minesweeping systems could alter conditions in bottom sediment of the lower Chesapeake Bay. As stated previously, the Chesapeake Bay was listed as an impaired water body under the CWA due to excess nutrients and sediment. Proposed operations would not impact nutrient inputs to the Bay, but could have an impact due to VEM units being deployed and retrieved in this area (approximately every 90 days), which could cause a temporary increase in turbidity and total suspended solids in the water column.

Under Alternative 2, OASIS sorties in the lower Chesapeake Bay would increase to 370 sorties annually (compared to 360 annual sorties under Alternative 1). The proposed OASIS range requires a depth of 40-150 feet within the Chesapeake Bay. Two 1 nm x 4 nm minefields with 20 VEMS units would be needed. Since this system would be deployed using MH-60S helicopters, the range must be within 25 nm for proper on-range training time. VEM units would be serviced approximately every 90 days to download data.

As stated previously, the Chesapeake Bay was listed as an impaired water body under the CWA due to excess sediment. Proposed operations could have an impact on sediment. Proposed mine countermeasure operations conducted in the Chesapeake Bay could potentially cause turbidity and total suspended solids to increase due to towing the OASIS system through the water, as well as deployment/recovery of VEM units. No detonations would occur in these training areas.

Although the portion of the Chesapeake Bay where these operations would occur lies within Virginia state territorial waters, the potential sediment disturbance would not be expected to exceed state or federal water quality standards; thus, no significant impact on water quality in the lower Chesapeake Bay is anticipated under the Preferred Alternative (Alternative 2).

3.3.4 Unavoidable Significant Environmental Effects

The analysis presented above indicates that Alternatives 1 and 2 would not result in unavoidable significant adverse effects to water resources and water quality; however, due to the sensitive estuarine environment and strict management of the Chesapeake Bay, special attention should be given to operations conducted in this area. As stated previously, the Chesapeake Bay was listed as an impaired water body under the CWA due to excess nutrients and sediment. Proposed operations would not impact nutrient inputs to the Bay, but could have an impact on sediment. Proposed mine countermeasure operations conducted in the Chesapeake Bay could potentially cause turbidity and total suspended solids to increase due to towing of minesweeping systems through the water, which could disturb sediment. In addition, the deployment and retrieval of VEM units on the Chesapeake Bay bottom surface could also cause turbidity and total suspended solids to increase.

3.3.5 Summary of Environmental Effects (NEPA and EO 12114)

Training activities would introduce expended materials and potential water pollutants to the water column. Based on the analysis presented above, however, these pollutants would be released in quantities and at rates that would not result in a violation of any water quality standard or criteria. Marine biota would not be substantially affected. Accordingly, these impacts would be less than significant, both individually and in the aggregate.

Table 3.3-4 provides a summary of water quality effects for the No-Action Alternative, Alternative 1, and Alternative 2. For purposes of analyzing such effects under both NEPA and EO 12114, the table allocates effects on a jurisdictional basis (*i.e.*, under NEPA for actions or effects within U.S. territory, and under EO 12114 for actions or effects outside U.S. territory).

TABLE 3.3-4
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES IN THE VACAPES EIS/OEIS STUDY AREA

Alternative and Stressor	Summary of Effects and Impact Conclusion	
	NEPA (U.S. Territorial Waters)	Executive Order 12114 (Non-Territorial Waters, >12 nm)
No Action		
Military Expended Materials (MEM)	Long-term, minor, and localized accumulation of MEM on the ocean floor.	Long-term, minor, and localized accumulation of MEM on the ocean floor.
Underwater Detonations and High Explosive Ordnance	Temporary, short-term, minor, and localized changes to immediate surrounding water quality from potential releases of munitions constituents from explosives and ordnance used during training exercises.	Temporary, short-term, minor, and localized changes to immediate surrounding water quality from potential releases of munitions constituents from explosives and ordnance used during training exercises.
Non-Explosive Practice Munitions	Long-term, minor, and localized accumulation of MEM on the ocean floor.	Long-term, minor, and localized accumulation of MEM on the ocean floor.
Mine Warfare Deployment/Recovery	Negligible effects.	Negligible effects.
Impact Conclusion	Less than significant impact.	Less than significant harm.
Alternative 1		
MEM	Long-term, minor, and localized accumulation of MEM on the ocean floor.	Long-term, minor, and localized accumulation of MEM on the ocean floor.
Underwater Detonations and High Explosive Ordnance	Temporary, short-term, minor, and localized changes to immediate surrounding water quality from potential releases of munitions constituents from explosives and ordnance used during training exercises. Slight increase compared to No Action.	Temporary, short-term, minor, and localized changes to immediate surrounding water quality from potential releases of munitions constituents from explosives and ordnance used during training exercises. Slight increase compared to No Action.
Non-Explosive Practice Munitions	Long-term, minor, and localized accumulation of MEM on the ocean floor. Slight increase compared to No Action.	Long-term, minor, and localized accumulation of MEM on the ocean floor. Slight increase compared to No Action.
Mine Warfare Deployment/Recovery	Negligible effects.	Negligible effects.
Impact Conclusion	Less than significant impact	Less than significant harm.
Alternative 2 (Preferred Alternative)		
MEM	Long-term, minor, and localized accumulation of MEM on the ocean floor.	Long-term, minor, and localized accumulation of MEM on the ocean floor.
Underwater Detonations and High Explosive Ordnance	Temporary, short-term, minor, and localized changes to immediate surrounding water quality from potential releases of munitions constituents from explosives and ordnance used during training exercises. A slight increase compared to No Action.	Temporary, short-term, minor, and localized changes to immediate surrounding water quality from potential releases of munitions constituents from explosives and ordnance used during training exercises. A significant decrease compared to No Action due to decrease in HE bombs used in non-territorial waters.
Non-Explosive Practice Munitions	Long-term, minor, and localized accumulation of MEM on the ocean floor. Slight increase compared to No Action.	Long-term, minor, and localized accumulation of MEM on the ocean floor. Slight increase compared to No Action.
Mine Warfare Deployment/Recovery	Negligible effects.	Negligible effects.
Impact Conclusion	Less than significant impact	Less than significant harm.

3.4 AIR QUALITY

3.4.1 Introduction and Methods

Air quality in a location is described by the concentration of various pollutants in the atmosphere, generally expressed in units of parts per million (ppm) or micrograms per cubic meter (µg/m^3); the size and topography of the air basin; and the prevailing meteorological conditions. The USEPA sets concentration levels for specific pollutants of concern with respect to the health and welfare of the general public.

The six major pollutants of concern are:

- Carbon monoxide (CO);
- Sulfur dioxide (SO_2);
- Nitrogen oxides (NO_x);
- Ozone (O_3);
- Suspended particulate matter with a diameter of 10 microns (PM_{10}) or less, and 2.5 microns or less ($PM_{2.5}$); and
- Lead (Pb).

The USEPA has established National Ambient Air Quality Standards (NAAQS) for these "criteria pollutants" that represent ambient concentrations considered protective of public health and welfare.

Pollutant emissions typically refer to the amount of pollutants or pollutant precursors introduced into the atmosphere by a source or group of sources. Pollutant emissions contribute to the ambient air concentrations of criteria pollutants, either by directly affecting the pollutant concentrations measured in the ambient air or by interacting in the atmosphere to form criteria pollutants. Primary pollutants, such as carbon dioxide, sulfur dioxide, lead, and some particulates, are emitted directly into the atmosphere from emission sources. Secondary pollutants, such as ozone, nitrogen oxides, and some particulates, are formed through atmospheric photochemical reactions that are influenced by meteorology, ultraviolet light, and other atmospheric processes.

Wind direction determines the path of air pollutants from their source to any receptor. Wind speed and the distance from the source determine the time it will take air pollutants to travel from source to receptor. At high wind speeds, the air experiences more turbulence and pollutants released near the ground will disperse more rapidly. However, air pollutants emitted by elevated stack sources may be more rapidly transported to the ground during high winds and can actually lead to higher ground-level pollutant concentrations. At low wind speeds, pollutants emitted from sources near the ground, such as vehicle exhaust, will disperse at a slower rate.

The combination of a strong temperature inversion and light winds may lead to a layer of cold, stagnant air near the ground. Pollutants emitted from low-level sources, such as vehicles, are trapped in this layer of air. A persistent temperature inversion over a long period of time may lead to increased concentrations of air pollutants in the lower atmosphere from low-level sources.

The region of air that extends from the earth's surface to the base of the temperature inversion is referred to as the mixing layer. This layer of air is relatively well mixed because of heating from the sun and from human sources. The depth of the mixing layer defines the volume of air in which air pollutants can be mixed. The lower the depth of the mixing layer, the less volume is available to disperse air pollutants. A persistent lack of a mixing layer or shallow mixing depth may lead to episodes of high pollution concentrations. The mixing layer is especially important in urban locations where large quantities of pollutants are released near ground level.

Generally, the air quality of the VACAPES Range Complex is very good. This conditions results from the relatively low number of air pollutant sources, size and topography of the VACAPES Range Complex, and prevailing meteorological conditions.

3.4.1.1 Regulatory Framework

Federal Air Quality Requirements

The USEPA is the agency responsible for enforcing the federal Clean Air Act (CAA) of 1970 and its 1977 and 1990 amendments (42 U.S.C. Part 7401, *et seq*.). Activities under the CAA have included:

- Establishing the NAAQS;
- Classifying the attainment status of areas relative to the NAAQS;
- Developing schedules and strategies to meet the NAAQS; and
- Regulating emissions of criteria pollutants and air toxics to protect public health and welfare.

Under the CAA, states are allowed to adopt ambient air quality standards and other regulations, provided they are at least as stringent as federal standards. Within the VACAPES Range Complex, implementation of the CAA is carried out by the:

- Delaware Department of Natural Resources and Environmental Control (DNREC);
- Maryland Department of the Environment (MDE);
- Virginia Department of Environmental Quality (VDEQ); and
- North Carolina Department of Environment and Natural Resources (NC DENR).

The USEPA requires each state to prepare a state implementation plan (SIP) that describes how that state will achieve compliance with the NAAQS. An SIP is a compilation of goals, strategies, schedules, and enforcement actions that will lead the state into compliance with all federal air quality standards. The air quality regulations promulgated under the CAA that are potentially applicable to the proposed action include the NAAQS and General Conformity Rule.

NAAQS

The CAA requires the USEPA to set primary and secondary NAAQS for the six pollutants considered harmful to public health and the environment (40 CFR Part 50). These standards for each of the states within the VACAPES Range Complex are presented in the NAAQS table in Appendix K. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

General Conformity Rule

Section 176(c)(1) of the CAA, the General Conformity Rule, requires federal agencies to ensure that their actions conform to applicable implementation plans for achieving and maintaining the NAAQS for criteria pollutants. To ensure compliance with the General Conformity Rule, a federal action must not contribute to new violations of ambient air quality standards, increase the frequency or severity of existing violations, or delay timely state and/or regional attainment of standards.

The USEPA rule implementing the conformity requirements, "Determining Conformity of General Federal Actions to State or Federal Implementation Plans," is codified in 40 CFR Parts 51 and 93. Part 51, Subpart W contains the General Conformity Rule provisions that must be incorporated into SIPs, including the requirement that states revise the SIPs to include the conformity requirements. Once an SIP has been revised and approved by the USEPA, the conformity requirements become federally enforceable and federal agencies are subject to the conformity requirements as they appear in the SIP. In cases where a federal implementation plan (FIP) is in effect, federal actions must conform to its requirements. Each federal agency taking an action subject to the General Conformity Rule must make a conformity determination (40 CFR 93.154).

A conformity review, with documentation, must be completed for every Navy action that generates air emissions in nonattainment or maintenance (former nonattainment) areas. The conformity review can be satisfied by a determination that the action is not subject to the General Conformity Rule, a record of non-applicability, or a conformity determination.

In some cases, the Navy can make a determination that a proposed action is not subject to the General Conformity Rule. Actions not subject to the rule include:

- Actions that occur in attainment areas, and that do not generate emissions in nonattainment areas; or
- Actions where the criteria pollutant emitted (or its precursors) is one for which the area is in attainment.

If NEPA documentation is prepared for an action, the determination that the proposed action is not subject to the General Conformity Rule is described in that documentation. Otherwise, no documentation is required. This EIS/OEIS includes the determination that all actions occurring in the attainment areas (that is, the coastal counties of Maryland and North Carolina) are not subject to the General Conformity Rule. Actions occurring adjacent to coastal Delaware counties and Virginia counties are separately addressed in a record of non-applicability.

3.4.1.2 Assessment Methods and Data Used

The method used in this EIS/OEIS to assess the air quality impacts associated with existing and proposed Navy training and testing within the VACAPES Range Complex included following the steps:

- Identify the federal and state air quality regulations that are applicable to the proposed action. Determine applicability of the General Conformity Rule.
- Define existing air quality and meteorological conditions in the range complex.
- Analyze the types of emissions sources associated with training and testing within the range complex.
- Review existing air quality assessments associated with individual Navy platforms and weapons systems.
- Determine air quality impacts associated with existing Navy training and testing within the range complex based on regulatory requirements.
- Determine air quality impacts that would result from the proposed increases in Navy training and testing within the range complex.

It was determined that air quality modeling or monitoring was not required for this analysis.

3.4.1.3 Warfare Areas and Associated Environmental Stressors

The warfare areas and emission sources (environmental stressors) associated with training in the VACAPES Range Complex are identified in Table 3.4-1. These sources will be analyzed in this section to determine their environmental consequences.

These sources/stressors may be associated with the training platform, weapon system used in the exercise, and/or target or support craft. The table also identifies whether training exercises that produce emissions occur within and/or beyond 12 nautical miles (nm) from shore, and whether they take place below and/or above 3,000 feet. Emissions above 3,000 feet would be above the atmospheric inversion layer and, therefore, would not affect local air quality.

As shown in Table 3.4-1, most helicopter and small boat exercises take place closer to the shore, while exercises involving fixed-wing aircraft and large ships take place at a greater distance from shore. This is important from an air quality perspective because defines which Navy exercise emission sources would contribute to the air quality for human receptors. For example:

- GUNEX (surface-to-surface) exercises are always conducted at least 12 nm from shore. Emissions associated with GUNEX (surface-to-surface) would include minor amounts of cruiser or destroyer engine exhaust and gun barrel exhaust from firing the 5-inch guns. Even if the wind moved these emissions toward the shore, they would be diluted to undetectable levels before they reached receptors and would not have the potential to affect public health and welfare.
- Most helicopter flights in connection with Mine Countermeasures (MCM) exercises are within 3 nm of the shore and all occur below 3,000 feet. Helicopters conducting certain types of MCM exercises tow a practice sled through the water. Emissions associated with existing MCM events are from the helicopter engines and sled hydrofoil engines. When these emissions occur near the shore, they have the chance (depending on wind direction) to mix with the air breathed by life ashore. The emissions from helicopters based at Naval Station Norfolk have been studied several times in previous environmental assessments and are shown to have a *de minimis* impact (*i.e.*, the change in the levels of NO_X and VOCs caused by the action do not exceed 100 tons per year for each.) (DoN, 2002)

Air quality criteria are set to protect the most susceptible sectors of the population such as children, the elderly, and people with asthma and breathing disorders.

TABLE 3.4-1
WARFARE AREAS AND ASSOCIATED AIR QUALITY ENVIRONMENTAL STRESSORS

		Stressors				Location			
Warfare Area and Operation	**Training Areas**	**Surface Vessel Emissions**	**Helicopter Emissions**	**Fixed-Wing Aircraft Emissions**	**Ordnance or Target Emissions**	**Below 3,000 feet**	**Above 3,000 feet**	**Overland or < 12 nm from Shore**	**> 12 nm from Shore**
Mine Warfare (MIW)									
Mine countermeasures exercise (MCM)	Lower Chesapeake Bay	✓	✓			✓		✓	
Mine countermeasures exercise (MCM)	W-50A/C, W-386, W-72	✓	✓			✓		✓	
Mine neutralization	W-50C	✓	✓		✓	✓		✓	
Surface Warfare (SUW)									
Bombing exercise (air-to-surface) (at sea)	W-386 (Air-K), W-72A (Air-3B), W-72A/B			✓	✓		✓		✓
Missile exercise (MISSILEX) (air-to-surface)	W-386 (Air-K), W-72A			✓	✓	✓			✓

TABLE 3.4-1
WARFARE AREAS AND ASSOCIATED AIR QUALITY ENVIRONMENTAL STRESSORS (Continued)

		Stressors				Location			
Warfare Area and Operation	**Training Areas**	**Surface Vessel Emissions**	**Helicopter Emissions**	**Fixed-Wing Aircraft Emissions**	**Ordnance or Target Emissions**	**Below 3,000 feet**	**Above 3,000 feet**	**Overland or < 12 nm from Shore**	**> 12 nm from Shore**
Gunnery exercise (GUNEX) (air-to-surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C		✓	✓	✓	✓		✓	✓
GUNEX (surface-to-surface) boat	W-50C, R-6606	✓				✓		✓	
GUNEX (surface-to-surface) ship	W-386, W-72	✓			✓	✓			✓
Laser targeting	W-386 (Air-K), W-72A		✓	✓		✓	✓		✓
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- Ship	VACAPES OPAREA	✓						✓	✓
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓			✓		✓	✓
Air Warfare (AW)									
Air combat maneuver (ACM)	W-72A, (Air-2A/B, 3A/B)			✓			✓		✓
GUNEX (air-to-air)	W-72A			✓			✓		✓
MISSILEX (air-to-air)	W-386 (Air D, G, H, K), W-72A			✓	✓		✓		✓
GUNEX (surface-to-air)	W-386, W-72	✓		✓		✓	✓		✓
MISSILEX (surface-to-air)	W-386 (Air D, G, H, K)	✓			✓	✓			✓
Air intercept control (AIC)	W-386, W-72	✓		✓		✓	✓		✓
Detect to engage (DTE)	W-386, W-72	✓				✓			✓
Strike Warfare (STW)									
HARM missile exercise	W-386 (Air E, F, I, J)			✓	✓		✓		✓

TABLE 3.4-1
WARFARE AREAS AND ASSOCIATED AIR QUALITY ENVIRONMENTAL STRESSORS (Continued)

		Stressors				Location			
Warfare Area and Operation	**Training Areas**	**Surface Vessel Emissions**	**Helicopter Emissions**	**Fixed-Wing Aircraft Emissions**	**Ordnance or Target Emissions**	**Below 3,000 feet**	**Above 3,000 feet**	**Overland or < 12 nm from Shore**	**> 12 nm from Shore**
Amphibious Warfare (AMW)									
Firing exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (preferred areas), W-386 (5C/D) (secondary areas)	✓			✓	✓			✓
Electronic Combat (EC)									
Chaff exercise- aircraft	W-386, W-386 (Air-K), and W-72		✓	✓		✓	✓		✓
Chaff exercise- ship	W-386 and W-72	✓				✓			✓
Flare exercise- aircraft	W-386, W-386 (Air-K), and W-72		✓	✓	✓	✓			✓
Electronic combat (EC) operations- aircraft	W-386 (Air-K)			✓			✓		✓
EC operations- ship	VACAPES OPAREA	✓				✓			✓
Other Training									
Shipboard Electronic Systems Evaluation Facility (SESEF) utilization	VACAPES OPAREA	✓				✓		✓	

3.4.2 Affected Environment

Most of the VACAPES Range Complex assessed in this EIS/OEIS is offshore training sea space, undersea space, and special use airspace (SUA). For air quality purposes, most of area assessed consists of the 28,672 nm^2 of SUA located above the VACAPES OPAREA (W-50, W-386, W-72, W-387, and W-110). This vast area begins 3 nm from shore, where state waters end. Emissions in these offshore areas have the potential to mix with air above nearby cities and counties in Delaware, Maryland, Virginia, and North Carolina.

Other smaller areas assessed for air quality impacts in this EIS/OEIS include:

- The restricted airspace (R-6606) between Naval Air Station Oceana Dam Neck Annex and W-50; and
- An area at the mouth of the Chesapeake Bay north of Naval Amphibious Base (NAB) Little Creek and Naval Station Norfolk (420 nm^2).

Emissions in these areas will be analyzed for their potential to impact the air quality in adjacent Virginia localities.

3.4.2.1 Regional Climate

The climate of the region plays an important role in determining air quality. The VACAPES Range Complex climate is temperate. Because of the proximity to the coast, the humidity is generally high.

Figure 3.4-1 is a graph of wind speeds at Wallops Flight Facility (WFF) on the Virginia eastern shore. This area is adjacent to the VACAPES Range Complex and the data are representative for the range complex. As shown in the figure, the wind speed averages 8.7 miles per hour, but exceeds 10 mph in March and falls to 7 mph in July or August of the year. Because of its consistently strong winds, the area has been recognized for its potential for offshore wind energy production. Figure 3.4-1 also indicates the general wind direction over a year. Winter and spring months generally experience winds from a northwesterly direction. Summer and autumn winds are from a generally southerly direction. Because winds occur from these directions and at these speeds, air is moved out of the region, which improves the air quality of the region by continuously refreshing the resource.

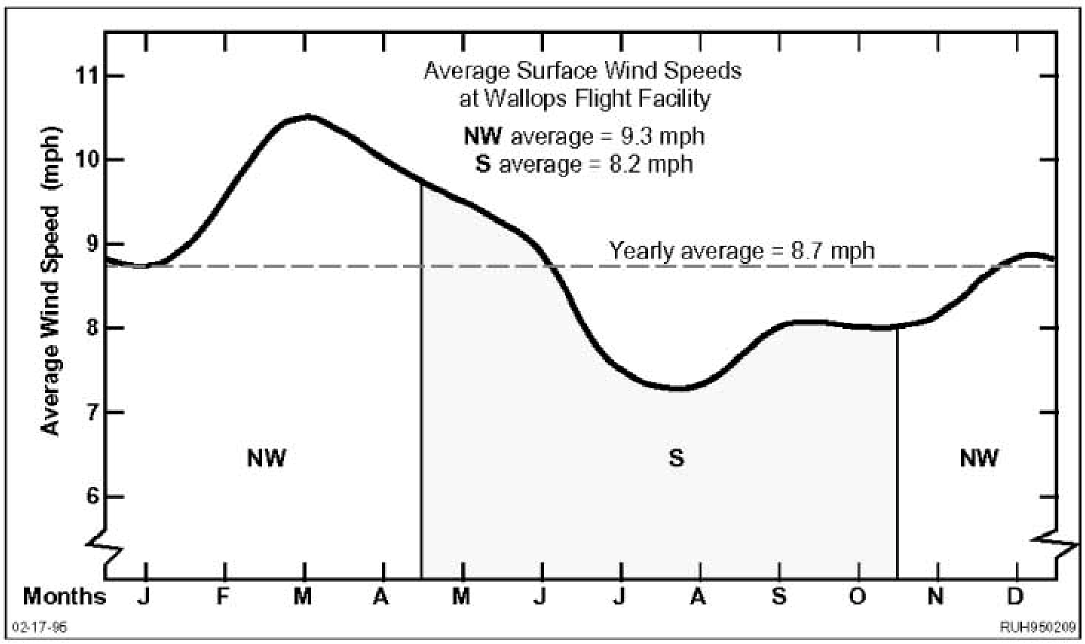


Figure 3.4-1 Regional Wind Direction and Wind Speed
Source: NASA 2003b

3.4.2.2 Delaware Air Quality

New Castle County is part of the Philadelphia-Wilmington, PA-NJ-DE Air Quality Control Region (AQCR). Kent County and Sussex County are part of the Southern Delaware Intrastate AQCR (40 CFR Part 80.178). Figure 3.2-4 shows the AQCRs in the vicinity of the VACAPES Range Complex.

The USEPA currently designates all three Delaware counties (Kent County, New Castle County, and Sussex County) as "nonattainment" for the 8-hour ozone standard. New Castle County is also a "nonattainment" area for suspended particulate matter with a diameter of 2.5 microns or less ($PM_{2.5}$).

Only Sussex County is close enough to the VACAPES Range Complex to be considered in this EIS/OEIS. Sussex County borders the northern tip of the VACAPES OPAREA and W-386 (sub-regions

Air-A and Air-B) scheduled by Fleet Area Control and Surveillance Facility (FACSFAC) VACAPES. Sussex County has been designated "in attainment," pursuant to 40 CFR Part 81.308, for all criteria pollutants except 8-hour ozone. Sussex County has been designated a "moderate nonattainment" area for 8-hour ozone.

Delaware currently operates 10 air monitoring sites around the state. These sites measure meteorology, ground-level concentrations of criteria pollutants, air toxics, and other research-oriented parameters.

3.4.2.3 Maryland Air Quality

The USEPA currently designates 11 cities/counties in Maryland as "nonattainment" for $PM_{2.5}$. These counties are Anne Arundel, Baltimore City, Baltimore, Carroll, Charles, Frederick, Harford, Howard, Montgomery, Prince Georges, and Washington (USEPA, 2007b). The large metropolitan areas of Maryland (Baltimore and Washington) are also "nonattainment" for the 8-hour ozone standard. The Baltimore metropolitan region, including the counties of Anne Arundel, Baltimore, Baltimore City, Carroll, Harford, and Howard, is in "moderate nonattainment" for 8-hour ozone. The Washington metropolitan region is designated as a "moderate nonattainment" area for 8-hour ozone by the USEPA. The Washington metropolitan region includes the Maryland counties of Calvert, Charles, Frederick, Montgomery, and Prince George's. Washington County, Maryland is designated as an Early Action Compact area.

None of the nonattainment areas are within the VACAPES Study Area, which is closest to the Maryland counties of Worchester, Wicomico, and Somerset. As shown in Figure 3.4-2, these counties are part of the Eastern Shore Intrastate AQCR. Each of these Maryland counties bordering the VACAPES Study Area has been designated as being "in attainment" for all criteria pollutants.

Maryland currently operates 24 air monitoring sites around the state and measures meteorology, ground-level concentrations of criteria pollutants, air toxics, and other research-oriented parameters (MDE, 2007). No monitoring stations are located in the Maryland counties nearest the VACAPES Study Area.

3.4.2.4 Virginia Air Quality

Portions of the VACAPES Study Areas are within the state of Virginia. These include R-6606 and nearshore areas proposed for Mine Warfare (MIW) training. Proposed MIW training areas are located within the Hampton Roads Intrastate AQCR, which consists of numerous counties and cites. These include the following cities and counties that are close to the VACAPES Study Area: Isle of Wight County, James City County, York County, City of Chesapeake, City of Hampton, City of Norfolk, City of Virginia Beach, City of Newport News, City of Poquoson, City of Williamsburg, City of Portsmouth, City of Hampton, and City of Suffolk. The Hampton Roads Intrastate AQCR has eight air quality monitoring sites.

Air quality in the Hampton Roads Intrastate AQCR has improved in recent years so that it now meets the federal air quality standard that protects people's health from ozone pollution (VDEQ, 2007). According to USEPA air quality records, the Hampton Roads Intrastate AQCR was in "marginal nonattainment" for 8-hour ozone during the years 2004, 2005, and 2006. This region was re-designated to "in attainment" as of July 1, 2007 (USEPA, 2007b). This re-designation to "in attainment" by the USEPA includes the agency's approval of an air quality maintenance plan submitted by the VDEQ that shows how the Hampton Roads Intrastate AQCR will keep ozone levels low through 2018.

The study area is also adjacent to the Virginia eastern shore counties of Northampton and Accomack, and to Matthews and Gloucester Counties on the western side of the Chesapeake Bay. As shown in Figure 3.4-2, these counties are part of the Northeastern Virginia Intrastate AQCR (40 CFR Part 81.144).

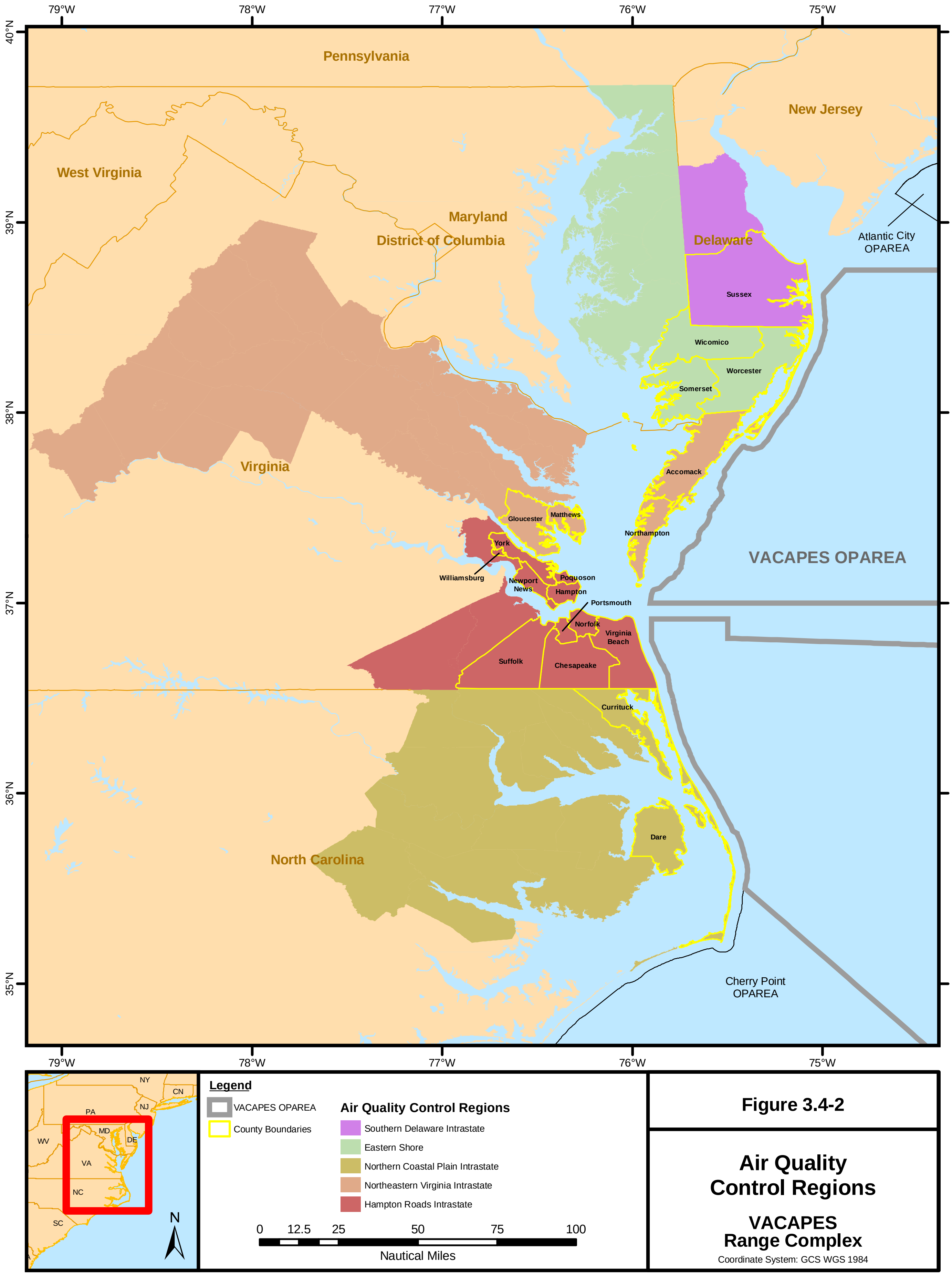


Figure 3.4-2

Air Quality Control Regions

VACAPES Range Complex

Coordinate System: GCS WGS 1984

These Virginia counties bordering the study area have been designated as “in attainment,” pursuant to 40 CFR Part 81.347, for all criteria pollutants.

3.4.2.5 North Carolina Air Quality

The VACAPES Study Area includes offshore waters adjacent to portions of North Carolina. The nearest North Carolina counties to the study area are Dare County and Currituck County. As shown in Figure 3.4-2, these counties are part of the Northern Coastal Plain Intrastate AQCR (40 CFR Part 81.149). Both of these North Carolina counties have been designated as being “in attainment,” pursuant to 40 CFR Part 81.334, for all criteria pollutants.

North Carolina has 122 air quality monitoring stations throughout the state (USEPA, 2007c). None are located in the counties bordering the study area.

3.4.3 Environmental Consequences:

The evaluation of potential air quality impacts includes two separate analyses.

- Effects of air pollutant emissions from VACAPES Range Complex operations occurring within U.S. territory (within 12 nm of the coastline) are assessed under NEPA.
- Effects of air pollutant emissions from VACAPES Range Complex operations occurring outside U.S. Territory are assessed under EO 12114.

For the NEPA analysis, all operations involving the use of aircraft and vessels at or below 3,000 feet in areas within U.S. territorial waters were included. This included, for example, operations within R-6606 and MIW operations at the mouth of the Chesapeake Bay. For the EO 12114 analysis, only those training operations that occur outside U.S. territorial waters at or below 3,000 feet were considered.

The NEPA analysis involved evaluating emissions generated from the proposed activities and assessing potential impacts on air quality, including an evaluation of potential exposures to toxic air pollutant emissions. Trace amounts of air toxics emissions would be generated from combustion sources and use of ordnance and include hazardous air pollutants not covered under the NAAQS. In particular, these would include rocket motor exhaust and unspent missile fuel vapors. These emissions would be minor and would not result in significant impacts because of the distance from humans that could be affected by air toxics and the low levels of emissions.

The NEPA analysis does not include a CAA General Conformity Rule determination because the Maryland and North Carolina AQCRs that are adjacent to the study area have all been designated “in attainment,” pursuant to 40 CFR 81.334, for all criteria pollutants. Furthermore, as explained in more detail later, a record of non-applicability (RONA) has been produced for air emissions bordering the states of Delaware and Hampton Roads, Virginia. The General Conformity Rule is satisfied by each of these determinations and a conformity determination is not otherwise necessary.

Surface Ship Emissions

Marine vessel traffic in the VACAPES OPAREA includes military ship and boat traffic, including support vessels providing services for military training exercises and tests. Numerous non-military commercial vessels and recreational vessels also are present within the VACAPES OPAREA. These vessels were not evaluated in the air quality analysis because they are not part of the Navy’s action.

Evaluating marine vessel emissions typically involves examining, for each type of vessel, its type of operation, number of hours of operation, type of propulsion engine, and type of generator used onboard. For Alternatives 1 and 2, operational estimates of future ship use percentages were obtained based on evolutionary changes in the Navy force structure and mission assignments. Where there were no major changes in types of ships, future operations estimates were based on the percentage distribution of historical operations. Detailed estimates of operations for baseline operations and future operations were obtained based on discussions with fleet subject matter experts (SME).

Because no time is spent by surface ships within a nonattainment AQCR, there was no need to investigate the time spent within particular locations, at what power level, or the path taken by vessels within the range complex.

As presented in Table 3.4-1, only a few training events, including mine neutralization and GUNEX (surface-to-surface) boat, primarily involve surface craft operations within 12 nm of the shoreline. Both events produce only minor amounts of small boat engine emissions off the coast of Virginia. Other training events may also have support craft involvement, such as target retrieval for MISSILEX (air-to-air) or MISSILEX (surface-to-air). These also would produce insignificant air quality impacts. Most Navy training events involving surface ships are projected to remain similar to the No Action Alternative under either action alternative. Associated ship engine emissions are, thus, expected to remain relatively constant among the alternatives.

Aircraft Emissions

Evaluating aircraft emissions involves evaluating, for each aircraft type, its type of operations, number of hours of operation, type of engine, and mode of operation. Aircraft emit the following CAA criteria pollutants: NO_x, CO, SO_2, and PM_{10}. They also emit volatile organic compounds (VOCs), which are precursors to the NAAQS criteria pollutant, ozone.

Emissions occurring above 3,000 feet are usually above the mixing layer, which is capped by the atmospheric inversion. Therefore, these emissions would not have any effect on local air quality. Flights by fixed-wing aircraft usually originate from onshore air stations, including Naval Air Station Oceana or Naval Air Station Patuxent River, but some originate from aircraft carriers offshore. It was assumed that all fixed-wing aircraft would be traveling from their home base to the VACAPES Range Complex SUA at an elevation above 3,000 feet, and that transit to and from the range would, therefore, not affect local air quality.

Fixed-wing fighter aircraft flights originating from the Naval Air Station Oceana (a primary user of the VACAPES Range Complex) were previously evaluated for air quality impacts in the final EIS for the introduction of the F/A-18 E/F Super Hornets to the east coast of the U.S. (DoN, 2003). According to that final EIS, the introduction of Super Hornet squadrons to Naval Air Station Oceana and transitioning of the Tomcat squadrons and some of the Hornet squadrons currently stationed there, would impact the station's total emissions under each of the siting alternatives. However, as noted in the final EIS, the projected annual emissions during the transition years (2000 through 2010) under Alternative 1 (the worst-case scenario with all 10 fleet squadrons and one fleet replacement squadron (FRS) located at Naval Air Station Oceana) would not be above the *de minimis* threshold defined in the General Conformity Rule. This final EIS is incorporated by reference into this VACAPES Range Complex EIS/OEIS.

Helicopter emissions were evaluated in the EA for the homebasing of the MH-60R/S on the east coast of the United States (DoN, 2002). The proposed action, described under Alternative 1 in the EA, would eventually result in an increase of 63 aircraft at Naval Station Norfolk. The time frame analyzed is similar to the time frame analyzed in this EIS/OEIS. Ozone and its precursor compounds NO_x and VOCs were of concern in the Homebasing EA because, as discussed in Section 3.4.2.4, the Hampton Roads Intrastate AQCR that includes this installation has only recently achieved an "in attainment" designation for ozone and must conform to an air quality maintenance plan. The results of the air emissions analysis in the EA, which are shown in Table 3.4-2, determined that air emission changes to both NO_x and VOC totals were below the *de minimis* thresholds of 100 tons per year (tpy) for impacts requiring evaluation under the General Conformity Rule. The EA included a RONA as an appendix. This EA is incorporated by reference into this VACAPES Range Complex EIS/OEIS and the conclusions are included in the RONA for this EIS/OEIS attached as Appendix L.

TABLE 3.4-2
AIR EMISSIONS ESTIMATES FOR MH-60S HOMEBASING AT NAVAL STATION NORFOLK [a/]

Net Change to Air Emissions at Naval Station Norfolk: 2002 to 2015					
Source	**VOC [b/]**	**NO_x**	**CO**	**SO_2**	**PM_{10}**
Helicopter operations	-7.98	34.72	29.07	2.26	20.61
Helicopter maintenance run-ups	-0.34	5.00	5.49	0.31	2.66
Total net change	-8.32	39.72	34.56	2.57	23.27

a/ Source: DoN 2002.
b/ VOC = Volatile organic compound; NO_x = nitrogen oxides; CO = carbon monoxide; SO_2 = sulfur dioxide; PM_{10} = Particulate matter (diameter of 10 microns or less).

The foregoing two environmental studies are mentioned here because they account for most of the Navy aircraft operating in the VACAPES Range Complex[7].

MH-60S aircraft typically conduct their training events closer to shore than fixed-wing aircraft. This is shown in Table 3.4-1. Many of the increased training events evaluated in this EIS/OEIS, including MCM, mine neutralization, GUNEX (air-to-surface), and MISSILEX (air-to-surface), are conducted by the MH-60S. These events will be conducted off the coast of Maryland, Virginia, and North Carolina. The *de minimis* emission levels mentioned in the 2002 EA, coupled with the current attainment status of the adjacent AQCRs, result in the conclusion of no significant impact on air quality.

Fixed-wing aircraft primarily conduct training operations in areas of the VACAPES Range Complex beyond the 12 nm U.S. territorial limits. Air quality may be temporarily affected in locations where a high number of aircraft simultaneously engage in practice operations, but such consequence would be of limited duration and emissions would quickly disperse. Significant impacts to air quality beyond the U.S. territorial limits also are not expected because of the high altitude of fixed-wing training operations (above 3,000 feet). Such high-altitude aircraft emissions are associated with training events, including: ACM, MISSILEX (air-to-air), GUNEX (air-to-air), MISSILEX (air-to-surface), and BOMBEX (air-to-surface).

Commercial air services (CAS) aircraft participate in Electronic Combat (EC), Air Intercept Control (AIC), GUNEX (S-A), GUNEX (A-A), and Detect-to-Engage (DTE) training events. CAS aircraft will be operated primarily above the 3,000 foot atmospheric inversion layer. Emissions from CAS aircraft are similar to Navy fixed-wing aircraft. As mentioned in Chapter 2, CAS aircraft displace Navy fixed-wing aircraft used in such CAS supported events and thus do not add to overall event emissions.

Aircraft operating in the VACAPES Range Complex SUA generally have reciprocating, turboprop, or jet engines. Most of these aircraft use JP-5 or JP-8 as a standard fuel. Emissions of concern are primarily hydrocarbons that disperse readily in the atmosphere. A portion of those emissions may be VOCs, which can be associated with the generation of ground-level ozone. However, the volume of aircraft operations in the VACAPES Range Complex SUA is relatively small, and adjacent areas of Maryland, Virginia, and North Carolina are “in attainment” areas for ozone. Therefore, emissions related to aircraft training

[7] The United States Air Force (USAF) also uses the VACAPES Range Complex SUA. The USAF evaluated their use of the VACAPES SUA in an EIS for the F-22 beddown at Langley AFB, Virginia and concluded that USAF aircraft impacts to air quality would not be significant (USAF, 2001).

activities in the VACAPES Range Complex SUA are not anticipated to have an adverse impact on the study area environment.

The northernmost SUA in the VACAPES Range Complex borders on the state of Delaware. As mentioned earlier, Sussex County, Delaware is “nonattainment” for the 8-hour ozone standard. Therefore, unlike in Maryland and North Carolina, the General Conformity Rule applies. The required conformity review is satisfied, however, by a RONA, which is attached to this EIS/OEIS in Appendix L.

As explained in the RONA, the Navy conducts test track flights in W-386 areas Air-A and Air-B, adjoining Sussex County, Delaware (Casey, 2007). These flights are conducted at altitudes greater than 6,000 feet above mean sea level (Casey, 2007). According to USEPA guidelines, emissions released into the atmosphere above the inversion base for pollutant containment, commonly referred to as the “mixing height” (generally 3,000 feet above ground level), do not have an effect on pollution concentrations at ground level (USEPA, 1992). Furthermore, Navy training and testing within W-386 areas Air-A and Air-B are not expected to increase under the proposed action. Therefore, as stated in the RONA, the proposed Navy training and testing in the VACAPES Range Complex conforms to the Delaware SIP.

The USAF recently calculated the aircraft emissions for the offshore SUA that would be expected in 2007. Table 3.4-3 presents the estimated 2007 emissions data for the three most frequently used VACAPES warning areas, W-72, W-386, and W-387. The estimates include commercial, U.S. Coast Guard (USCG), USAF, and Navy aircraft emissions as the airspace is utilized by multiple entities.

TABLE 3.4-3
ESTIMATED AIRCRAFT EMISSIONS IN 2007
WITHIN THE OFFSHORE VACAPES SPECIAL USE AIRSPACE

Aircraft	Annual Sorties	% Time below Mixing Height	Approximate Emissions (tons per year)				
			CO [b/]	VOCs	NO_x	SO_2	PM_{10}
W-72 Sorties							
Commercial (B737)	947	0	0	0	0	0	0
USCG [c/] (assume C-130)	79	80	0.66	0.13	3.56	0.01	0.25
KC-130	4	80	0.03	0.006	0.18	.0007	0.01
Adversary (assume F-18)	2,287	17	2.23	0.18	38.9	0.07	1.08
F-18	13,277	17	12.9	1.03	226	0.40	6.3
F-14	9,296	11	7.94	0.34	63	0.17	1.11
F-16	758	17	0.12	0.10	10.8	0.02	0.04
F-22	3,706	5	0.77	0.29	31.2	0.05	0.11
P-3	2,975	80	12.4	2.38	67.1	0.25	4.78
Total	33,329	----	37.0	4.4	440.1	1.0	13.7
W-387 Sorties							
Commercial (B737)	131	0	0	0	0	0	0
USCG (assume C-130)	9	80	0.04	0.0007	0.20	0.0007	0.01
F-18	116	17	0.08	0.006	1.31	0.002	0.04
F-14	270	11	0.15	0.007	1.22	0.003	0.02
F-16	116	17	0.01	0.01	1.11	0.002	0.004
F-22	430	0	0	0	0	0	0
P-3	131	17	0.08	0.01	0.42	0.002	0.03
Total	1,203	----	0.4	0.03	4.3	0.01	0.1

TABLE 3.4-3
ESTIMATED AIRCRAFT EMISSIONS IN 2007
WITHIN THE OFFSHORE VACAPES SPECIAL USE AIRSPACE (Continued)

Aircraft	Annual Sorties	% Time below Mixing Height	Approximate Emissions (tons per year)				
			CO [b/]	VOCs	NO_x	SO_2	PM_{10}
W-386 Sorties							
Commercial (B737)	951	0	0	0	0	0	0
USCG (assume C-130)	43	80	0.36	0.07	1.94	0.0007	0.14
F-18	865	17	0.98	0.08	17.1	0.03	0.48
F-14	1,990	11	1.98	0.08	15.7	0.04	0.28
F-16	847	17	0.16	0.13	14.1	0.02	0.05
F-22	5,512	5	1.33	0.50	54.1	0.08	0.18
P-3	979	17	1.01	0.19	5.47	0.02	0.39
Total	11,187	----	5.8	1.0	108.4	0.2	1.5

a/ Source: USAF, 2001.
b/ VOC = CO = Carbon monoxide; volatile organic compound; NO_x = nitrogen oxides; SO_2 = sulfur dioxide; PM_{10} = Particulate matter (diameter of 10 microns or less).
c/ USCG = United States Coast Guard.

As shown in the table, sortie operations in the VACAPES Range Complex Warning Areas are predominantly above the mixing layer, and associated emissions within the mixing layer are low. Emission concentrations associated with aircraft operations are minimal, considering the large size of the airspace units. Because these emissions are dispersed over more than 24 million acres of SUA, they do not measurably affect air quality. Thus, impacts to the air quality of the global commons is not expected.

Emissions from Weapons and Explosives

Other common chemical emissions associated with Navy training are explosive compounds and oxidation products. Oxides of carbon, nitrogen, and water are formed during this process, which reduces the likelihood of parent chemicals (trinitrotoluene [TNT] and cyclonite [RDX]) entering surrounding environments. Other nitroaromatic compounds such as octogen (HMX), tetryl, and picric acid (used in fuzes and primers) produce the same reactions.

Practice ordnance does not carry an explosive charge; it carries only a smoke or marking charge and, thus, the incidence of emission particles is negligible (DoN, 2007). The detonation of the marking charge or of the explosive bomb consumes approximately 98 to 99 percent of the explosive component. The one to two percent of explosive component not consumed is generally dispersed, with most falling to the water in the immediate vicinity of the blast and the balance being dispersed in the air, where it is subject to dilution by wind currents and weather conditions.

Many of the smokes and fumes given off by pyrotechnics and screening devices are nontoxic and only mildly irritating to the eyes and nasal passages when encountered in relatively light concentrations out-of-doors. However, heavy concentrations in closely confined spaces are dangerous and may be lethal because they reduce the amount of oxygen in the air (NAVSEA, 1996). Because smoke floats and flares are used infrequently, out-of-doors, and at great distances from land, associated air emissions would be non-toxic to residents in the VACAPES Range Complex.

Air emissions from an Army Hellfire missile launch, helicopter motor combustion, and warhead detonation were calculated in the *Life Cycle Environmental Assessment for Hellfire Modular Missile System, August 1994* (Department of the Army, 1994). The highest percentage (by weight) of motor combustion and warhead detonation products consists of nitrogen, water, carbon dioxide, carbon monoxide, elemental carbon, and ammonia at totals between 95 percent (motor combustion) to 99.51 percent (warhead detonation). Air emissions that make up the additional 0.49 percent to 4.1 percent are from aluminum oxide, lead, hydrogen cyanide, ethane, hydrogen, and methane. Because of the low concentrations and rapid dispersal of Hellfire combustion and detonation products, it was determined that Hellfire testing would have no significant impact on air quality (Department of the Army, 1994). Other missiles used in the VACAPES Range Complex are expected to have similarly negligible impacts on regional air quality.

Underwater detonations (UNDET) associated with EOD mine neutralization training utilize C4, which consists of RDX plus a small amount of polyisobutylene binder. The principal explosive byproducts are water, carbon dioxide, carbon monoxide, nitrogen, and hydrogen. Underwater explosions create a cavity filled with high-pressure gas, which pushes the water out radially against the opposing external hydrostatic pressure. At the instant of explosion, a certain amount of gas is instantaneously generated at high pressure and temperature, creating a bubble. In addition, the heat causes a certain amount of water to vaporize, adding to the volume of the bubble. This action immediately begins to force the water in contact with the blast front in an outward direction. It is estimated that 90 percent of the gaseous explosion products would become airborne (DoN, 2001). Airborne explosion products are assumed to stabilize in a spherical form and move downwind, with concentrations remaining for the first 100 feet. This "cloud" would not be visible. Then, the airborne cloud would continue to move at the speed of the wind and become diluted and dispersed by atmospheric turbulence (DoN, 2001). The UNDET explosive byproducts are not expected to significantly impact the regional air quality. The proposed new mine neutralization systems, including the Airborne Mine Neutralization System (AMNS) and Rapid Airborne Mine Clearance System (RAMICS), do not have air emissions associated with their use, other than the helicopter platforms used to deploy them.

The WFF launches between five and ten BQM-34 and the same number of BQM-74 drone targets per year (NASA, 2005). WFF also launches approximately 20 AQM-37 (Coyote) drone targets per year (NASA, 2005). The AQM-37 launches were assessed by NASA in the *Final Environmental Assessment for AQM-37 Operations at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility* (NASA, 2003a). VC-6 launches approximately 50 BQM-74 drone targets per year from the Naval Air Station Oceana Dam Neck Annex. Combustion products from AQM-37, BQM-74, and BQM-34 target launches are predominantly aluminum oxide, carbon monoxide, hydrogen chloride, water, nitrogen, carbon dioxide, and hydrogen (NASA, 2003a). Table 3.4-4 details the air quality guidelines for exposure to these products. The combustion of fuel and self-contained oxidizers produces emissions in accordance with National Institute for Occupational Safety and Health (NIOSH) guidelines. Under normal launch conditions, these emissions are distributed along the flight vehicle trajectory.

TABLE 3.4-4
AIR QUALITY GUIDELINES FOR EXPOSURE TO ROCKET EXHAUST [A/]

Combustion Product	CAS No. [b/]	TWA mg/m³	Ceiling mg/m³	PEL mg/m³
Aluminum oxide (as aluminum)	1344-28-1	-	-	15 (total)
Chlorine	7782-50-5	-	1.45	3
Hydrochloric acid	7647-01-0	-	7	7
Lead, inorganic dusts and fumes (as lead)	7439-92-1	0.050	-	0.050

a/ Source: NASA, 2003a.
b/ Abbreviations: CAS No. = Chemical Abstract System number; TWA = time-weighted average; Ceiling = Ceiling Limit; PEL = Permissible Exposure Limit; mg/m^3 = Milligrams per cubic meter.

The air quality impacts of chaff were evaluated by the USAF in *Environmental Effects of Self-Protection Chaff and Flares* (USAF, 1997). The study concluded that most chaff fibers maintain their integrity after ejection. Although some fibers are likely to fracture during ejection, it appears that this does not result in the release of particulate matter. Although not significant, tests indicated that the explosive charge in the impulse cartridge results in minimal releases of particulate matter. Therefore, it appears that chaff deployment would not result in an exceedence of the NAAQS (USAF, 1997). Chaff exercises in the VACAPES Range Complex are conducted relatively infrequently, and they are always conducted beyond 12 nm from shore. These conditions further reduce any potential for impacts to NAAQS.

The volume of emissions from ordnance and explosives has a minimal impact on regional air quality. In conformance with NEPA evaluation procedures, no significant impact is expected to the regional air quality and, under EO 12114, no significant harm is expected to the air quality of the global commons.

3.4.3.1 No Action Alternative

The No Action Alternative consists of maintaining the current levels of training and testing in the VACAPES Range Complex. Thus, there would be no change in current levels of emissions associated with training or testing operations.

The primary source of air emissions under the No Action Alternative is fixed-wing aircraft emissions. These emissions are primarily associated with ACM and EC training sorties. These sorties occur above 3,000 feet in altitude and beyond 12 nm from shore. Emissions are dispersed over the vast expanse of SUA airspace. Because of these factors, such emission would not have a discernable effect on study area air quality.

The cities and counties in Maryland and North Carolina adjoining the range complex are currently designated “in attainment” for all criteria pollutants. This reflects good regional air quality. Included within this characterization of regional air quality are the existing emissions from Navy aircraft, surface ship, target, and weapons. A continuation of baseline training and testing levels adjacent to the coastal counties in Maryland and North Carolina would not be subject to the General Conformity Rule because the training occurs in or adjacent to locations designated as attainment areas for all criteria pollutants.

Training and testing adjacent to Sussex County, Delaware (a nonattainment area) occurs above 6,000 feet and would not affect pollutant concentrations at the ground level. A RONA is included in Appendix L. Therefore, there would be no significant impact to air quality from implementing the No Action Alternative.

Training and testing adjacent to Hampton Roads, Virginia cities and counties (attainment area with a maintenance plan) is conducted primarily by the MH-60S helicopters. The 2002 Homebasing EA for the MH-60S helicopter thoroughly examined the air quality impacts associated with the helicopter emissions through 2015 (DoN, 2002). The EA concluded that emissions were below *de minimis* levels for impacts requiring evaluation under the General Conformity Rule and a RONA was included with the EA. This same conclusion is reiterated here in Appendix L. Therefore, there would be no significant impact to air quality from implementing the No Action Alternative.

The offshore reaches of the VACAPES OPAREA (beyond 12 nm) are not classified for priority pollutants under the CAA. Therefore, a CAA general conformity review is not applicable. Initial concentrations of air emissions over the ocean would disperse rapidly in the atmosphere. Because of the low initial concentrations and rapid dispersion of exhaust and explosion byproducts, there would not be any risk to human health and welfare. Therefore, there would be no significant impacts (NEPA) and no significant harm (EO 12114) to air quality from implementing the No Action Alternative.

3.4.3.2 Alternative 1

Under Alternative 1, there would be a minor increase in air pollutant emissions within the study area. The CAA General Conformity Rule would not apply to the actions conducted in the study area offshore from Maryland or North Carolina (those areas within the 3-nm jurisdiction of the CAA), because the counties in these states are designated “in attainment” for all criteria pollutants. Flights located in W-386 near

Delaware (where counties are designated "nonattainment" for the 8-hour ozone standard) would occur above 6,000 feet and would not affect pollutant concentrations at the ground level. Expected increases in helicopter emissions associated with MH-60S helicopter training were determined to be below *de minimis* levels for impacts requiring evaluation under the General Conformity Rule.

The air quality impacts from surge level operations would be primarily from aircraft, target and missile emissions, and associated mobile source emissions from support craft. These impacts would be minor, dispersed, and short-term in nature. Most of these training events would take place above 3,000 feet. Air emissions above 3,000 feet are not addressed in accordance with USEPA guidance (USEPA, 1992). Most of the training events also would occur beyond 12 nm from shore, which would substantially reduce the likelihood that any of the associated emissions would mix with over-land airsheds.

CAS usage would increase under Alternative 1 over current levels. Ninety-three additional sorties are proposed in connection with CAS supported events (i.e., EC, AIC, DTE, and GUNEX (S-A) and GUNEX (A-A)) under Alternative 1. CAS supported events would occur primarily above 3,000 feet and more than 12 nm from the shore. Thus, no significant impacts to air quality are expected from CAS flights or CAS supported events.

Under Alternative 1, there would most notably be an increase in helicopter operations associated with the siting of MH-60S at Naval Station Norfolk. Training events involving these helicopters include MCM, mine neutralization, GUNEX (air-to-surface), MISSILEX (air-to-surface), laser targeting, chaff exercise, and flare exercises. Although these particular training events were not analyzed in the MH-60R/S Homebasing EA (DoN, 2002), the air emissions of the helicopters were thoroughly evaluated in that EA, which is incorporated here by reference.

According to the Homebasing EA, the addition of air emissions under the proposed action in the Homebasing EA were below the *de minimis* thresholds of 100 tpy for NO_x and VOCs, as required in the SIP for Naval Station Norfolk. The MH-60 R/S Homebasing EA concluded that the proposed action (to base all MH-60S helicopters at Naval Station Norfolk) was exempt from the requirement conformity analysis under the General Conformity Rule and was presumed to conform to the Virginia SIP. At the time of this Homebasing EA, the Hampton Roads Intrastate AQCR in Virginia was under a maintenance plan for the control of ozone through the control of the ozone precursor compounds, NO_x and VOCs. As of July 2007, the Hampton Roads AQCR has been designated "in attainment" for all criteria pollutants. Despite the re-designation, it still has an 8-hour ozone maintenance plan, which supersedes the earlier 1-hour ozone plan. A RONA is included in Appendix L.

Other VACAPES Range Complex training events evaluated under Alternative 1 are expected to increase moderately. Such events include surface ship emissions in connection with GUNEX (surface-to-surface), GUNEX (surface-to-air), chaff exercises, and EC. These events would occur infrequently, and typically would be more than 12 nm from shore. In an EO 12114 evaluation, surface ship emissions and associated ordnance emissions are not expected to measurably impact the air quality of the global commons.

Under Alternative 1, fixed-wing aircraft emissions are expected to increase in SUA outside the nation's territorial limits. The associated events include EC, ACM, laser targeting, BOMBEX (air-to-surface), MISSILEX (air-to-air), and GUNEX (air-to-air). These events would occur above the mixing layer and would not affect study area air quality.

In conclusion, the actions evaluated under Alternative 1 would not result in detectable changes to air quality. This would occur because the emission-producing activities associated with this alternative generally take place within:

- Areas designated "in attainment" (Maryland, North Carolina, and Virginia Eastern Shore) for all criteria pollutants and, therefore, where the CAA General Conformity Rule does not apply.

- An area designated "in attainment" with a maintenance plan (Hampton Roads, Virginia AQCR) for all criteria pollutants, but would involve helicopter emissions determined to be below *de minimis* levels for impacts requiring evaluation under the General Conformity Rule. Pursuant to this conformity review, a RONA has been drafted and is included with this EIS/OEIS.
- An area designated "nonattainment" (Delaware) for 8-hour ozone, but would involve the production of no additional emissions above No Action Alternative levels, and no emissions that would mix with ground-level concentrations. Pursuant to this conformity review, a RONA has been drafted and is included with this EIS/OEIS.
- Offshore areas unclassified for priority pollutants, where surface ship emissions are minimal and fixed-wing aircraft typically produce emissions above the mixing layer.

Therefore, under NEPA, there would be no significant impact to air quality from implementing Alternative 1. Under EO 12114, there would be no significant harm to the air quality over non-territorial waters from implementing Alternative 1.

3.4.3.3 Alternative 2 –(Preferred Alternative)

Under Alternative 2, there would be a minor increase in air pollutants within the EIS/OEIS study area over No Action Alternative levels. Emissions expectations under Alternative 2 would be nearly identical to those under Alternative 1. For example, CAS flights and CAS supported events would have the same emissions under Alternative 2 and stated in Alternative 1. However, under Alternative 2, there would be a further slight increase in helicopter emissions associated with new system MCM and mine neutralization training. Approximately 50 additional helicopter flights would take place each year under Alternative 2 versus Alternative 1. The associated helicopter emissions would take place within or adjacent to attainment areas off the coast of Virginia. These emissions impacts would be minor, dispersed, and short-term in nature.

MH-60S emissions have been shown to have an insignificant impact on regional air quality (DoN, 2002). The small increase in annual helicopter emissions under Alternative 2 would be offset by a reduction in the amount of fixed-wing aircraft emissions associated with BOMBEX (air-to-surface) training. Under Alternative 2, there would be approximately 60 fewer BOMBEX (air-to-surface) events (roughly 120 sorties) per year than No Action Alternative levels.

As with Alternative 1, the emission-producing activities evaluated under Alternative 2 take place within:

- Areas designated "in attainment" (Maryland, North Carolina, and Virginia Eastern Shore) for all criteria pollutants and, therefore, where the CAA General Conformity Rule does not apply.
- An area designated "in attainment" with a maintenance plan (Hampton Roads, Virginia AQCR) for all criteria pollutants, but would involve helicopter emissions determined to be below *de minimis* levels for impacts requiring evaluation under the General Conformity Rule. Pursuant to this conformity review, a RONA has been drafted and is included with this EIS/OEIS.
- An area designated "nonattainment" (Delaware) for 8-hour ozone, but would involve the production of no additional emissions above No Action Alternative levels, and no emissions that would mix with ground-level concentrations. Pursuant to this conformity review, a RONA has been drafted and is included with this EIS/OEIS.
- Offshore areas unclassified for priority pollutants, where surface ship emissions are minimal and fixed-wing aircraft typically produce emissions above the mixing layer.

Therefore, under NEPA, there would be no significant impact to air quality from implementing Alternative 2. Under EO 12114, there would be no significant harm to the air quality over non-territorial waters from implementing Alternative 2.

3.4.4 Unavoidable Significant Environmental Effects

Under either action alternative, the participation of additional helicopter and fixed-wing aircraft in Navy training within the VACAPES Range Complex would result in minor, short-term effects, such as minor increases of aircraft air emissions within the airsheds. However, they would not result in any unavoidable significant environmental effects.

3.4.5 Summary of Environmental Effects (NEPA and EO 12114)

Activities associated with implementation of Alternatives 1 and 2 would result in increases in air emissions above No Action Alternative conditions. Within U.S. territory, emission increases mainly would be associated with increased engine operations of MH-60S helicopters, small boats, and range support craft. Outside U.S. territory, emission increases primarily would be associated with increased operations of surface vessels and fixed-wing aircraft. Although Alternatives 1 and 2 would result in increases in emissions of air pollutants, all air impacts would be less than significant in scope and intensity for the following reasons.

- All training and testing events associated with the action alternatives within or adjacent to Maryland, North Carolina and Virginia Eastern Shore counties would occur in areas designated by the USEPA as “in attainment” for all criteria pollutants. Therefore, the General Conformity Rule would not apply.
- All training and testing events associated with the action alternatives within or adjacent to Delaware would occur within areas designated by the USEPA as “nonattainment” areas for the 8-hour ozone standard. However, because test track flights would occur above 6,000 feet, aircraft emissions would not affect pollutant concentrations at ground level. A RONA is included with this EIS/OEIS.
- Most training event types and operations or sorties would occur more than 12 nm from the shore, and would not affect the air quality for human receptors.
- Most aircraft training emissions would occur above 3,000 feet, which is above the atmospheric inversion layer. As a result, they would not affect local air quality.
- MH-60S emissions associated with the homebasing of the aircraft at Naval Station Norfolk were evaluated in an EA (DoN, 2002) and were determined to be below *de minimis* levels. These operations are applicable to actions occurring within the Hampton Roads, Virginia AQCR.
- F/A-18 E/F emissions associated with the homebasing of the aircraft at Naval Air Station Oceana were evaluated in a final EIS (DoN, 2003) and were determined to be below *de minimis* levels.

As shown in Table 3.4-5, implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in significant impacts to regional air quality. Implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in significant harm to the air quality of the global commons.

TABLE 3.4-5
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON AIR QUALITY IN THE VACAPES EIS/OEIS STUDY AREA

Alternative and Stressor	Summary of Effects and Impact Conclusion	
	NEPA (Territorial Waters, 0 to 12 nm)	Executive Order 12114 (Non-Territorial Waters, >12 nm)
No Action		
Surface ship emissions	Minor localized emissions.	Minor at-sea emissions. No long-term harm to the global commons.
Helicopter emissions	Minor localized emissions. Coastal counties in MD and NC are “in attainment” for all criteria pollutants. RONA for Hampton Roads AQCR.	Minor at-sea emissions. No long-term harm to the global commons.
Fixed-wing aircraft emissions	Minor localized emissions. Coastal counties in MD and NC are “in attainment” for all criteria pollutants. RONA for DE.	Minor at-sea emissions. No long-term harm to the global commons.
Weapon and target emissions	Negligible impacts.	Negligible harm to the global commons.
Impact conclusion	No significant impacts to study area air quality.	No significant harm to study area air quality.
Alternative 1		
Surface ship emissions	Minor localized emissions.	Minor at-sea emissions. No long-term harm to the global commons.
Helicopter emissions	Minor localized emissions. Coastal counties in MD and NC are “in attainment” for all criteria pollutants. RONA for Hampton Roads AQCR.	Minor at-sea emissions. No long-term harm to the global commons.
Fixed-wing aircraft emissions	Minor localized emissions. Coastal counties in MD and NC are “in attainment” for all criteria pollutants. RONA for DE.	Minor at-sea emissions. No long-term harm to the global commons.
Weapon and target emissions	Negligible impacts.	Negligible harm to the global commons.
Impact conclusion	No significant impacts to study area air quality.	No significant harm to study area air quality.
Alternative 2		
Surface ship emissions	Minor localized emissions.	Minor at-sea emissions. No long-term harm to the global commons.
Helicopter emissions	Minor localized emissions. Coastal counties in MD and NC are “in attainment” for all criteria pollutants. RONA for Hampton Roads AQCR.	Minor at-sea emissions. No long-term harm to the global commons.
Fixed-wing aircraft emissions	Minor localized emissions. Coastal counties in MD and NC are “in attainment” for all criteria pollutants. RONA for DE.	Minor at-sea emissions. No long-term harm to the global commons.
Weapon and target emissions	Negligible impacts.	Negligible harm to the global commons.
Impact conclusion	No significant impacts to study area air quality.	No significant harm to study area air quality.

3.5 AIRBORNE NOISE ENVIRONMENT

3.5.1 Introduction and Methods

Sound is a physical phenomenon and a form of energy that can be described, measured, and represented with mathematical expressions. Noise, on the other hand, is not a physical process, but rather an implicit social value, defined generally as unwanted sound. Recognition of sound is based on the receptor's objective and reproducible response to sound's primary physical attributes: intensity (perceived by the receptor as loudness), frequency (perceived as pitch), frequency distribution and variation over time, and duration (whether continuous, sporadic, or impulse). Perception of sound, however, is subjective and circumstantial. Sounds that are soothing to some are annoying to others, and sounds barely noticed and generally ignored in one circumstance, may be considered highly objectionable in another circumstance.

Beyond subjective effects, however, sound at higher intensities or power levels can have physical consequences. The range of such impacts have been defined as falling into three categories as sound pressure levels increase: subjective effects (*e.g.*, annoyance, nuisance, dissatisfaction), interferences with activities (*e.g.*, communication, sleep, learning, behavioral changes), and physiological effects (*e.g.*, anxiety, hearing impacts, loss of hearing).

The analysis presented in this section is limited to impacts resulting from airborne noise. Impacts of military-generated underwater sound on natural resources are addressed in Sections 3.6 (Marine Communities), 3.7 (Marine Mammals), 3.8 (Sea Turtles), 3.9 (Fish), and 3.10 (Seabirds and Migratory Birds).

3.5.1.1 Sound Characteristics

Sound Fundamentals

Sound is typically described by its magnitude (otherwise referred to as amplitude), intensity, and frequency and the changes in those values over time (*e.g.*, sudden impulse vs. continuous vs. repetitive). The physical phenomenon of sound is generated by mechanical vibrations traveling through an elastic medium (*i.e.* air or water), resulting in a rapid change in pressure (high and low pressure fluctuations or waves) in the medium.

Sound waves are characterized by parameters such as amplitude, intensity, wavelength, frequency, and velocity. The amount of energy contained in a sound pressure wave is referred to as its amplitude, while the amount of energy passing through a unit area per unit of time is the sound wave's intensity. The units of sound intensity are watts per square meter (energy per unit of time per unit of area). Amplitude and intensity are directly and linearly related. Higher amplitude sounds are perceived to be louder than lower amplitude sounds. Sound pressures are usually represented in Pascals (Pa.). A Pascal is equal to one Newton of force distributed over one square meter. The maximum noise pressure level of a noise event is referred to as the "peak noise level."

The frequency of sound represents the rate at which the source produces sound waves (a complete cycle of high and low pressure waves) or the rate at which the sound-producing body completes one vibration cycle. Frequency is a precisely measurable quantity representative of a particular sound. Sounds are produced throughout a wide range of frequencies, including frequencies beyond the audible range of a given receptor. Most of the sounds we hear in the environment do not consist of a single frequency, but rather a broad band of frequencies differing in sound level. The intensities of each frequency add to generate the sound we hear.

The speed of sound is not affected by its intensity, amplitude, or frequency, but rather is dependent wholly on the characteristics of the medium through which it is passing. Sound generally travels faster as the density of the medium increases. Speed of sounds through air are primarily influenced by air temperature, and negligibly by the air's relative humidity and pressure, averaging about 1,115 ft/s (340 m/s) at standard barometric pressure. Sound speeds in air increase as air temperature increases. Speed of sounds in liquid is similarly influenced primarily by the liquid's density and temperature. Thus, the speed of sound in 0ºC (32ºF) water is 4,600 ft/s (1402 m/s) and in 20ºC (68ºF) water is 4,862 ft/s (1533 m/s).

The speed of sounds in solids is a more complex matter, with longitudinal and transverse waves traveling at different speeds depending on the density of the material as well as its geometry and molecular structure.

The mathematical relationship between sound stimulus and sound perception by a receptor is logarithmic. This logarithmic relationship between magnitude and perception is the basis for the decibel (dB) scale used to express sound intensity. The decibel scale measures relative sound intensities rather than absolute intensities; specifically, it measures the ratio of a given intensity (of sound) to the threshold sound intensity of human hearing (by definition 0 dB). For most human individuals, a sound wave pressure of 20 micro Pascals (μPa) represents the hearing threshold. As sound stimuli increases geometrically (*i.e.*, multiplied by a fixed factor), the corresponding perception changes arithmetically (*i.e.*, additive by constant amounts). Thus, a tenfold increase in sound stimulus over the threshold of hearing is assigned a value of 10 dB but is perceived as a doubling of loudness; a hundredfold increase to 20 dB is perceived as sound that is four times louder, and so forth.

Although sound is a physical phenomenon that can be represented by mathematical expressions and measured with precision, perception of sound pressure levels (SPL) is the result of physiological responses as well as subjective factors, each influenced by current circumstances and past exposures. The SPL is the perception of a sound wave's pressure by a single receptor at a specified distance and direction from the sound source.

SPLs are measured by sound level meters, which typically contain filters that reduce the meter's sensitivity to frequencies of little or no relevance to the receptor. The method commonly used to quantify environmental sounds consists of determining all the frequencies according to a weighting system that reflects the nonlinear response characteristics of the human ear. A meter that filters very low and very high frequency sounds thus acts as a general approximation of the human ear's response to sounds of medium intensity. This is called "A" weighting, and the decibel level measured is called the A-weighted sound level (dBA). In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA curve.

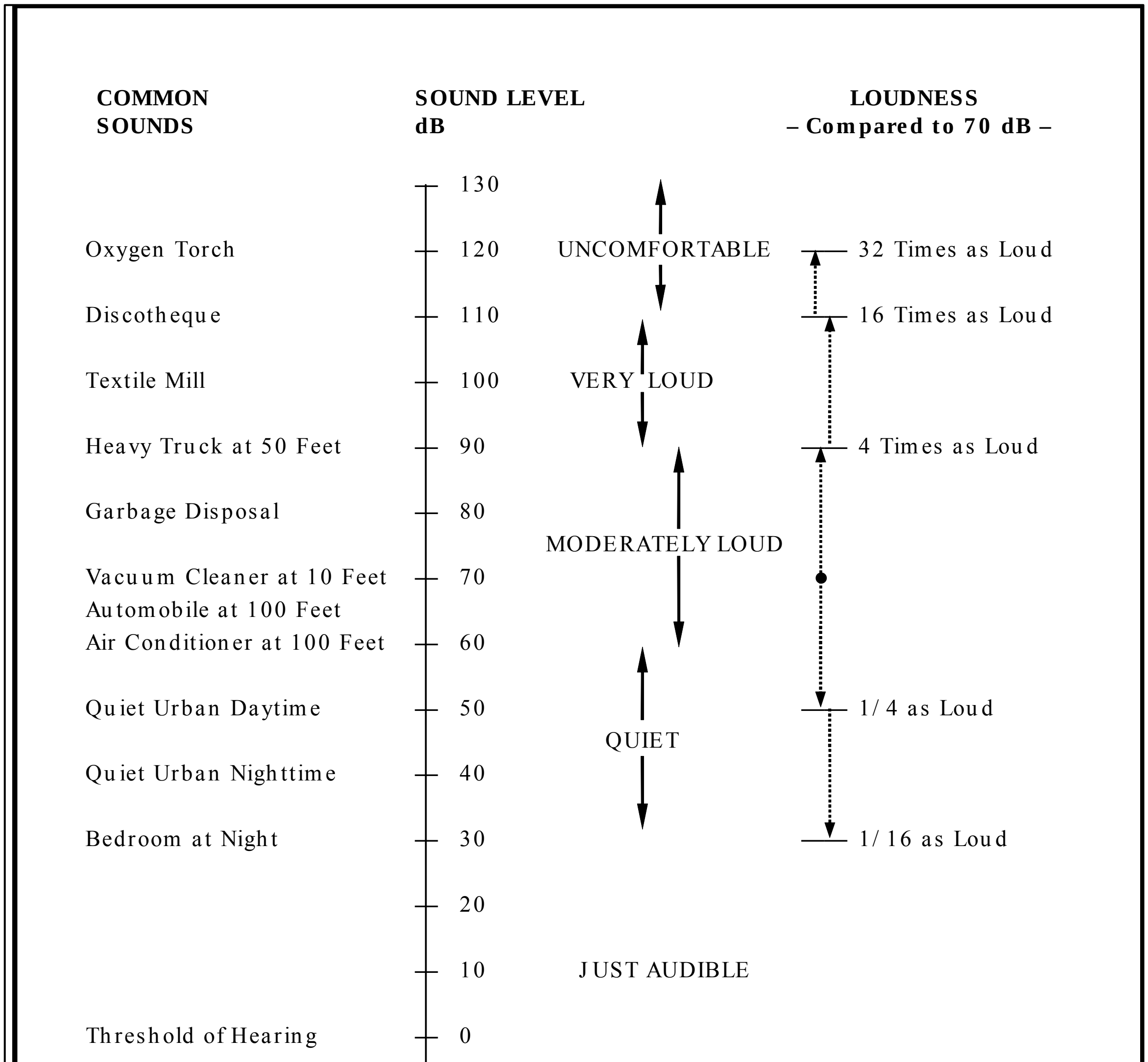
Sound meters also can be used to measure loud high- and middle-frequency sound (B-weighted), very loud low-frequency sound (C-weighted), very loud sounds associated with aircraft (D-weighted), and infrasound (<20Hz), or low-frequency sound including frequencies below the lower limit of human auditory response (10 to 200 Hz (G-weighted)). Infrasound propagates farther than sound of higher frequencies, and typically is perceived not only as sound, but as tactile sensation such as vibration.

A closely related value to the SPL is the sound power level, expressed as PWL or LW. The sound power level represents the total sound power emanating from a source in all directions. While each individual receptor is experiencing the sound's pressure level, the overall impact of a sound source on the environment is properly represented by the sound power level because, in most circumstances and discounting the effects of reflection and absorption, sound waves propagate spherically from a point source to impact many receptors at different pressure levels, depending on their distance from the source.

A common method of describing sound pressure levels is by comparing commonly experienced sounds. Typical sound sources and their corresponding environments are listed below in Figure 3.5-1. The sound levels indicated are for single events. Such events are discrete, and two or more events cannot simply be added together. Integrating varying noise levels and sources over a given period requires complex calculations or modeling.

To describe the time-varying character of environmental noise, the statistical noise descriptors L_{10}, L_{50}, and L_{90} are commonly used. They are the noise levels equaled or exceeded during 10 percent, 50 percent, and 90 percent of a stated period, respectively. L_{10} values reflect transient or short-term events, while L_{90} values describe the most prevalent noise conditions. The acoustic range of the noise source is determined by measuring the maximum (L_{max}) and minimum (L_{min}) sound levels. The L_{min} value obtained for a particular monitoring location is the "acoustic floor" for that location.

A sound measure employed by federal agencies is known as the Day-Night Average Sound Level (L_{dn}). The L_{dn} is defined as the A-weighted average sound level for a 24-hour day. It is a calculated noise metric derived from measurements, but includes a 10-dB penalty for late-night (*i.e.*, 10:00 p.m. to 7:00 a.m.) sound levels. This penalty accounts for the increased sensitivity of humans to noise at night.



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

Figure 3.5-1 Sound Levels of Typical Airborne Noise Sources and Environments

Sound Propagation

Understanding the impact of sound on a receptor requires a basic understanding of how sound propagates from its source. Sound propagation follows the inverse square law: the intensity of a sound wave deceases inversely with the square of the distance between the source and the receptor. Thus, doubling the distance between the receptor and a sound source results in a reduction in the intensity of the sound of one fourth of its initial value; tripling the distance results in one ninth of the original intensity, and so on.

The distinctions between airborne sound and underwater sound transmission are based on the different physical characteristics of the two media. In general, sound is transmitted much more efficiently in water than in air. A simple rule-of-thumb is to add 26 dB to airborne sound levels to get their underwater equivalents (Kinsler *et al.,* 1982).

3.5.1.2 Regulatory Framework

The Navy meets its noise management obligations at air-to-ground training ranges (*i.e*., on-land targets) through the Range Air Installations Compatible Use Zone (RAICUZ) program found in OPNAV Instruction 3550.1A (DoN, 2008). RAICUZ Program implementation includes developing current and future Range Compatibility Zones (RCZ) and current and prospective noise analysis for the range, partnering with appropriate federal, state, and local government agencies (working with these agencies for compatible land use near and around the ranges), considering operational alternatives as necessary, implementing a complaint response program in the surrounding communities, and developing strategies to protect the long term viability of the range while maintaining a high degree of public safety (DoN, 2008). According to Appendix C of OPNAVINST 3550.1A, the only air-to-ground ranges within the VACAPES Range Complex, wherein the RAICUZ Program requirements must be implemented are R-5313 Stumpy Point Range and R-5314 Navy Dare County Range (DoN, 2008). However, because no air-to-ground training ranges are considered under this EIS/OEIS, the RAICUZ program is inapplicable here. All training spaces considered within this EIS/OEIS are over water and distant from any noise receptors.

The DoD has a similar program for air stations, called the Air Installation Compatibility Use Zone (AICUZ) program (DoN, 2002b). The foundation of the AICUZ program is an active local command effort to work with local, state, regional, other federal agencies, and community leaders to encourage compatible development of land adjacent to military airfields. The Navy is particularly susceptible to such encroachment with many of its installations located in high growth urban areas. The AICUZ process involves four basic steps:

1. Develop, and periodically update, a study for each air installation to quantify aircraft noise zones and identify accident potential zones; develop a noise reduction strategy for impacted lands, both on and off the installation; prepare a compatible land use plan for the installation and surrounding areas; and develop a strategy to promote compatible development on land within these areas.
2. Develop a prospective long-term (5 to 10 years) AICUZ analysis to illustrate impact on known future missions and how it will be implemented by the AICUZ program.
3. Implement the AICUZ plan for the installation including coordination with federal, state and local officials to maintain public awareness of AICUZ.
4. Identify and program property rights acquisition and sound suppression projects when appropriate in critical areas, where action to achieve compatibility within AICUZ program guidelines through local land use controls is either impossible or has been attempted and proven unsuccessful.

Although not within the boundaries of the VACAPES Range Complex and not analyzed in this EIS/OEIS, Naval Air Station Oceana is mentioned here due to its proximity to the Complex, and because the aircraft stationed there are primary users of the range complex. The AICUZ program for Naval Air Station Oceana and NALF Fentress was first established by the Navy in 1978. This AICUZ was considered representative of operations at these facilities for over 20 years. In 1998, the Navy initiated a study to update the AICUZ based on operational changes that occurred with the realignment of the majority of the Hornet squadrons from Naval Air Station Cecil Field, FL to Naval Air Station Oceana in 1999.

Due to the possibility of mission changes at Naval Air Station Oceana and Chambers Field Naval Station, Norfolk, the formal approval of a new AICUZ was put on hold until the completion of the siting process for the MH-60 R/S helicopters and the Superhornet aircraft. However, the cities of Chesapeake and Virginia Beach adopted the noise contours as part of their comprehensive plans and zoning ordinances (DoN, 2003). Primary flight operations that occur at NAS Oceana are departures, straight-in full stop arrivals, overhead-break arrivals, carrier-break arrivals, touch-and go, Field Carrier Landing Practice (FCLP), and Ground Controlled Approaches (GCA). These operations form the basis for the noise contours and Accident Potential Zones (APZ).

An AICUZ Study was also performed for Naval Station Norfolk (Chambers Field). The latest AICUZ was the adopted AICUZ map from 1979. This study is reflected in the Joint Land Use Study (JLUS) for Hampton Roads. The baseline noise contours for this area are depicted in Section 3.5.2.2.

3.5.1.3 Assessment Methods and Data Used

The method used in this EIS/OEIS to assess the noise environment impacts associated with existing and proposed Navy training and testing within the VACAPES Range Complex, includes following the below steps:

- Analyze existing federal noise management regulations applicable to the proposed action;
- Consider existing Navy policies affecting noise production levels (*e.g.*, the RAICUZ Program and range Standard Operating Procedures);
- Analyze the natural ambient or background noise levels in the range complex;
- Analyze the various types of noise sources associated with training and testing within the VACAPES Range Complex (*e.g*., continuous versus impulsive noises);
- Review existing noise studies performed in connection with homebasing decisions, individual exercises, or tests;
- Determine the overall noise environment impacts associated with existing Navy training and testing within the range complex given the regulatory/procedural framework; and
- Determine the overall noise environment impacts associated with the proposed Navy training and testing within the range complex given the regulatory/procedural framework.

It was determined that no noise modeling or monitoring was specifically required for a complete and thorough analysis.

The analysis presented in this section is limited to impacts of airborne sound on humans. Impacts of military-generated sound, including underwater sound, on natural resources are addressed in Sections 3.6 (Marine Communities), 3.7 (Marine Mammals), 3.8 (Sea Turtles), 3.9 (Fish), 3.10 (Seabirds and Migratory Birds), and 3.19 (Atlantic Fleet Active Sonar Training).

3.5.1.4 Warfare Areas and Associated Environmental Stressors

Table 3.5-1 illustrates the various training events that occur within the VACAPES Range Complex and the associated noise stressors. The table also indicates the location of the noise in terms of distance from shore-based receptors, and in terms of altitude above receptors.

TABLE 3.5-1
WARFARE AREAS AND ASSOCIATED NOISE STRESSORS

		Stressors				Location			
Warfare Area and Operation	**Training Areas**	**Surface Vessel Noise**	**Helicopter Noise**	**Fixed-Wing Aircraft Noise**	**Ordnance or Target Noise**	**Below 3,000 feet**	**Above 3,000 feet**	**Overland or < 12 nm from Shore**	**> 12 nm from Shore**
Mine Warfare (MIW)									
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay	✓	✓			✓		✓	
Mine Countermeasures Exercise (MCM)	W-50A/C W-386, W-72	✓	✓			✓		✓	
Mine Neutralization	W-50C	✓	✓		✓	✓		✓	
Surface Warfare (SUW)									
Bombing Exercise (Air-to-Surface) (at-sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B			✓	✓		✓		✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A			✓	✓	✓			✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C		✓	✓	✓	✓		✓	✓
GUNEX (Surface-to-Surface) Boat	W-50C, R-6606	✓				✓		✓	
GUNEX (Surface-to-Surface) Ship	W-386, W-72	✓			✓	✓			✓
Laser Targeting	W-386 (Air-K), W-72A		✓	✓		✓	✓		✓
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- Ship	VACAPES OPAREA	✓						✓	✓
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓			✓		✓	✓
Air Warfare (AW)									
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)			✓			✓		✓
GUNEX (Air-to-Air)	W-72A			✓			✓		✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A			✓	✓		✓		✓
GUNEX (Surface-to-Air)	W-386, W-72	✓		✓		✓	✓		✓

TABLE 3.5-1
WARFARE AREAS AND ASSOCIATED NOISE STRESSORS
(Continued)

		Stressors				Location			
Warfare Area and Operation	**Training Areas**	**Surface Vessel Noise**	**Helicopter Noise**	**Fixed-Wing Aircraft Noise**	**Ordnance or Target Noise**	**Below 3,000 feet**	**Above 3,000 feet**	**Overland or < 12 nm from Shore**	**> 12 nm from Shore**
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)	✓			✓	✓			✓
Air Intercept Control (AIC)	W-386, W-72	✓		✓		✓	✓		✓
Detect to Engage (DTE)	W-386, W-72	✓				✓			✓
Strike Warfare (STW)									
HARM Missile Exercise	W-386 (Air E,F,I,J)			✓	✓		✓		✓
Amphibious Warfare (AMW)									
Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓			✓	✓			✓
Electronic Combat (EC)									
Chaff Exercise- aircraft	W-386, W-386 (Air-K) and W-72		✓	✓		✓	✓		✓
Chaff Exercise- ship	W-386 and W-72	✓				✓			✓
Flare Exercise- aircraft	W-386, W-386 (Air-K) and W-72		✓	✓	✓	✓			✓
Electronic Combat (EC) Operations- aircraft	W-386 (Air-K)			✓			✓		✓
EC Operations- ship	VACAPES OPAREA	✓				✓			✓
Other Training									
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓				✓		✓	

3.5.2 Affected Environment

Various activities and processes, both natural and anthropogenic, above and below the water's surface, contribute to the sound profile of the ocean environment. This section focuses on sound above the water's surface and its potential impacts to human receptors. Later sections of this EIS/OEIS describe the potential impacts of underwater sound on human divers and marine species. Section 3.5.2.1 describes the affected sound environment offshore, while Section 3.5.2.2 describes the affected sound environment near shore.

3.5.2.1 VACAPES OPAREA

Ambient Sound in the Ocean Environment

Ambient airborne sound in the ocean environment typically consists of continuous noise sources emanating from breaking waves and wind. In general, ambient sound levels tend to be greatest in relatively shallow nearshore environments and appear to be directly related to wind speeds and indirectly related to sea-state (Willie and Geyer, 1984). Intermittent airborne noise sources also include those from man-made sources. In addition to sound from shipping, other manmade sources of airborne noise include military, general aviation, and commercial aircraft; dredging; nearshore construction activities; military explosive use; oil and gas exploration and extraction; mineral exploration and extraction; and geophysical surveys.

Sound from Military Sources

Airborne noise attributable to military activities in the VACAPES Range Complex emanates from multiple sources including naval ship power plants, military aircraft, targets, bombs, missiles, small arms, and water-based demolitions. Sound from military sources in the VACAPES Range Complex is virtually all transitory, and can be widely dispersed or concentrated in small areas for varying periods. Sound levels from naval ships are analogous to sound levels of commercial shipping.

Aircraft Overflights

Aircraft overflights contribute sound to the ocean environment. Motors, propellers, or rotors provide the major contributions, while aerodynamic turbulence also can contribute. In general, helicopters produce higher intensity sounds than fixed wing aircraft (Richardson *et al.,* 1995). Helicopter training activities are a common source of airborne sound in offshore areas. As with most manmade sounds, most aircraft sounds involve low frequencies. The angle of incidence of a sound wave propagating from an aircraft must enter the water at an angle of incidence of 13º from the vertical or less for the wave to continue propagating under the water's surface. At greater angles of incidence, the water surface acts as an effective reflector of the sound wave and very little penetration of the wave below the water occurs (Urick, 1972). Military activities involving aircraft generally are dispersed over large expanse of the open ocean, but can be highly concentrated in time and location near Naval Station Norfolk and Naval Air Station Oceana. Representative airborne sound levels associated with military aircraft are depicted in Table 3.5-2.

In addition to Navy aircraft, commercial air services (CAS) aircraft also produce airborne noise. CAS aircraft include Lear jets, tankers, small propeller drive aircraft, and Kafir jets. The noise generated by these CAS aircraft will occur during Electronic Combat (EC), Air Intercept Control (AIC), GUNEX (S-A), GUNEX (A-A) and Detect-to-Engage (DTE) events. Most noise generated by these CAS aircraft will occur above 3,000 feet and greater than 12 nm from shore. CAS aircraft participating in VACAPES Range Complex training events depart from the Newport News/Williamsburg International Airport in Newport News, Virginia. This airport is adjacent to the Virginia Capes Range Complex Study Area.

TABLE 3.5-2
REPRESENTATIVE AIRCRAFT AND ORDNANCE AIRBORNE SOUND SOURCES IN THE VACAPES EIS/OEIS STUDY AREA

Noise Source	Sound Level (dBA)	Typical Noise Environment
Jet Aircraft under Military Power	144 @ 50 ft.	VACAPES OPAREA at Aircraft Carrier
Jet Aircraft under Afterburner	148 @ 50 ft.	VACAPES OPAREA at Aircraft Carrier
H-60[8] Helicopter Hovering	90 @ 50 ft.	VACAPES OPAREA, Chesapeake Bay/Willoughby Bay and R-6606
Marine Marker Charge MK-58, 25	60 @ 50 ft.	VACAPES OPAREA
Mine Shapes (BDU-45,MK-62, 63, 65)	105 @ 50 ft.	VACAPES OPAREA
Chaff Packets (at impact) Aircraft ALE-37	90 @ 50 ft.	VACAPES OPAREA
Aircraft Defensive Flares	65 @ 50 ft.	VACAPES OPAREA
High Explosive (HE) MK-82*	136 dBP @ 1000 ft.	See Figures 2.2-6 and 2.2-7
HE MK-83*	138 dBP @ 1000 ft.	See Figures 2.2-6 and 2.2-7
HE MK-84*	141 dBP @ 1000 ft.	See Figures 2.2-6 and 2.2-7
NEPM Bombs 25 lb, spotting charge	60 @ 50 ft.	VACAPES OPAREA
NEPM Bombs 500 lb (at impact)	105 @ 50 ft.	VACAPES OPAREA
NEPM Bombs 1,000 lb (at impact)	108 @ 50 ft.	VACAPES OPAREA
Naval Gun Ammunition five in/54	110 @ 50 ft.	VACAPES OPAREA
Cannon Shells 20mm (at source)	105 @ 50 ft.	VACAPES OPAREA
Cannon Shells 25mm (at source)	110 @ 50 ft.	VACAPES OPAREA
7.62mm M60 Machine Gun	90 @ 50 ft.	VACAPES OPAREA
.50 cal Machine Gun	98 @ 50 ft. (or 136 dBP, at 50 ft)	VACAPES OPAREA

Notes: 50 feet and 1,000 feet are standard reference distances. AB – afterburner; BDU - Bomb Dummy Unit; cal - caliber; dBA - decibels, A-weighted; ft. - feet; lb - pound; mm - millimeters; NEPM: Non-explosive practice munition; HE: high explosive; dBP (peak sound level). * Noise levels predicted using US Army Corps of Engineers BNOISE 2 model
Source except as noted: Investigative Science and Engineering (ISE), 1997; CDR Solberg, 2008.

Airborne noise at this airport and immediate vicinity is dominated by the larger commercial airline aircraft. According to the Federal Aviation Administration, there are 227,363 operations per year at Newport News/Williamsburg International Airport (FAA, 2008). Under the Proposed Action, there would be an additional 93 flights from the airport to support VACAPES Range Complex training events. This represents 4/100ths of one percent increase in flights from the airport. When combined with the flights from this airport that also support certain Navy Cherry Point Range Complex training events, the increase in flight operations from the airport represents an increase of 14/100ths of one percent.

Missile and Target Launch

Sound associated with missile and target launches occurs in the VACAPES OPAREA during scheduled events. Due to safety concerns over launch activities, a buffer zone of several square miles is always instituted and enforced. Sound due to missile and target launches is typically at a maximum at the point

[8] Noise Data for the H-60 platform is considered comparable to the MH-53 and SH-60B/F platforms evaluated in this EIS/OEIS.

of initiation of the booster rocket, and rapidly fades as (1) the missile or target reaches optimal thrust conditions; and (2) the missile or target reaches a downrange distance where the booster burns out and the sustainer engine continues. For example, data for the BQM-34 show that its booster Jet Assisted Take-Off (JATO) bottles generate 113 dBA at the source at launch. Sound levels decrease to 99 dBA at 2,400 feet (732 m) (DoN, 1998b). The BQM-34 is used in the VACAPES OPAREA (though much less frequently than the smaller BQM-74).

Figure 3.5-2: Target Drone Launch

In the VACAPES Range Complex, the BQM-74 is the typical target. It can be launched from land, sea or air. Noise related to land launches is discussed in Section 3.5.2.2. It is launched from surface vessels (Figure 3.5-2) (*e.g.*, the Theater Support Vessel (TSV)1 Prevail) via a rail by a solid rocket booster and sustained by a small conventional jet engine. The typical time that such target drones are launched is during the Composite Training Unit Exercises (COMPTUEX) conducted a few times per year. Missiles are launched from high-altitude aircraft and from surface ships in the offshore area.

Ordnance Use

Sound results from ordnance use in the VACAPES Range Complex, both within the VACAPES OPAREA and the nearshore areas. Representative ordnance sound levels are depicted in Table 3.5-2.

Sonic Boom Noise

Supersonic aircraft flights can occur from time to time in the VACAPES OPAREA. Such flights are usually limited to altitudes above 30,000 feet (9,100 m) and/or locations more than 30 nm (56 km) from shore. Several factors influence sonic booms: weight, size, shape or aircraft or vehicle; altitude; flight paths; and atmospheric conditions. A larger and heavier aircraft must displace more air and create more lift to sustain flight, compared with small, light aircraft. Therefore, larger aircraft create sonic booms that are stronger and louder than those of smaller, lighter aircraft. Consequently, the larger and heavier the aircraft, the stronger the shock waves will be (DoN, 2007).

Of all the factors influencing sonic booms, increasing altitude is the most effective method of reducing sonic boom intensity. The width of the boom "carpet" or area exposed to sonic boom beneath an aircraft is about 1 mile (1.6 km) for each 1,000 feet (300 m) of altitude. For example, an aircraft flying supersonic straight and level at 50,000 feet (15,000 m) can produce a sonic boom carpet about 50 miles (80 km) wide. The sonic boom, however, will not be uniform. Maximum intensity is directly beneath the aircraft, and decreases as the lateral distance from the flight path increases until shock waves refract away from the ground and the sonic boom attenuates. The lateral spreading of the sonic boom depends only on altitude, speed, and the atmosphere, and is independent of the vehicle's shape, size, and weight. The ratio of the aircraft length to maximum cross sectional area also influences the intensity of the sonic boom. The longer and more slender the aircraft, the weaker the shock waves. The wider and more blunt the vehicle, the stronger the shock wave can be (DoN, 2007).

Sonic booms are generated as aircraft reach Mach 1.0 (speed of sound) and increase in intensity as the Mach number increases. Increasing speeds above Mach 1.3 result in only small changes in shock wave strength. The direction of travel and strength of shock waves are influenced by wind, speed, direction, air temperature, and pressure. At speeds slightly greater than Mach 1.0, the effect of these factors can be significant, but their influence is small at speeds greater than Mach 1.3. Therefore, supersonic flight activity has been characterized for aircraft capable of supersonic flight at a fixed speed of Mach 1.3 and at various altitudes in standard atmospheric conditions (DoN, 2007). A detailed discussion of sonic booms is provided in Appendix H.

Non-Explosive Impact Noise

Non-explosive impact sound in the VACAPES Range Complex is generally from high-velocity "dummy" projectiles and non-explosive practice munitions (training bombs). Sounds of this type are produced by the kinetic energy transfer of the object with the target surface, and are highly localized to the area of disturbance. Sound associated with the impact event is typically of low frequency (less than 250 Hz) and of a short enough duration (*i.e.*, impulse sound) that it produces negligible amounts of acoustic energy. These events occur on remote ranges that are restricted from the public, so they often go unobserved and unheard. The impacts may be scored by remote observers - participants in the exercise who are at a safe distance from the source.

Explosives

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. The acoustic energy of an explosive is generally greater than that of sonar. Three source parameters influence the effect of an explosive: the weight of the explosive warhead, the type of explosive material, and the detonation depth. The net explosive weight (NEW) accounts for the first two parameters. The NEW of an explosive is the weight of the explosive material in a given round, referenced to the explosive power of TNT.

The detonation depth of an explosive is important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface reflection scattering loss). Since most explosive sources used in military activities in the VACAPES OPAREA are munitions that detonate essentially upon impact, the effective source depths are quite shallow and, therefore, the surface-image interference effect can be pronounced. Table 3.5-3 identifies explosive ordnance types used, corresponding NEWs, and expected detonation depths.

TABLE 3.5-3
EXPLOSIVE SOURCES IN THE VACAPES RANGE COMPLEX

Ordnance	Net Explosive Weight	Detonation Depth
5" Naval gunfire	8.5-lbs	1 ft
Maverick missile	100-lbs	At or just below water's surface
Hellfire AGM-114 missile	8-lbs	At or just below water's surface
HARM Missile	48-lbs	30-60 ft above surface
AIM-7 missile	86-lbs	N/A - High altitude above surface
AIM-9 missile	88-lbs	N/A - High altitude above surface
AIM-120 missile	340-lbs	N/A - High altitude above surface
MK-20 bomb	109.7-lbs	3.28 ft
MK-82 bomb	192.2-lbs	3.28 ft
MK-83 bomb	415.8-lbs	3.28 ft
MK-84 bomb	944.7-lbs	3.28 ft
Underwater Mine Neutralization Charges	20-lbs	Mid-column to bottom
AMNS	3.24-lbs	Variable mid-column

The sound of a Hellfire missile detonation is described in the Overseas Environmental Assessment of Testing the Hellfire Missile System's Integration with the H-60 Helicopter (NAVAIR, 2005). The greatest sound intensity generated from the firing of a Hellfire missile is approximately 149 dB re 1 μPa at 15 feet altitude (NAVAIR, 2005). Due to the great distance from shore where these events occur, these explosions are not likely to impact human sound receptors ashore.

3.5.2.2 Sound in the Chesapeake Bay / Willoughby Bay and Nearshore Atlantic Ocean

Sound Sources

Sound from Ordnance

Sound attributable to training and testing ordnance in the nearshore Study Area environment results from small caliber gunfire (*e.g*., 7.62 mm, .50 cal), and mine neutralization events (using up to 20 lbs NEW). The types and quantities of ordnance expended, and thus the sound levels generated, depend on the training objectives and the range used. Table 3.5-2 depicts sound levels for representative ordnance types utilized in military training in the nearshore environment.

Because impulsive noise, such as that generated by explosions or gun firing, is fundamentally different from noise from continuous sources, threshold criteria for impulsive noise are different from those for continuous noise. The threshold for permanent ear damage to unprotected ears due to continuous noise is approximately 85 dBA based on an eight-hour-per-day exposure, while the threshold for permanent ear damage to unprotected ears due to impulsive noise is approximately 140 dBP based on 100 exposures per day (Pater, 1976).

Gunnery exercises near shore would be limited to R-6606 and W-50 for boats and Naval Special Forces. W-50 is used for mine neutralization events, which were previously evaluated in 2002 (DoN, 2002a; NMFS, 2002). No gunnery or mine neutralization would occur in the Chesapeake Bay area. The Chesapeake Bay area is a proposed area for mine countermeasures exercises. Such events are intermittent, and distant enough from sensitive human receptors to be insignificant.

Aircraft Overflight

The dominant nearshore aircraft noise sources in the EIS/OEIS Study Area stem from rotary wing aircraft overflights associated with MIW training. Noise associated aircraft flight in the Chesapeake Bay/Willoughby Bay Area is generated primarily by low-level operation of rotary-wing aircraft and F/A-18 aircraft. Baseline noise levels in this area were recently studied in the EA for the Homebasing of the MH-60R/S Helicopter on the East Coast of the United States (DoN, 2002a). It was determined that the proposed action would not expand the noise contours at any of the three installations. The composite noise contours at Naval Station Norfolk would continue to be dominated by fixed-wing aircraft.

The MH-60R/S Homebasing EA incorporated a noise study produced by Wyle Laboratories, Inc (Wyle). Wyle used the Rotorcraft Noise Model (RNM) version 3.0 to model the existing and forecast conditions for Naval Station Norfolk. RNM, developed by Wyle for the NASA-Langley Research Center, is a computer model that calculates far-field noise for single-event or multiple flight vehicle operations.

According to the Noise Study, the 65, 70 and 75 dB contours are almost wholly contained within the boundaries of the base, but do extend in certain places out over bodies of water. The noise contours at either end of Runway 10/28 (Chambers Field) are caused by the pattern operations, of which 5 percent of all touch and go operations and 100 percent of the ground controlled approach patterns occur on this runway. The bulk of the operations take place on the heliport, and the noise exposure around this helipad is, thus, larger than any of the other locations. The contour primarily extends out over the river and does not pose a burden to residences.

Figure 3.5-3 depicts the 2001 baseline noise contours at NS Norfolk.

Target Drone Launches

In addition to launches initiated from the VACAPES OPAREA, airborne targets are sometimes launched from land. The locations for these launches are: the NAS Oceana's Dam Neck Annex in Virginia Beach, Virginia, and Wallops Island on Virginia's Eastern Shore. The BQM-74 is launched via a rail by a solid rocket booster and sustained by a small conventional jet engine. Although no data are available on the BQM-74, another Navy training range (*i.e.*, the Point Mugu Sea Range on the U.S. west coast) has recorded sound measurements for BQM-34 target launches. The BQM-34 is almost twice as large as the BQM-74; data for the BQM-34 show that its booster JATO bottles generate 113 dBA at the source at launch. Sound levels decrease to 99 dBA at 2,400 feet (732 m) (DoN, 1998b). The Dam Neck BQM-74 launch pad is located within the sand dune line next to the Atlantic Ocean. Due to high ambient noise levels from the wave breaks and sea breezes, it is difficult to hear the target drone launches from as close as a few hundred yards.

Sensitive Receptors

Sensitive receptors are those noise-sensitive areas, including developed and undeveloped areas for land uses such as residences, business, schools, churches, libraries, hospitals, and parks. Military personnel are not considered to be sensitive receptors of airborne noise for purposes of environmental impact analysis. While persons on recreational or fishing vessels within the Willoughby Bay, Chesapeake Bay, or VACAPES OPAREA might be exposed to sound generated by military activities, the likelihood of such exposure is quite low, due to extensive SOPs employed by the Navy to ensure civilian persons do not interfere and are not inadvertently affected by military activities.

The Navy tries to reduce the impacts of noise on civilian populations. The FACSFAC VACAPES Operations Manual (incorporating CINCLANTFLT INST 3120.26) reminds pilots to avoid populated areas, prohibits use of afterburners in certain areas, and other actions that could cause increased noise levels. The Navy has an established complaint line (1-757-433-2162) to receive noise complaints from the community around Naval Air Station Oceana. This is an automated system capable of receiving calls 24 hours a day. The messages are reviewed each day to provide an opportunity for a Navy official to follow-up with a phone call to the person placing the complaint if sufficient call return information is provided in the message. The incidents are investigated as to the nature of the offensive noise event, and the appropriate squadrons or users of the Range are notified if the pilot operated outside the approved parameters of range use (NAS Oceana, 2007).

The nearest human receptors to the Dam Neck target drone launch area, and W-50 are located in the residential community of Sandbridge Beach (over 1,000 yards south of the launch pad). Gunnery exercises in W-50 would take place at least 3 miles offshore. The Officer in Charge of BQM-74E target drone launches at Dam Neck has received no noise complaints in the past few years (Barnes, 2007).

3.5.3 Environmental Consequences:

3.5.3.1 No Action Alternative

Military activities in the VACAPES OPAREA, especially live firing of weapons and aircraft operations, are sources of intrusive noise in the vicinity within which they occur. Military personnel who might be exposed to noise from these activities are required to take precautions, such as the wearing of personal protective equipment, to reduce or eliminate potential harmful effects of such exposure (military personnel are not considered sensitive receptors for purposes of impacts analysis). With regard to potential exposure of non-military personnel in ocean areas (such as fishermen in the VACAPES

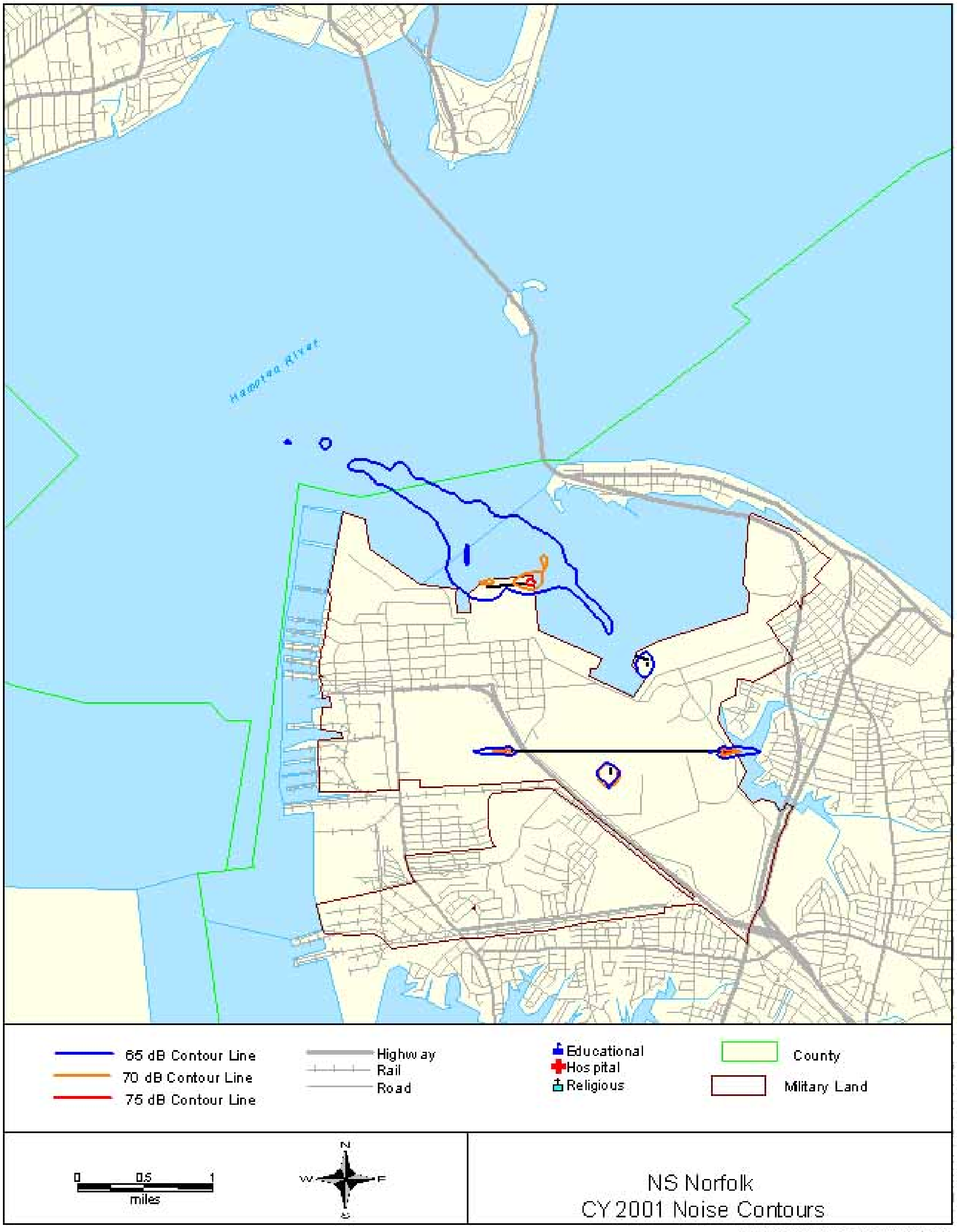


Figure 3.5-3 Naval Station Norfolk Calendar Year 2001 Noise Contours

OPAREA) precautions are taken pursuant to SOPs to prevent such exposure (see Section 3.18). Aircraft training (including its commercial air services support) in the VACAPES OPAREA typically occurs above 3,000 feet which, thus, reduces the sound exposure to humans operating commercial or recreational surface vessels.

As shown on the noise study map for the Naval Station Norfolk area (Figure 3.5-3), noticeable noise levels are contained within the air station and over adjacent waters and, therefore, do not present an impact to human receptors. The noise contours on this map are representative of noise levels associated with current helicopter mine countermeasures training with MK-105 towed arrays. As evidenced by the lack of noise complaints, noise associated with BQM-74E target drone launches from the Dam Neck Annex has not affected the closest residential community (1,000 yards away). No known noise complaints have been filed relative to EOD underwater detonations. Because sound-generating events are intermittent, occur in remote areas or off-limits areas, they do not expose a substantial number of human receptors to high noise levels. Few sensitive receptors are likely to be exposed to sound from such military activities in the near shore or offshore areas. Therefore, there would be no significant impact on the human noise environment from implementing current Navy training and testing. Furthermore, there would be no significant harm to the human noise environment from implementing the No Action Alternative.

3.5.3.2 Alternative 1

Under Alternative 1, the number of noise generating operations or activities would increase. This increase in operations would not be expected to result in substantial increases of overall Study Area noise levels. As noted, extensive precautions are taken to eliminate exposure of non-military personnel to unwanted sound from military activities. As with the No-Action Alternative, sound-generating events in the VACAPES OPAREA under Alternative 1 are intermittent, occur in remote areas or off-limits areas, and do not expose a substantial number of human receptors to high noise levels. No sensitive receptors are likely to be exposed to sound from such military activities.

Certain events (i.e., EC, AIC, DTE, GUNEX (A-A) and GUNEX (S-A)) using commercial air services (CAS) will increase by ninety-three sorties under Alternative 1. The CAS flights typically occur at altitudes over 3,000 feet and greater than 12 nm from shore. Shore-based sensitive receptors are not expected to be impacted by the noise generated. Given the small number of departures/landings at the Newport News/Williamsburg International Airport, CAS aircraft-generated noise at the airport under Alternative 1 is considered insignificant. Thus, CAS flights and CAS supported events are not expected to produce significant impacts to the airborne noise environment under Alternative 1.

In the Willoughby Bay/Chesapeake Bay area, noise levels under Alternative 1 are expected to increase slightly due to the arrival of additional helicopters at Naval Station Norfolk. The noise contours for this increase in platforms were also presented in the MH60R/S Homebasing EA (DoN, 2002a). Figure 3.5-4 illustrates the expected (2015) noise contours in this area. The noise contours do not change appreciably over land between 2001 and 2015, and it was determined in the 2002 EA that noise levels associated with the additional helicopters was less than significant. Noise associated with BQM-74E target drone launches from the Dam Neck Annex is expected to remain consistent with current levels. Drone launches from the shore at the Dam Neck Annex under Alternative 1 are expected to remain at the current levels of approximately 50 launches per year.

Therefore, there would be no significant impact on the human noise environment from implementing the Navy training and testing considered under Alternative 1. Furthermore, there would be no significant harm to the human noise environment from implementing Alternative 1.

Figure 3.5-4 Naval Station Norfolk Calendar Year 2015 Noise Contours

3.5.3.3 Alternative 2 (Preferred Alternative)

The types of effects on humans from sound generated by military activities under Alternative 2 would be nearly identical to those under Alternative 1. For example, CAS flights and CAS supported events are the same under Alternative 1 as under Alternative 2. No significant impacts to the airborne noise environment are expected from these events which take place at high altitude and at a great distance from shore based sensitive receptors. The only events producing additional noise above those discussed under Alternative 1 are MCM and Mine Neutralization. Training usage of the proposed mine training areas would produce noise offshore and distant from human receptors ashore. Military personnel who might be exposed to noise from these mine warfare training activities are required to take precautions, such as the wearing of personal protective equipment (*e.g*., earplugs and flight helmets), to reduce or eliminate potential harmful effects of such exposure (military personnel are not considered sensitive receptors for purposes of impacts analysis). In comparison to Alternative 1, twenty additional helicopter sorties would occur each year in connection with Mine Neutralization training under Alternative 2. In comparison to Alternative 1, 40 additional helicopter sorties would occur each year in connection with MCM training under Alternative 2. Under Alternative 2, MCM training would be conducted at a variety of mine training areas. Each of these areas, however, is located over water and distant from shore. Helicopter noise associated with this training is not expected to significantly impact human receptors. Helicopter Mine Neutralization training under Alternative 2 is proposed to occur in the Atlantic Ocean in W-50C. The proposed location is over 3 nm offshore from Back Bay National Wildlife Refuge and False Cape State Park. Few sensitive human receptors would experience the helicopter noise at this distance. Under Alternative 2, there would also be a substantial decrease in impulsive noise associated with BOMBEX (A-S) training. The noise associated with this training would occur beyond 12 nm from shore and distant from any sensitive receptors. As with the No-Action Alternative and Alternative 1, other sound generating testing and training events under Alternative 2 are intermittent, occur in remote areas or off-limits areas, and do not expose a substantial number of human receptors to high noise levels.

Therefore, there would be no significant impact on the human noise environment from implementing the Navy training and testing considered under Alternative 2. Furthermore, there would be no significant harm to the human noise environment from implementing Alternative 2.

3.5.4 Unavoidable Significant Environmental Effects

Increases in operational activity in the VACAPES Range Complex would increase airborne noise levels. However, because Navy training takes place in remote and cleared areas, airborne noise levels would primarily affect military personnel operating the equipment/weapon systems producing the noise. Military personnel wear personal protective equipment and are not considered sensitive receptors as such term is used in this EIS/OEIS analysis. Underwater noise impacts to aquatic life are addressed in Sections 3.6 (Marine Communities), 3.7 (Marine Mammals), 3.8 (Sea Turtles), and 3.9 (Fish). There are not expected to be any unavoidable significant environmental effects associated with noise generated by the proposed action.

3.5.5 Summary of Environmental Effects (NEPA and EO 12114)

Airborne noise levels generated by the proposed action under the No-Action Alternative and Alternatives 1 and 2 would be less than significant because:

- Noise from training activities in the VACAPES OPAREA would be dispersed and intermittent, which would not contribute substantially to long-term noise levels, and few or no sensitive receptors (non-participants) would be exposed to these noise events;
- Noise would be generated in training areas that have been in similar use for more than 50 years - no new public areas would be exposed to noise from training and testing activities.

- The incremental increases in the numbers of range events would not substantially increase long term average noise levels; hourly average equivalent noise levels are and would remain relatively low; and
- Increased helicopter operations at Naval Station Norfolk were evaluated in the MH-60R/S Siting Study Environmental Assessment and determined to be less than significant.

Table 3.5-4 summarizes noise effects for the No Action, Alternative 1, and Alternative 2.

TABLE 3.5-4
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON THE SOUND ENVIRONMENT OF THE VACAPES EIS/OEIS STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (U.S. Territory)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
No Action		
Surface ship noise	Minor localized engine noise. Few to no sensitive receptors present.	Minor at-sea noise. Few to no sensitive receptors present.
Aircraft noise	Short-term noise impacts during transits to and from range areas.	Short-term noise impacts, including sonic booms. Few to no sensitive receptors present.
Weapon and target noise	Very short-term noise impacts. Few to no sensitive receptors present.	Very short-term noise impacts. Few to no sensitive receptors present.
Impact Conclusion	No significant impact to Study Area sound environment.	No significant harm to Study Area sound environment.
Alternative 1		
Surface ship noise	Minor localized engine noise. Few to no sensitive receptors present.	Minor at-sea noise. Few to no sensitive receptors present.
Aircraft noise	Short-term noise impacts during transits to and from range areas.	Short-term noise impacts, including sonic booms. Few to no sensitive receptors present.
Weapon and target noise	Very short-term noise impacts. Few to no sensitive receptors present.	Very short-term noise impacts. Few to no sensitive receptors present.
Impact Conclusion	No significant impact to Study Area sound environment.	No significant harm to Study Area sound environment.
Alternative 2		
Surface ship noise	Minor localized engine noise. Few to no sensitive receptors present.	Minor at-sea noise. Few to no sensitive receptors present.
Aircraft noise	Short-term noise impacts during transits to and from range areas.	Short-term noise impacts, including sonic booms. Few to no sensitive receptors present.
Weapon and target noise	Very short-term noise impacts. Few to no sensitive receptors present.	Very short-term noise impacts. Few to no sensitive receptors present.
Impact Conclusion	No significant impact to Study Area sound environment.	No significant harm to Study Area sound environment.

3.6 MARINE COMMUNITIES

3.6.1 Introduction and Methods

3.6.1.1 Regulatory Framework

A community is an assemblage of plants and/or animal populations sharing a common environment and interacting with each other and with the physical environment. This section specifically addresses the following marine communities occurring within the VACAPES Study Area: plankton and macroalgae, benthic communities, seagrasses/submerged aquatic vegetation, and artificial habitats. Marine mammals are addressed in Section 3.7, sea turtles are addressed in Section 3.8, fish and essential fish habitat are addressed in Section 3.9, and seabirds and migratory birds are addressed in Section 3.10 of this EIS/OEIS. Marine species listed under the Endangered Species Act (ESA) are addressed in Sections 3.7 through 3.10, as applicable. No National Marine Sanctuaries are located within the Study Area boundaries; therefore, they are not addressed in this EIS/OEIS.

The various federal laws and regulations that afford protection and management of marine communities are primarily aimed at specific community components. These include ESA-listed species and designated critical habitat; marine mammals; federally managed fish species and essential fish habitat; and migratory birds. Regulatory frameworks for these marine community components are presented in Appendix K.

3.6.1.2 Assessment Methods and Data Used

Each alternative analyzed in this EIS/OEIS includes several warfare areas (*e.g.,* Mine Warfare, Air Warfare, *etc*.) and most warfare areas include multiple types of training operations (*e.g.,* Mine Neutralization, Air-to-Surface Missile Exercise, *etc*.). Likewise, several activities (*e.g.,* vessel movements, aircraft overflights, weapons firing, *etc*.) are accomplished under each operation, and those activities typically are not unique to that operation. For example, many of the operations involve Navy vessel movements and aircraft overflights. Accordingly, the analysis for marine communities is organized by specific activity and/or stressors associated with that activity, rather than warfare area or operations.

The following general steps were used to analyze the potential environmental consequences of the alternatives to marine communities:

- Identify those aspects of the proposed action that are likely to act as stressors to biological resources by having a direct or indirect effect on the physical, chemical, and biotic environment of the Study Area. As part of this step, the spatial extent of these stressors, including changes in that spatial extent over time, were identified. The results of this step identified those aspects of the proposed action that required detailed analysis in this EIS/OEIS.
- Identify resources that may occur in the Study Area.
- Identify the biological resources that are likely to co-occur with the stressors in space and time, and the nature of that co-occurrence (exposure analysis).
- Determine whether and how biological resources are likely to respond given their exposure and available scientific knowledge of their responses (response analysis).
- Determine the risks those responses pose to biological resources and the significance of those risks.

Study Area

The Study Area for marine communities is described in Section 1.5 and is shown in Figure 1.5-1.

Data Sources

A comprehensive and systematic review of relevant literature and data has been conducted to complete this analysis for marine communities and to ensure that best available information was used. Of the available scientific literature (both published and unpublished), the following types of documents were utilized in the assessment: journals, books, periodicals, bulletins, Department of Defense operations reports, EISs, Range Complex Management Plans, and other technical reports published by government agencies, private businesses, or consulting firms. The scientific literature was also consulted during the search for geographic location data on the occurrence of marine resources within the study area. The primary sources of information used to describe the affected environment for marine communities were the Navy's Marine Resources Assessment reports for VACAPES OPAREA (DoN, 2008) and the lower Chesapeake Bay (DoN, 2007). The Marine Resources Assessment reports provide compilations of the most recent data and information on the occurrence of marine resources in the Study Area. Descriptions of literature and data searches conducted during preparation of the Marine Resources Assessment reports are described in detail in those documents.

Factors Used to Assess Effects

The factors used to assess significance of the effects to marine communities include the extent or degree to which implementation of an alternative would result in permanent loss or long-term degradation of the physical, chemical, and biotic components that make up a marine community.

3.6.1.3 Warfare Areas and Associated Environmental Stressors

The Navy used a screening process to identify aspects of the proposed action that could act as stressors to marine communities. Navy subject matter experts analyzed the warfare areas and operations included in the proposed action to identify specific activities that could act as stressors. Public and agency scoping comments, previous environmental analyses, previous agency consultations, laws, regulations, Executive Orders, and resource-specific information were also evaluated. This process was used to focus the information presented and analyzed in the affected environment and environmental consequences sections of this EIS/OEIS. As summarized in Table 3.6-1, potential stressors to marine communities include vessel movements (disturbance and collisions), aircraft overflights (disturbance), towed Mine Warfare devices (strikes), non-explosive mine shape deployment/recovery (habitat alteration), non-explosive practice munitions (NEPM) (strikes), underwater detonations and high explosive (HE) ordnance (explosions), and military expended materials (ordnance related materials, targets, chaff, self-protection flares, and marine markers). The potential effects of these stressors on marine communities are analyzed in detail in Section 3.6.3.

As discussed in Section 3.3 – Water Resources and Section 3.4 – Air Quality, some water and air pollutants would be released into the environment as a result of the proposed action. The analyses presented in Sections 3.3 and 3.4 indicate that any increases in water or air pollutant concentrations resulting from Navy training in the Study Area would be negligible and localized, and impacts to water and air quality would not be significant. Based on the analyses presented in Sections 3.3 and 3.4, water and air quality changes would have no effect or negligible effects on marine communities. Accordingly, the effects of water and air quality changes on marine communities are not addressed further in this EIS/OEIS.

3.6.2 Affected Environment

3.6.2.1 Plankton and Macroalgae

Plankton are organisms that float or drift with the sea and cannot maintain distribution against the movement of water masses (Parsons *et al*., 1984). Plankton include phytoplankton (plant-like/algae), zooplankton (animals), ichthyoplankton (fish eggs and larvae, a form of zooplankton), and bacterioplankton (bacteria). In general, this group of organisms is very small or microscopic, although

TABLE 3.6-1
SUMMARY OF POTENTIAL STRESSORS TO MARINE COMMUNITIES[9]

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)									
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓	✓	✓			
Mine Countermeasures Exercise (MCM)	W-50A/C W-386, W-72	✓	✓	✓	✓	✓		✓	
Mine Neutralization	W-50C	✓	✓	✓	✓	✓	✓	✓	✓
Surface Warfare (SUW)									
Bombing Exercise (Air-to-Surface) (at sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B			✓			✓	✓	✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A			✓			✓	✓	✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C			✓			✓		✓
GUNEX (Surface-to-Surface) Boat	W-50C, R-6606	✓	✓				✓		✓
GUNEX (Surface-to-Surface) Ship	W-386, W-72	✓	✓				✓		✓

[9] For detailed information on the numbers and types of ordnance, specific weapons platforms, types of targets used and location of operations see Table 2.2-4 and Appendix D.

TABLE 3.6-1
SUMMARY OF POTENTIAL STRESSORS TO MARINE COMMUNITIES
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Laser Targeting	W-386 (Air-K)			✓					
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA	✓	✓						
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓	✓					
Air Warfare (AW)									
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)			✓					
GUNEX (Air-to-Air)	W-72A			✓			✓		✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A			✓			✓	✓	✓
GUNEX (Surface-to-Air)	W-386, W-72	✓	✓	✓			✓		✓
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)	✓	✓	✓			✓		✓
Air Intercept Control (AIC)	W-386, W-72	✓	✓	✓					
Detect to Engage (DTE)	W-386, W-72	✓	✓	✓					
Strike Warfare (STW)									
HARM Missile Exercise	W-386 (Air E,F,I,J)			✓			✓		✓

TABLE 3.6-1
SUMMARY OF POTENTIAL STRESSORS TO MARINE COMMUNITIES
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Amphibious Warfare (AMW)									
FIREX (Surface-to-Surface) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓	✓				✓	✓	✓
Electronic Combat (EC)									
Chaff Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓					✓
Chaff Exercise- ship	W-386 and W-72	✓	✓						✓
Flare Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓					✓
Electronic Combat (EC) Operations-aircraft	W-386 (Air-K)			✓					
EC Operations- ship	VACAPES OPAREA	✓	✓						
Test and Evaluation									
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓	✓						

there are exceptions. Jellyfish and pelagic *Sargassum*, for example, are unable to move against the surrounding currents and are considered part of the plankton group even though some jellyfish can grow to approximately 10 ft in diameter.

Phytoplankton are single-celled organisms that are similar to plants because they use sunlight and chlorophyll to photosynthesize. At the base of the marine food chain, phytoplankton are very important to the overall productivity of the ocean. Their growth and distribution are influenced by several factors, the most important of which are temperature (Eppley, 1972), light (Yentsch and Lee, 1966), and nutrient concentration (Goldman *et al*., 1979). Phytoplankton distribution is patchy, occurring in environments that have optimal light, temperature, and nutrient conditions. In general, the concentration of phytoplankton is higher in nearshore areas where there is input of nutrients from land sources. In continental shelf and slope waters, the concentration of phytoplankton generally decreases with distance from shore and with increasing bottom depth. Concentrations can be higher in upwellings and eddies along the Gulf Stream.

Freshwater flow into the Chesapeake Bay largely determines gradients of light and nutrients, and therefore phytoplankton, along the north–south axis of the Bay (Glibert *et al*., 1995). Due to increased levels of eutrophication in the Chesapeake Bay, there has been an increased abundance of phytoplankton (Harding and Perry, 1997; Kemp *et al*., 2005). Numerous harmful algal blooms have been reported in the Chesapeake Bay and its tributaries; several appear to be related directly to nutrient inputs (Glibert *et al*., 2001; Heil, 2005; Kemp *et al*., 2005).

Zooplankton are a taxonomically and structurally diverse group of aquatic animals. They range in size from microscopic, unicellular organisms such as protozoans to large, multicellular organisms such as jellyfish (Wiebe *et al.,* 1987). Although many are able to swim sizable distances at moderate speeds, their large-scale horizontal distributions are determined by ocean currents and the suitability of the physical, chemical, and biological components of their environment. Zooplankton cannot photosynthesize and may be herbivorous (consuming plants), carnivorous (consuming animals), detrivorous (consuming dead organic material), or omnivorous (consuming a mixed diet). Examples of zooplankton include foraminifera, pteropods, copepods, and myctophid fish. In offshore waters zooplankton are expected to be most abundant in areas of high primary productivity, including the Gulf Stream and associated upwellings and eddies.

The Chesapeake Bay undergoes large seasonal changes in temperature, salinity, nutrient input, dissolved oxygen, primary production, and predator abundance. As a result, local zooplankton populations change throughout the year with different species becoming dominant during the differing seasons. Throughout the year, copepods tend to dominate the local zooplankton community (Heinle, 1966; White and Roman, 1992) with polychaete, barnacle, and bivalve larvae dominating the community for short periods. Smaller microzooplankton (20 to 200 µm in size) are generally dominated by protozoa and rotifers; however, copepod nauplii can be the most abundant members during spring and summer months.

Ichthyoplankton are the eggs and larvae of fish found mainly in the upper 200 m of the water column. The eggs are passive and drift in the ocean along with the water currents. Most fish larvae have almost no swimming ability initially; however, half way through their development they are active swimmers. Ichthyoplankton are a relatively small but vital component of total zooplankton. They feed on smaller plankton and are prey for larger animals (Southwest Fisheries Science Center, 2007). Larval fish survival and recruitment success of shelf-spawned estuarine species are likely tied to oceanographic conditions on the inner shelf related to upwelling and downwelling conditions and plume dynamics, rather than to simple, wind-driven recruitment mechanisms (Reiss and McConaugha, 1999). Total larval abundance is higher within the frontal zone south of the Chesapeake Bay mouth than elsewhere on the shelf. Densities can exceed 300/100 m^3 (Reiss and McConaugha, 1999).

Pelagic *Sargassum*, or gulfweed, is a type of large, brown seaweed (algae) characterized by a brushy, highly branched structure with numerous leaf-like blades and berry-like gas-filled floats (pneumatocycts). Containing mostly oxygen, these floats maintain its pelagic existence. *Sargassum* often occurs in extensive floating mats on the surface. These mats are valuable habitat as they provide shelter and a food source for a diverse community of attached and swimming organisms. Throughout the Sargasso Sea and Gulf Stream, these mats frequently aggregate into large windrows in response to wind forcing, or shear forcing along frontal boundaries (Coston-Clements *et al*., 1991). Pelagic *Sargassum* also occurs in continental shelf waters of the U.S. Atlantic coast although no abundance or specific distribution information exists for the coastal region. The Gulf Stream is a dispersal mechanism for pelagic *Sargassum*, so it is quite likely that *Sargassum* would be found within the VACAPES OPAREA (DoN, 2008). Large mats of *Sargassum* are reported from an area on the western boundary of the Gulf Stream where the cool waters from the Labrador Current and the warm waters of the Gulf Stream meet, resulting in a high concentration of many forms of marine life (Golder, 2004). Although it is possible, it is not likely for *Sargassum* to be found floating within the waters of the Chesapeake Bay (DoN, 2007).

3.6.2.2 Benthic Communities

Benthic habitats are comprised of a variety of sediments, substrates, and marine life (infauna/flora, epifauna/flora, and demersal organisms) that are commercially and economically valuable. Benthic organisms including crustaceans, echinoderms, anthozoans, annelids, mollusks, and ground fish play a major role in altering underlying benthic substrates and in breaking down organic material which provides sustenance for economically important species of pelagic fish (Sumich, 1988).

Benthic or bottom-dwelling communities of organisms are strongly dependent on the type of bottom habitat or substrate that exists in an area. While some benthic organisms burrow into soft bottom sediments, others attach themselves to any hard substrate available. Areas where the bottom is covered by soft sediments, like those found throughout most of the Study Area (Figure 3.1-2) will largely be vacant of benthic organisms requiring hard substrate for attachment, growth, and development. Common benthic animals found in soft bottom communities in the Atlantic Ocean include polychaetes (worms), amphipods, archiannellids (worms), bivalves, and asteroids (star fish) (Brooks *et al*., 2004). Factors affecting distribution and abundance can include depth, sediment type, grain size, temperature, and salinity. A literature review conducted by Brooks *et al*. (2004) found inconsistent trends concerning the relationship between benthic macrofaunal density and depth off the U.S. east coast.

Live/Hard Bottom Communities

Hard bottom is a type of benthic habitat that can support sessile fauna, flora, and demersal fish species (Jones *et al*., 1985; Cahoon *et al*., 1990). Hard bottom is made up of three-dimensional geologic structures (topographic features) (*i.e*., rock outcroppings and hard fossil substrate) and is usually covered with a thin layer of soft sediments (Emery and Uchupi, 1972; LBG, 1999). Communities of living organisms found on hard bottom substrates include bryozoans, hard and soft corals, hydroids, anemones, encrusting algae, sponges, sea turtles, and commercial/recreational fishes (Jones *et al*., 1985; Cahoon *et al*., 1990). From Delaware Bay to Virginia there is not abundant hardbottom on the continental shelf but there are artificial reefs and shipwrecks throughout (Figures 3.6-1 and 3.6-2) (Steimle and Zetlin, 2000).

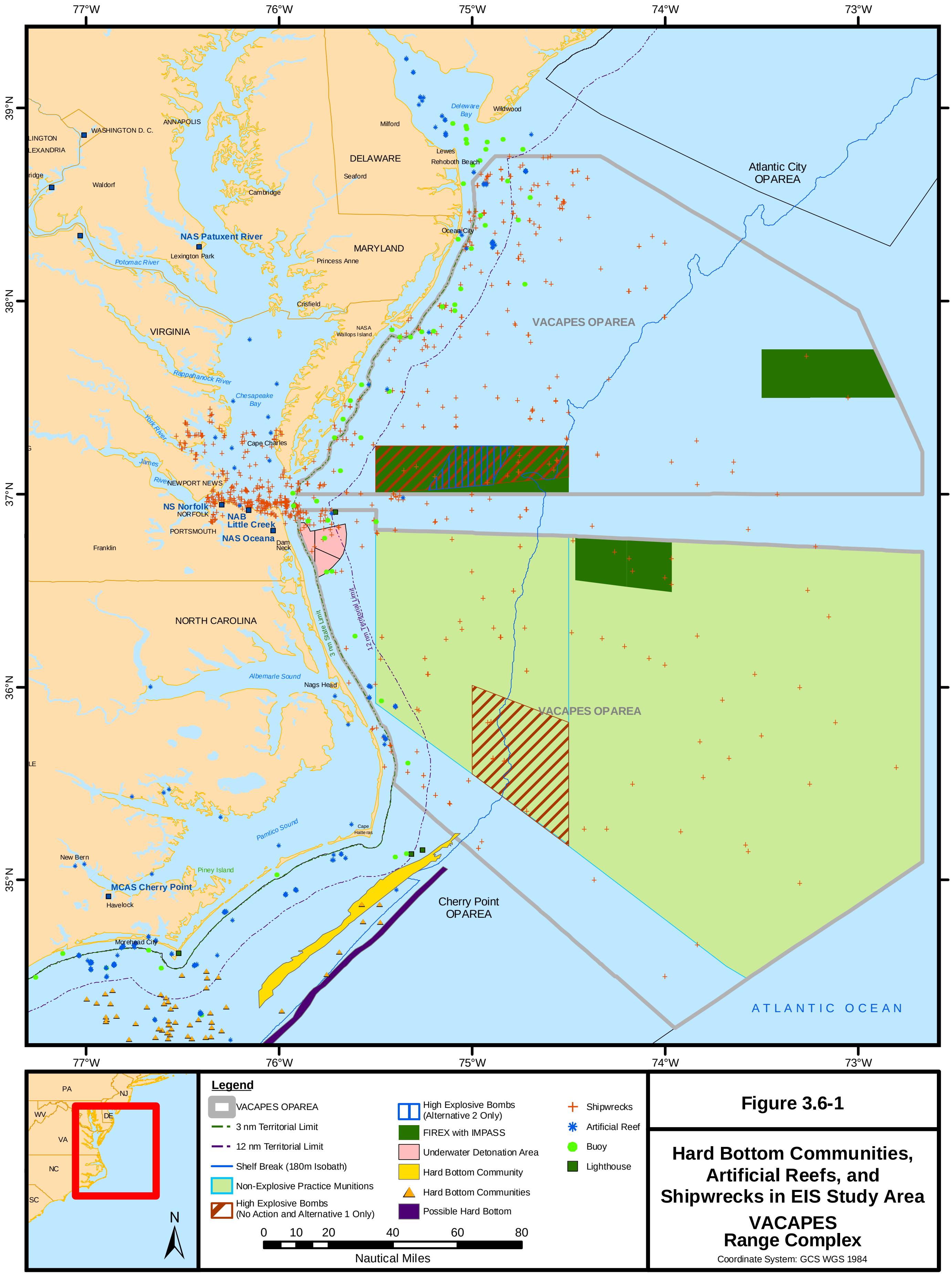


Figure 3.6-1

Hard Bottom Communities, Artificial Reefs, and Shipwrecks in EIS Study Area

VACAPES Range Complex

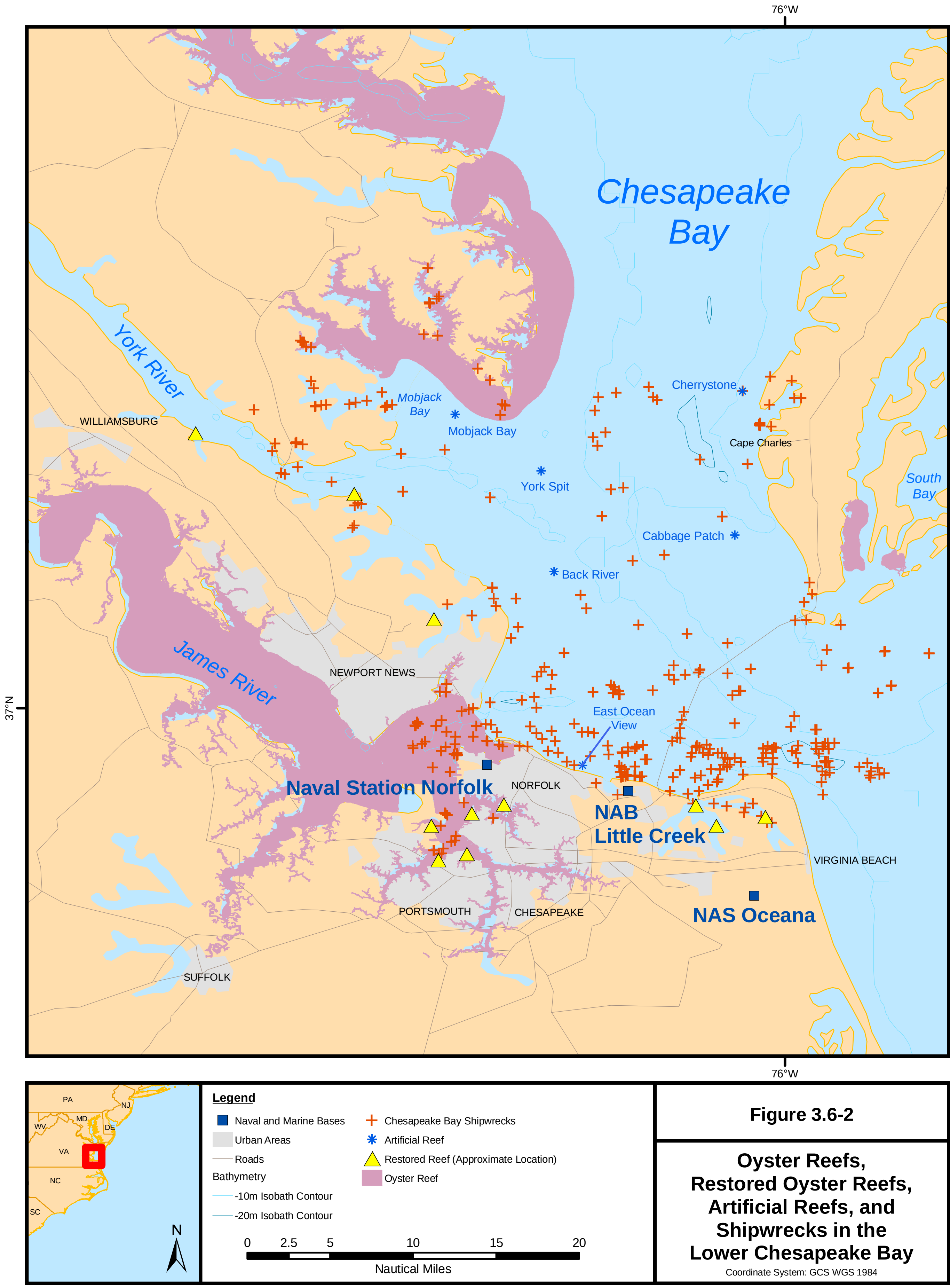


Figure 3.6-2

Oyster Reefs, Restored Oyster Reefs, Artificial Reefs, and Shipwrecks in the Lower Chesapeake Bay

Coordinate System: GCS WGS 1984

In general there have not been many comprehensive surveys of seafloor substrates conducted in the southern region of the Mid-Atlantic Bight except Wigley and Theroux (1981) conducted comprehensive macrobenthic surveys on the shelf and slopes within the Mid-Atlantic Bight. Off the coast of North Carolina there is considerable hard bottom as documented by the Southeast Area Monitoring Program (SEAMAP, 2001). The Bureau of Land Management (BLM) in 1975 also performed comprehensive benthic and hard bottom surveys along the continental shelf from North Carolina to Florida (BLM, 1976). The hard bottom that was surveyed by the BLM consisted of sponges, hard and soft corals, and various algae species (BLM, 1976).

Hard bottom of the VACAPES OPAREA consist of a variety of naturally-occurring and human-made substrates (Steimle and Zetlin, 2000) colonized by sessile and motile benthic organisms, and used by demersal organisms. Benthic communities include hard and soft corals, hydroids, anemones, crustaceans, encrusting algae, sponges, sea turtles, and commercial/recreational fishes (Wigley and Theroux ,1981; Jones *et al*., 1985; Steimle and Zetlin, 2000). Throughout the U.S. Atlantic continental shelf, hard bottom substrates composed of lower Miocene marl are overgrown by encrusting algae and various calcareous organisms (Emery and Uchupi, 1972). Benthic habitats in this area also include numerous sand and sand-shell shoals which do not support high biotic diversity. Yet, between shoals, "valleys" carved by currents do support considerable benthic diversity such as annelids and bivalves (Cutter and Diaz, 2000).

Shelf Fauna—Between, Delaware Bay and Maryland there is very little hard bottom (Figure 3.6-1) (Wigley and Theroux, 1981). Virginia's shelf sediments are comprised mostly of shell and sand-shell (very little hard bottom) with various shoals scattered throughout supporting macrobenthic organisms such as annelids, arthropods, and bivalves (Wigley and Theroux, 1981). North Carolina's shelf sediments are mostly comprised of a mixture of sand-shell and sand with various shoals supporting macrobenthic species including hard and soft corals, anemones, hydrozoans, zoanthids, annelids, arthropods, mollusks, isopods, and amphipods (Wigley and Theroux, 1981). The continental shelf off the coast of North Carolina is narrow. The convergence of the cold water currents flowing down from the north and the warm currents (*i.e*., Gulf Stream Current) flowing up from the south combined with steep topography off the coast of Cape Hatteras, North Carolina characterizes an area called "The Point". The Point supports a high assemblage of commercial fish species (*e.g*., dolphinfish and wahoo) (SAFMC, 2003; NOAA, 2006). A coral, coral reef, live, or hard bottom Habitat Area of Particular Concern is located at The Point (see Section 3.9 – Fish and Essential Fish Habitat and Figure 3.9-1).

From Delaware to northern North Carolina, the benthic fauna (mostly annelids and ophiuroides) of the outer continental shelf and slope are not as dense as the inner and mid-shelf fauna (Wigley and Theroux, 1981). The four submarine canyons within or near the VACAPES OPAREA (Wilmington, Baltimore, Washington, and Norfolk) (Figure 3.1-1) support numerous benthic species, including invertebrates, fish, and coral. In Baltimore Canyon Hecker *et al*. (1980) found crabs (*Geryon quinquedens*) and fish (*Synaphobranchus kaupi*) to be the most abundant deep sea organisms. The coral and sponge species found in Baltimore canyon are discussed below.

Coral (Hard and Soft) and Sponge Distributions

Corals are invertebrates in the phylum Cnidaria and classes Hydrozoa (fire and lace corals) and Anthozoa (subclasses Octocoralia and Hexacoralia) (Veron, 2000). Reef building corals are hexacorals and belong to the order Scleractinia. Octocorals include gorgonians, soft corals, and telastaceans. Corals exist throughout the worlds oceans at all depths (Veron, 2000). The most widely known corals are the true stony corals or scleractinians (*i.e*., hermatypic hard corals) which are coral reef frame builders in the tropics. Coral reefs are typically found in oligotrophic, shallow water (mostly up to a 50 m water depth) within a latitudinal range of 30°N and 30°S (Kaplan, 1982; Spalding *et al*., 2001). There are no tropical coral reefs within the VACAPES OPAREA or vicinity, but there are temperate corals found on the shelf that not only use photosynthesis as a mode of nutrition, but also consume zooplankton (Wigley and Theroux, 1981; Steimle and Zetlin, 2000). In addition deep sea corals are found along the continental slope between 200 and 1,000 m in the VACAPES OPAREA and vicinity and form large coral communities (see the section on deep sea corals for more information) (Reed *et al*., 2006).

Corals in the VACAPES OPAREA off North Carolina are protected from harvesting under the South Atlantic Fishery Management Council, fishery management plan for coral. This fishery management plan states that: "The Coral, Coral Reef, and Live/Hardbottom Habitat Plan prohibits the harvest of stony corals, sea fans, coral reefs, and live rock except as authorized for scientific and educational purposes (SAFMC, 2006)". The Mid-Atlantic Fishery Management Council has no management plans for corals (MAFMC, 2006). Coral, coral reef, live, or hard bottom Essential Fish Habitat has been identified in the OPAREA (see Section 3.9 Fish and Essential Fish Habitat and Figure 3.9-1).

Temperate corals appear to be limited in their distribution by biotic factors such as competition for substrate with macroalgae (Miller, 1995). Temperate corals are capable of surviving at high latitudes where solar irradiance is much less compared to tropical areas because of the availability of greater concentrations of phytoplankton and nutrients. Indeed, hermatypic corals can grow in high latitudes because they can capture and digest zooplankton and possibly alter their photoadaptive responses by slowing their photosynthetic and respiration rates (Jaques *et al*., 1977). Corals reproduce through sexual (spawning) and asexual (fragmentation) reproduction. Spawning occurs seasonally (Szmant, 1986). Physical-environmental factors influencing the growth of temperate corals, is not as clearly understood as it is for tropical corals (Miller, 1995).

Sponges (phylum Porifera) are found throughout the VACAPES OPAREA (see below for species and distribution). Sponges are multicellular filter feeders (although some are carnivorous) that rely on the supply of food (microscopic organisms) transported by water currents (UCMP, 2006). They live at all depths, temperatures, and latitudes, and come in many shapes (including vaselike, tubular, spherical, and fingerlike shapes) (Kaplan, 1982). Sponges have a seasonal reproduction cycle and reproduce both sexually and asexually (UCMP, 2006). Sponges are found in the VACAPES OPAREA (Wigley and Theroux, 1981; Steimle and Zetlin, 2000) and are not protected under the Mid-Atlantic Fishery Management Council (MAFMC, 2006).

<u>Nature and Distribution of Corals and Sponges on the Inner and Mid-shelf</u>—The VACAPES OPAREA has some isolated patches of soft and hard corals, hydroids, zoanthids, and sponges that colonize rock outcroppings, artificial reefs, and shipwrecks (Figure 3.6-1) (Steimle and Zetlin, 2000). The southern region (northern North Carolina) of the VACAPES OPAREA contains more sponge and coral coverage as natural hard bottom increases and warmer water temperatures prevail (Wigley and Theroux, 1981). Seventeen species of hard corals are found from Cape Hatteras to Maine, only one species is shallow (northern star coral [*Astrangia poculata*]); the remaining species are found in water depths of 100 m and deeper (Cairns and Chapman, 2001). The northern star coral is found in the shallow areas (1 to 35 m) of the VACAPES OPAREA and vicinity associated with hard bottom such as artificial reefs (Cairns and Chapman, 2001; Figley, 2003).

Whip coral (*Leptogorgia virgulata*) is a soft coral that grows in estuaries and coastal zones between 1 and 20 m (Kaplan, 1988). Whip coral is common in the Chesapeake Bay (Kaplan, 1988). The most common anthozoans in the VACAPES OPAREA are sea anemones (*Metridium senile*) and hydroids (Wigley and Theroux, 1981; Steimle and Zetlin, 2000). Sponges of the VACAPES OPAREA include *Halichondria* sp., *Polmastia* sp. and the loggerhead sponge, *Spheciosponia vesparia* (Wigley and Theroux, 1981; Steimle and Zetlin, 2000).

Deep Sea Coral (Hard and Soft) and Sponge Distributions

Nature and Distribution of Corals and Sponges on the Outer Shelf and Slope—While shallow reef building corals typically contain zooxanthellae which promote calcium carbonate accretion, deep sea corals do not. Nevertheless, localized accumulations of deep sea corals (scleractinians) can form extensive bioherms (mounds made of living organisms). Deep sea corals are found within a broad depth range (39 to 3,383 m), in cool water (4 to 13ºC), and on top of canyons, plateaus, edges of the continental shelf, and bases of slopes (Hecker *et al*., 1980; Freiwald *et al*., 2004). Deep sea corals occur as solitary colonies, thickets, coppices, and banks (Stetson *et al*., 1962; Avent *et al*., 1977; Cairns and Stanley, 1981; Mullins *et al*., 1981). Deep sea corals are slow growing, can live thousands of years, and thrive in areas exposed to strong currents and upwelling (Freiwald *et al*., 2004). They reproduce sexually and asexually and grow as large as their skeleton can support (Freiwald *et al*., 2004). Deep sea coral bioherms support hundreds of species of invertebrates and act as spawning and feeding grounds for commercially important species of fish such as grouper (SAFMC, 1998). Like deep sea corals, deep sea sponges can live thousands of years (8,000+ yr) (Freiwald *et al*., 2004).

Within the VACAPES OPAREA sponges exist in moderate densities between 1 and 24 m^2 along the outer shelf and rise region (Wigley and Theroux, 1981). Finger sponge (*Haliclona oculata*) is found in this region on the inner shelf from 1 to 124 m and can grow to a height of 46 cm. In addition to sponges, soft corals (*Alcyonaria*) are found in abundance along the shelf, slope, and part of the rise (Watling and Auster, 2005). In water depths greater than 500 m alcyonaceans such as *Anthomastus* spp., *Acanthogorgia* spp. *Acanella* spp., and *Anthothela* spp. are found within the VACAPES OPAREA. *Paragorgia arborea* and *Primnoa resedaeformis* are also found in the VACAPES OPAREA on the outer Continental shelf and upper slope (150 m) (Watling and Auster, 2005).

Besides sponges and soft coral species, several hard coral species also exist on the outer continental shelf within the VACAPES OPAREA such as: *Dasmosmilia lymani* (depth range: 48 to 366 m), and *Dellocyathus italicus* (403 to 2,634 m) (Cairns and Stanley, 1981). Past the outer shelf on the slope more hard coral species exist such as: *Solenosmilia variabilis* (280 to 2,165 m), *Flabellum alabastrum* (357 to 1,977 m), *Flabellum macandrewi* (128 to 1,170 m), *Flabellum angulare* (2,266 to 3,186 m), and *Javania cailleli* (400 to 2,165 m) (Cairns and Stanley, 1981).

Submarine canyons in the VACAPES OPAREA provide habitat for deep sea corals and sponges (primarily at depths between 100 and 2,000 m) along with commercially important fish species (Watling and Auster, 2005). Corals and sponges are found in the canyons despite heavy sedimentation and limited suitable substrates for attachment (Hecker *et al*., 1980). The upper slope fauna of Baltimore Canyon is similar to the fauna found on the nearby shallow water shelf (Hecker *et al*., 1980). The most abundant coral in the Baltimore Canyon is the small, white, sea pen (soft coral), *Pennatula aculeata*, which lives on soft sediment between 100 and 300 m (Hecker *et al*., 1980). The lower slope fauna of Baltimore Canyon (1,400 m+) has similar species to the upper slope fauna and is mainly composed of soft corals (Alcyonaceans) (Hecker *et al*., 1980, 1983).

Chesapeake Bay Benthic Communities

With a surface area of over 3,350 nm^2 and a watershed that encompasses some 64,000 square miles in parts of six states, the Chesapeake Bay is the largest estuarine system in the United States (Kemp *et al*., 2005) and is an important national treasure. The Bay provides habitat to more than 3,600 species of plants, fish, and other animals; is a commercial and recreational resource for more than 15 million people living in the watershed; and yields approximately 500 million pounds of seafood annually (Morgan and Owens, 2001). Live/hard bottom habitats within the lower Chesapeake Bay consist mainly of oyster reefs (also known as oyster bars, oyster beds, and aquatic reefs) (CBP, 2003a). Oyster reefs vary in size from clumps to large mounds (up to 33 feet in diameter) and consist of densely packed live and dead eastern oysters (*Crassostrea virginica*) (Bahr and Lanier, 1981; CBP, 2003a; CBP, 2005). Oyster reefs form intertidal and subtidal habitats, and primarily occur from just below the mean low water level to approximately 1.5 m above mean low water level. Oyster reefs can be found in 10 m of water, and in some cases down to a 30 m (Bahr and Lanier, 1981; Burrell, 1986; CBP, 2003a; CBP, 2005).

Oyster reefs provide habitat for over 40 species of sessile and motile organisms ranging from juvenile to adult life stages, including the eastern oyster, other bivalves, many finfish species, and crustaceans (Bahr and Lanier, 1981; Meyer and Townsend, 2000; Rodney and Paynter, 2006). Two hundred years ago, some oyster reefs in the Bay were large enough to be navigational hazards. Yet, intensive mechanized fishing practices, water pollution, and diseases have caused severe losses of oyster reef habitat in the Chesapeake Bay. From 1884 to 1992, the oyster catch in the Bay declined by 98 percent (from 615,000 tons to 12,000 tons). The native oyster population is currently believed to be 1 percent of what it was 200 years ago (Rothschild *et al*., 1994; CBP, 2005).

Within the lower Chesapeake Bay, oyster reefs are concentrated in the following general areas: James River, Elizabeth River, and Mobjack Bay (Figure 3.6-2) (Southworth *et al*., 2006; NOAA, 2007). However, no reefs are known or expected to occur in the immediate vicinity of the proposed Mine Warfare Training Areas. Federal, state, and local partners in Maryland and Virginia are implementing large-scale native oyster restoration projects and are conducting oyster management research to address native oyster population declines. Various oyster restoration and management techniques, including sanctuaries, managed reserves, and genetic rehabilitation, are being used in different parts of the Bay. Due to shortages of oyster shell for restoration projects, various alternative substrates are also being considered (NOAA, 2008). Since the early 1990s, the Virginia Marine Resources Commission (VMRC) Shellfish Conservation Division, Virginia Institute of Marine Science, and the Virginia Oyster Heritage Program originated the construction of over 80 sanctuary oyster reefs in the Chesapeake Bay (VIMS, 2006). Sixteen of these reefs are within the Study Area in the East, North, Ware, York, Poquoson, Back, Elizabeth, Lafayette, and Lynnhaven Rivers, and Broad Bay (Berman *et al*., 2002; VIMS, 2006) (Figure 3.6-2), but none are located in the immediate vicinity of the proposed Mine Warfare Training Areas.

3.6.2.3 Seagrasses/Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) refers to benthic macroalgae and seagrasses that grow in or attach to soft sediments in relatively shallow coastal, estuarine, and freshwater habitats. Macroalgae (sometimes called seaweed) are multicellular, eukaryotic algae held to the substrate by holdfasts (root-like structures). Seagrasses are vascular, rooted flowering plants that are adapted to the saline environment and grow fully submerged (Dennison *et al*., 1993). Both seagrasses and macroalgae grow in often dense aggregations called beds. SAV beds are highly productive and provide habitat for many fish and wildlife species. Their importance to coastal and estuarine ecosystems has been acknowledged in the past 20 years. Beds of SAV provide food, protective habitat, nutrient sinks, substrate for epiphytes, and sediment/shoreline stabilization (Hemminga and Duarte, 2000).

The OPAREA and areas along the Atlantic Ocean shoreline do not support SAV communities. In the VACAPES Study Area, SAV habitats are limited to nearshore, shallow waters of the lower Chesapeake Bay where there is sufficient light and unconsolidated sediment to support their root systems (Figure 3.6-3). High salinity communities of eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) are most common in this area (CBP, 2006). Historically, the Chesapeake Bay has supported more than 200,000 acres of SAV habitat. In the late 1960s and early 1970s, the Bay experienced a large scale decline in SAV habitat that affected all major species and reduced overall SAV abundance by 90 percent (Orth and Moore, 1984). SAV has been steadily recovering since the low point in 1984 when

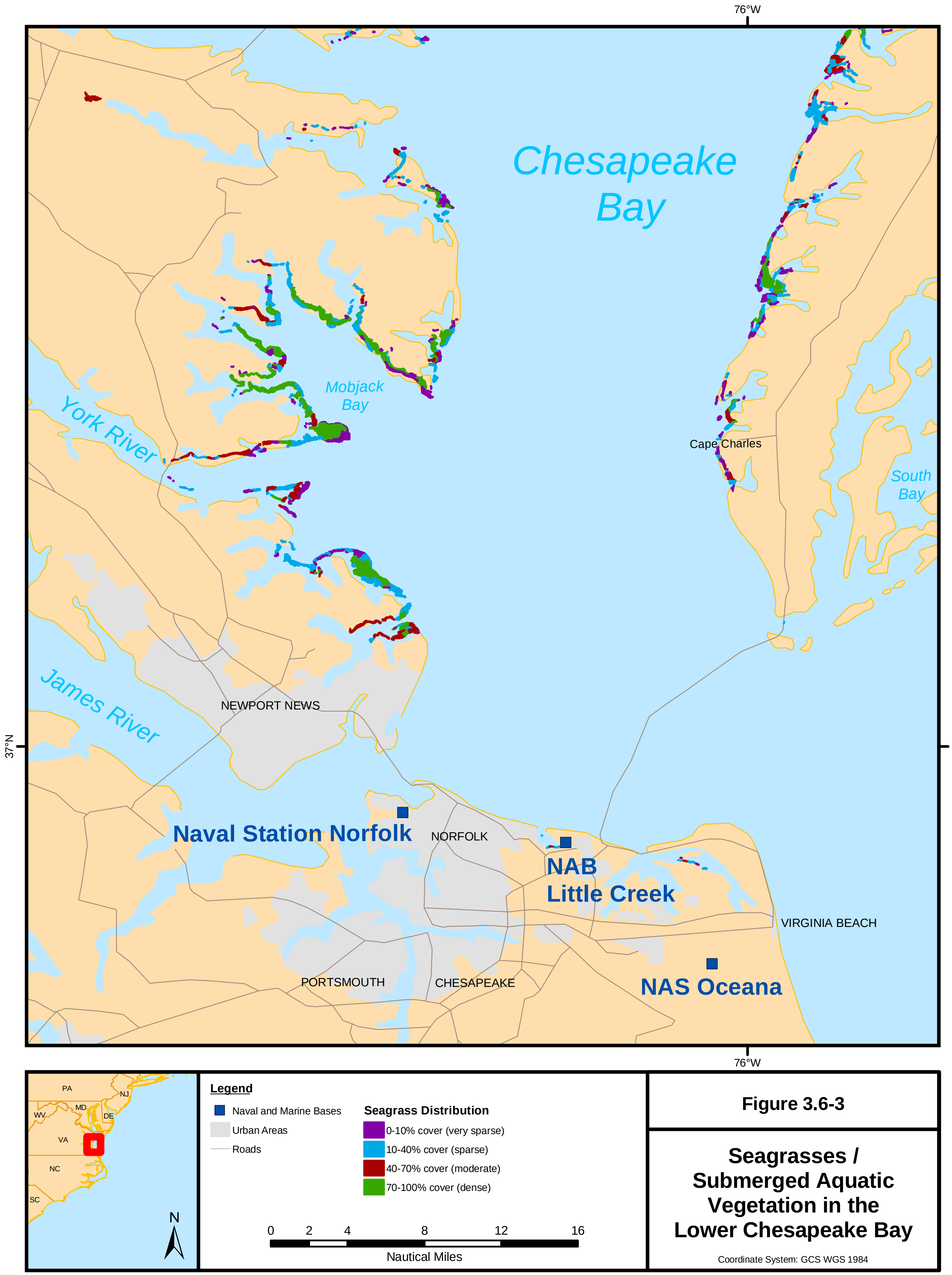


Figure 3.6-3

Seagrasses / Submerged Aquatic Vegetation in the Lower Chesapeake Bay

a survey in the Chesapeake Bay and its tidal tributaries documented only 37,000 acres of SAV habitat. Since 1984, the restoration of SAV habitats through water quality control has been a cornerstone of Bay management policies (CBP, 1987). Due to the amount of light attenuation through the water column of Chesapeake Bay waters, SAV habitats are confined to shallow waters less than 2 m deep (Cerco *et al*., 2004). Therefore, SAV habitats are not expected to be present in the proposed lower Chesapeake Bay Mine Warfare Training Areas (Figure 3.6-3). Similarly, no tidal flats or tidal marshes are located in the immediate vicinity of the proposed Mine Warfare Training Areas (DoN, 2007).

3.6.2.4 Artificial Habitats

Epibenthic marine organisms (organisms that live on the top of the sea floor) such as algae, sponges, anemones, barnacles, and tunicates require a hard surface on which to attach, develop, and grow (Bohnsack *et al.*, 1991). Since soft sediments such as sand dominate the sea floor of the Study Area, some of the only hard substrate available for attachment is artificial reefs. Artificial reefs may have been created accidentally (shipwrecks) or deliberately (National Artificial Reef Plan, Liberty Ship Act, and various state artificial reef programs [VMRC, 2001]). The National Fishing Enhancement Act of 1984 defined an artificial reef as a man-made structure created in the navigable waters of the United States or in waters adjacent to the outer continental shelf (Seaman, 2000). Artificial reefs consist of such materials as rock or concrete rubble, decommissioned military vehicles, culverts, and even retired offshore oil/gas production platforms. The deliberate purpose underlying construction of artificial reefs is to create and enhance marine benthic habitat as well as help improve recreational fishing. An additional effect of artificial reef construction has been broadening the distribution of some species into previously unoccupied habitat (Seaman, 2000).

Whether purposefully or accidentally created, artificial reefs are so successful at enhancing habitat and improving fishing that they are called fish havens on some nautical charts. In addition to recreational fishing, artificial reefs and shipwrecks also support the recreational diving and commercial fishing industries. Commercial use may involve setting pots or gillnets adjacent to reefs or trawling along the outer margins of a reef (Polovina, 1991). Commercial and recreational use of these areas varies from state to state, as do restrictions that regulate individual species. Some of the species found on artificial reefs in the VACAPES OPAREA area include black sea bass, monkfish, and scup.

The states adjacent to the VACAPES OPAREA (North Carolina, Virginia, Maryland, and Delaware) have each established non-profit, artificial reef programs. Of the four states, Virginia has the largest artificial reef program, having created more reefs than any of its neighbors. There are 41 offshore artificial reefs (there seem to be fewer because of their proximity and map scale) within the VACAPES OPAREA, found primarily nearshore on the inner continental shelf (Figure 3.6-1). Shipwrecks also provide excellent habitat for fishes and invertebrates. The VACAPES OPAREA contains 159 shipwrecks, most of which are more widely dispersed on the continental shelf than the artificial reefs. The concentration of shipwrecks off the North Carolina coast near Cape Hatteras and the Outer Banks gives evidence to why this area has been coined, "the graveyard of the Atlantic."

The VMRC currently manages 22 artificial reefs in the Chesapeake Bay. There are seven artificial reef sites within the lower Chesapeake Bay portion of the Study Area, five off the western shore (Mobjack Bay, York Spit, Poquoson, Back River, East Ocean View) and two off the eastern shore (Cherrystone and Cabbage Patch) (Figure 3.6-2, Table 3.6-2). While an artificial reef site is found near the Poquoson River, the VMRC provides no formal description of the site. Further, an artificial reef was established in May 2007 southeast of the Bluefish Rock area (south of the Back River artificial reef site). Artificial reef sites of the lower Chesapeake Bay are intended to replenish the fish population of the Chesapeake Bay by creating foraging habitat and shelter. Artificial reef material is colonized by suspension feeders (bivalves, barnacles) and macrofauna (polychaetes, crabs, and other crustaceans). Macrofauna living on artificial reefs attract predatory fish including tautog, sea bass, amberjack, bluefish, king mackerel, cobia, striped bass, and sharks (VMRC, 2007).

TABLE 3.6-2
ARTIFICIAL REEF SITES OF THE LOWER CHESAPEAKE BAY

Artificial Reef	Materials Used	Depth (m)	Profile (m)
Mobjack Bay Reef	Concrete pipe (1,250 tons); Bridge sections and rubble (8,202 tons)	8	No data
York Spit Reef	Concrete pipe; reef balls; bridge sections (21,000 tons)	9	3
Poquoson Reef	No data	No data	No data
Back River Reef	Concrete igloos (40 units); concrete tetrahedrons; concrete pipe; girders; clusters; concrete bridge sections and piles (2,400 tons)	7	2
East Ocean View Reef	Concrete igloos (40 units); concrete tetrahedrons; concrete bridge rubble (1,000 tons)	8	2
Cherrystone Reef	Concrete igloos; stacks of concrete pipe; concrete deck stations (Chesapeake Bay Bridge Tunnel); tires in concrete (2,900 units); concrete block (2,000 tons)	10	2
Cabbage Patch	Double T beams (36 units; each 60 ft in length); concrete slabs (28 units); concrete sinkers (187 tons); concrete block (1,000 tons); reef balls (10 units)	9	2

Source: VMRC, 2007.

Over 1,800 shipwrecks exist in the Chesapeake Bay (CBP, 2003b), 348 of which are located within the lower Chesapeake Bay Study Area (Figure 3.6-2) (Veridian Corporation, 2001). Most shipwrecks found within the lower Chesapeake Bay lie in shallow waters (less than 10 m) and potentially support numerous live benthic communities, including sessile and motile benthic organisms as well as fish.

3.6.3 Environmental Consequences

3.6.3.1 No Action Alternative

Vessel Movements

Many of the ongoing and proposed operations within the VACAPES Study Area involve maneuvers by various types of surface ships, boats, and submarines (collectively referred to as vessels) (see Tables 2.2-4 and 2.2-5). Currently, the number of Navy vessels operating in the Study Area varies based on training schedules and can range from 0 to about 10 vessels at any given time. Currently there are about 67 surface ships and submarines homeported in Norfolk. Ship sizes range from 362 feet for a nuclear submarine (SSN) to 1,092 feet for a nuclear powered aircraft carrier (CVN). During training and operations, speeds generally range from 10 to 14 knots. Operations involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to two weeks. These operations are widely dispersed throughout the OPAREA, which is a vast area encompassing 27,661 nm^2 (an area approximately the size of Indiana). Consequently, the density of ships within the Study Area at any given time is extremely low (*i.e.*, less than 0.0004 ships/nm^2). The Navy would log about 1,400 total steaming days within the Study Area during a typical year under the No Action Alternative. Vessel movements would have no direct effect on benthic communities or artificial habitats because Navy vessels are operated in relatively deep waters and have navigational capabilities to avoid contact with these habitats. Seagrasses and SAV would not be directly affected by vessel movements because these communities do not occur in areas where Navy vessels are operated.

Vessel movements would result in short-term and localized disturbances to water column and *Sargassum* habitats. Phytoplankton, zooplankton, and ichthyoplankton in the upper portions of the water column could be displaced, injured, or killed by vessel and propeller movements. However, no measurable effects on plankton populations would occur because the number of organisms exposed to vessel movements would be low relative to total plankton biomass. Navy mitigation measures include avoidance of large *Sargassum* mats by vessels (Chapter 5). Vessel movements in territorial waters would have no significant impact on marine communities under the No Action Alternative. Similarly, vessel movements in non-territorial waters would not cause significant harm to marine communities under the No Action Alternative.

Aircraft Overflights

Various types of fixed-wing aircraft and helicopters are used in training exercises throughout the VACAPES Study Area (see Chapter 2 and Appendix D). These aircraft overflights would produce airborne noise and some of this energy would be transmitted into the water. The potential effects of aircraft noise on various marine community components are analyzed in detailed in Sections 3.7 – Marine Mammals, 3.8 – Sea Turtles, and 3.9 – Fish and Essential Fish Habitat. Based on the analyses presented in those sections, aircraft overflights over territorial waters would have no significant impact on marine communities under the No Action Alternative. In addition, aircraft overflights over non-territorial waters would not cause significant harm to marine communities under the No Action Alternative.

Towed Mine Warfare Devices

As described in Chapter 2 and Appendix D, Mine Warfare Exercises conducted in the Study Area include the use of various underwater mine detection and countermeasures systems that are towed through the water by helicopters flying approximately 75 ft above the water at low airspeeds. Under the No Action Alternative, this training would occur in the lower Chesapeake Bay, W-50C, and portions of the OPAREA within 45 nm of NS Norfolk (see Figures 2.2-1, 2.2-2, 2.2-3, and 2.2-4). The use of towed Mine Warfare devices would result in short-term and localized disturbances to the water column, but benthic habitats would not be affected because the devices are not towed on the bottom. Training with these devices is conducted in areas where little or no *Sargassum* habitat is expected to occur. Plankton in the upper portions of the water column could be displaced, injured, or killed by towed devices. However, no measurable effects on plankton populations would occur because the number of organisms exposed would be low relative to total plankton biomass. The use of towed Mine Warfare devices in territorial waters under the No Action Alternative would have no significant impact on marine communities. Furthermore, the use of towed Mine Warfare devices in non-territorial waters would not cause significant harm to marine communities.

Non-explosive Mine Shape Deployment/Recovery

The No Action Alternative does not include establishment of Mine Warfare Training Areas where non-explosive mine shapes would be deployed.

Non-explosive Practice Munitions

Current Navy operations in the Study Area include firing a variety of weapons and employ a variety of NEPM, including bombs, missiles, naval gun shells, cannon shells, and small caliber ammunition. NEPM use occurs in several training areas, but its use in state waters (0 to 3 nm from shore) is limited to R-6606 (see Table 2.2-6 for a summary of ordnance use by training area). Ordnance use is not authorized in W-110, W-387, or the lower Chesapeake Bay. Therefore, NEPM use would have no effect on marine communities in these areas, including seagrasses, SAV, or oyster reefs.

NEPM and associated shrapnel have the potential to directly strike marine life and marine habitats as it travels through the water column and comes in contact with the sea floor. The potential effects of direct NEPM strikes at or near the sea surface and within the water column are analyzed in Sections 3.7.3 –

Marine Mammals, Section 3.8.3 - Sea Turtles, and Section 3.9.3 – Fish and Essential Fish Habitat. This section analyzes the potential effects of NEPM strikes on benthic communities and artificial habitats.

The potential for NEPM strikes to adversely affect benthic communities depends on several factors, including the size and speed of the ordnance, water depth, the number of rounds delivered, the frequency of training, and the presence/absence of sensitive benthic communities. While a broad area of benthic habitat could be exposed to direct NEPM strikes, the training exercises are intermittent and widely dispersed, which decreases the likelihood that a given area would be subjected to repeated exposure. With the exception of exercises that take place in R-6606 and W-50, NEPM use is limited to areas greater than 12 nm offshore in relatively deep water (greater than 20 m). NEPM velocity would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, NEPM strikes would cause minimal physical damage to benthic habitat and any damage would be localized.

The sand, clay, and silt substrates that are most prevalent in the OPAREA (Figure 3.1-2) support soft bottom communities, which have lower diversity and abundance than live/hard bottom communities. Soft bottom communities would be expected to recover quickly from any minor damage caused by NEPM strikes through natural sedimentation processes and recolonization.

Live hard bottom or artificial habitats would be vulnerable to damage from NEPM strikes. This is particularly true for areas that support coral because coral is fragile and could be easily broken by contact with larger objects such as non-explosive practice bombs. Repopulation and recovery of damaged hard bottom habitats would be relatively slow compared to soft bottom areas (NRC, 2002).

Non-explosive practice bombs are the largest types of NEPM used in the OPAREA (Table 3.6-3). Based on their weight, non-explosive practice bombs could cause damage if they struck sensitive hard bottom habitat. A total of 295 non-explosive practice bombs would be dropped per year under the No Action Alternative in W-72A/B. Assuming an even distribution, the relative concentration of non-explosive practice bombs would be 2.1 per 100 nm^2/year. Actual concentrations would vary based on specific training scenarios, but would nonetheless be extremely low. The maximum area of benthic habitat affected by non-explosive practice bomb strikes would be approximately 3,306 ft^2 per year or 33,060 ft^2 over a ten-year period for the No Action Alternative, assuming that the area affected by a single non-explosive practice bomb would be two times its footprint (Table 3.6-4).

TABLE 3.6-3
SIZE OF NON-EXPLOSIVE PRACTICE BOMBS USED IN THE VACAPES OPAREA

NEPM Type	Weight (pounds)	Length (inches)	Diameter (inches)	Footprint (ft^2)[(2)]
BDU-45	500	66	11	5.0
MK-76	25	25	4	0.7
MK-20 Rockeye Cluster (each dispenses 247 bomblets)	1.32 (per bomblet)	6.5 (per bomblet)	2 (per bomblet)	22.3 (total per bomb)
MK-82	500	90	11	6.9
MK-83[(1)]	1,000	119	14	11.6
MK-84	2,000	129	18	16.1

[(1)]Alternative 2 only.
[(2)]Length x diameter.

TABLE 3.6-4
ESTIMATES OF MARINE BENTHIC HABITAT THAT WOULD BE AFFECTED BY NON-EXPLOSIVE PRACTICE BOMBS IN THE VACAPES OPAREA

NEPM Type	No Action Alternative		Alternative 1		Alternative 2	
	#/Yr	Area Affected/Yr (ft^2)(1)	#/Yr	Area Affected/Yr (ft^2)(1)	#/Yr	Area Affected/Yr (ft^2)(1)
BDU-45	45	450	50	500	50	500
MK-76	185	259	204	286	204	286
MK-20	51	2,275	56	2,498	68	3,033
MK-82	7	97	8	110	158	2,180
MK-83	0	0	0	0	50	1,160
MK-84	7	225	7	225	7	225
Total =	295	3,306	325	3,619	537	7,384

(1)Assumed that the area of marine benthic habitat affected per year = footprint x 2 x #/yr.

As shown in Figure 3.6-1, few artificial reefs are located in W-72-A/B and shipwrecks are widely dispersed. The probability of non-explosive practice bombs striking artificial habitats would be low because these resources occupy a relatively small area.

Based on the limited hard bottom OPAREA (Figure 3.6-1), it is possible that a small percentage of non-explosive practice bombs would strike in these areas. The potential for strikes to adversely affect benthic communities in these areas would depend on the substrate and community types found at the point of physical impact. Given the dispersed nature of the training activities, often patchy distribution of community types, and relatively limited bottom mapping data, it is not possible to accurately determine the number of non-explosive practice bombs that would strike soft bottom habitats versus more sensitive areas such as live hard bottom. Nonetheless, the total area of benthic habitat affected by non-explosive practice bomb strikes would be small (about 3,306 ft^2 per year) and only a percentage of the total area affected (far less than 3,306 ft^2 per year) would be sensitive benthic habitat such as live hard bottom.

Non-explosive practice bomb strikes could result in long-term, minor effects to benthic communities, but the effects would be localized and no long-term changes to community structure or function would be expected. NEPM strikes in territorial waters would have no significant impact on marine communities under the No Action Alternative. Similarly, NEPM strikes in non-territorial waters would not cause significant harm to marine communities under the No Action Alternative.

Underwater Detonations and High Explosive Ordnance

Explosions that occur in the OPAREA are associated with training exercises that use HE ordnance, including bombs (BOMBEX), missiles (MISSILEX), and naval gun shells (FIREX with IMPASS, 5-inch HE rounds), as well as underwater detonations associated with Mine Neutralization training (MINEX). Underwater detonation and HE ordnance use is limited to specific training areas (see Table 2.2-7 for a summary of explosions by training area) and does not occur in the lower Chesapeake Bay or in state waters of the Atlantic Ocean (0 to 3 nm from shore). The potential effects of explosions on marine mammals, sea turtles, fish, and their habitat are analyzed in Sections 3.7.3, 3.8.3, and 3.9.3, respectively. This section analyzes the potential effects of underwater detonations and HE ordnance use on benthic communities and artificial habitats. Underwater detonations and HE ordnance use do not occur in nearshore waters and would not affect seagrasses, SAV, or oyster reefs.

Explosions associated with BOMBEX, MISSILEX, and FIREX with IMPASS occur at or near the water's surface in areas where depths range from 20 m to over 2,900 m. Of the ordnance types used during these exercises, the MK-84 HE bomb has the highest net explosive weight (NEW) (944.7 lbs). Using the equation presented in Swisdak (1978), the maximum radius of the gas bubble produced by a MK-84 HE bomb explosion would be about 11.9 m. The gas bubble would not extend to the bottom based on the minimum water depth (20 m) and a detonation depth of 1 m below the surface. Likewise, the gas bubbles produced by other ordnance types used in BOMBEX, MISSILEX, and FIREX would not extend to the bottom because they have smaller NEWs. Therefore, explosions during BOMBEX, MISSILEX, and FIREX are expected to have minimal effects on benthic communities and artificial habitats. These explosions would result in short-term and localized disturbances to the water column. Plankton in the immediate vicinity of explosions would be injured or killed. However, no measurable effects on plankton populations would occur because the number of organisms affected would be low relative to the total plankton biomass. Effects of explosions on *Sargassum* would be minimal because Navy mitigation measures (see Chapter 5) include avoidance of *Sargassum* mats.

Underwater detonations would be associated with mine neutralization training exercises, where explosive ordnance disposal detachments place explosive charges next to or on non-explosive practice mines. Under the No Action Alternative 12 charges with 20-lbs NEW would be detonated per year in W-50, where water depths range from about 15 to 20 m. Some charges would be detonated directly on the bottom and the others would be detonated in the water column.

The Navy does not set explosive charges within 1,000 ft of known live/hard bottom, artificial reefs, and shipwrecks (see Chapter 5 for detailed description of Navy mitigation measures). Therefore, only unconsolidated, soft bottom habitats would be exposed to impacts from underwater detonations. Cratering of soft bottom sea floor and water column disturbance would result from underwater detonations. For a specific size of explosive charge, crater depths and widths would vary depending on depth of the charge and sediment type, but crater dimensions generally decrease as bottom depth increases. A 20-lbs NEW charge detonated on the bottom can create depressions in the substrate up to 4 to 5 ft in diameter and 1 ft deep (DoN, 2000). Assuming a worst-case scenario where all underwater detonations occurred on the bottom, about 151 to 235 ft^2 of benthic habitat would be affected per year. Crater effects are usually temporary in sand and mud bottoms. Only short-term increases in turbidity and resuspension of bottom sediments would be expected. Repopulation of displaced sediments should be relatively rapid compared to hard bottom areas (NRC, 2002).

Underwater detonations and HE ordnance use in territorial waters would have no significant impact on marine communities under the No Action Alternative. Furthermore, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to marine communities under the No Action Alternative.

<u>Military Expended Materials</u>

The Navy uses a variety of military expended materials during training exercises conducted in the OPAREA. The types and quantities of military expended materials used and information regarding fate and transport of these materials within the marine environment are discussed in Section 3.2 (Hazardous Materials and Hazardous Waste Section). Soft bottom benthic communities throughout the OPAREA would be exposed to military expended materials because use is widely dispersed and a majority of the materials rapidly sink to the sea floor. The analysis presented in Section 3.2 indicates that military expended materials would become encrusted by natural processes and incorporated into the sea floor, with no significant accumulations in any particular area and no negative effects to water quality. Some of the materials are the same as those often used in artificial reef construction (*e.g.,* concrete and metal) and would be colonized by benthic organisms that prefer hard substrate. This colonization could result in localized increases in species richness and abundance, but no significant changes in community structure or function would be anticipated based on the limited amount and dispersed nature of the materials. Military expended material use in territorial waters would have no significant impact on marine communities under the No Action Alternative. Furthermore, military expended material use in non-territorial waters would not cause significant harm to marine communities under the No Action Alternative.

3.6.3.2 Alternative 1

Vessel Movements

Vessel movements would increase by about 1.4 percent per year in the VACAPES Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased potential for phytoplankton, zooplankton, and ichthyoplankton in the upper portions of the water column to be displaced, injured, or killed by vessel and propeller movements compared to baseline conditions. However, no measurable effects on plankton populations would occur because the number of organisms exposed to vessel movements would continue to be low relative to total plankton biomass. Navy mitigation measures would continue to include avoidance of large *Sargassum* mats by vessels (Chapter 5). Vessel movements in territorial waters would have no significant impact on marine communities under Alternative 1. Similarly, vessel movements in non-territorial waters would not cause significant harm to marine communities under Alternative 1.

Aircraft Overflights

Alternative 1 would include a 10 percent increase in fixed-wing aircraft sorties per year and an 88 percent increase in helicopter sorties per year in the VACAPES Study Area (Table 2.2-5). A majority of the new helicopter sorties would occur over the lower Chesapeake Bay and in W-50. The potential affects of aircraft noise on various marine community components are analyzed in detailed in Sections 3.7 – Marine Mammals, 3.8 – Sea Turtles, and 3.9 – Fish and Essential Fish Habitat. Based on the analyses presented in those sections, aircraft overflights over territorial waters would have no significant impact on marine communities under Alternative 1. In addition, aircraft overflights over non-territorial waters would not cause significant harm to marine communities under Alternative 1.

Towed Mine Warfare Devices

Towed Mine Warfare device sorties would increase by 75 percent per year under Alternative 1. Similar to the No Action Alternative, use of towed Mine Warfare devices under Alternative 1 would result in short-term and localized disturbances to the water column, but benthic habitats would not be affected because the devices are not towed on the bottom. Training with these devices would be conducted in areas where little or no *Sargassum* habitat is expected to occur. Plankton in the upper portions of the water column could be displaced, injured, or killed by towed devices. However, no measurable effects on plankton populations would occur because the number of organisms exposed would be low relative to total plankton biomass. The use of towed Mine Warfare devices in territorial waters under Alternative 1 would have no significant impact on marine communities. Furthermore, the use of towed Mine Warfare devices in non-territorial waters would not cause significant harm to marine communities.

Non-explosive Mine Shape Deployment/Recovery

As discussed in Chapter 2, a Mine Warfare Training Area would be designated in W-50C under Alternative 1 (Figure 2.2-1). This section addresses potential effects on marine communities associated with establishing and maintaining this training area (*i.e.*, non-explosive mine shape deployment/recovery). The effects of conducting training exercises in this area are the same as those analyzed under aircraft overflights and towed Mine Warfare devices.

As discussed in Chapter 2, the mine shape assembly would include a concrete anchor, mooring line (steel cable or chain), and the mine shape. In some cases the entire assembly (mine shape, mooring line, and anchor) would be deployed concurrently from a boat or aircraft and recovered immediately following the exercise. In other cases concrete anchors would be permanently placed on the sea floor and divers would attach the mooring lines and mine shapes for specific exercises. Mine shapes and mooring lines that would not pose a navigation or fishing hazard could be left in place for up to six months. Up to 20 permanent concrete anchors would be placed in the proposed Mine Warfare Training Area in W-50C (Figure 2.2-2).

The process of deploying and recovering mine shape assemblies would result in localized disturbances to benthic habitat. Benthic organisms could be crushed, injured, or killed by the impact of the concrete anchor. Approximately 6.25 ft^2 of benthic habitat would be disturbed when a concrete anchor makes contact with the sea floor. A similar size area would be affected when a concrete anchor is recovered. The total area affected per year is not expected to exceed 125 ft^2 based on 20 deployments/recoveries per year. Soft bottom substrates occur in the proposed training area. Mine shapes would not be deployed in areas with live/hard bottom, oyster reefs, SAV, artificial reefs, or shipwrecks. Therefore, disturbed benthic areas would be expected to quickly recover through natural sedimentation processes. The process of divers attaching mooring lines and mines shapes to permanent concrete anchors would not be expected to result in more than minor habitat disturbances.

The permanent concrete anchors would result in minor, long-term changes to benthic habitat. Each permanent anchor would provide about 31.25 ft^2 of exposed hard surface area. Similar to an artificial reef structure, the anchors would be colonized overtime by benthic organisms that prefer hard substrate and would provide structure that could attract some species of fish. Localized increases in species richness and abundance could occur, but significant changes in community structure or function would not be anticipated based on the small surface area provided (625 ft^2 for 20 anchors) and the dispersed nature of the anchors. Mine shape deployment/recovery in territorial waters under Alternative 1 would have no significant impact on marine communities. Mine shape deployment/recovery would not take place in non-territorial waters and would have no effect on marine communities in non-territorial waters.

Non-explosive Practice Munitions

The amount of NEPM used in the VACAPES Study Area would increase under Alternative 1 (Tables 2.2-5 and 2.2-6). The number of non-explosive practice bombs dropped in W-72A/B would increase from 295 to 325 per year (Table 3.6-3). These changes would result in increased potential for NEPM to strike benthic communities and artificial habitats compared to baseline conditions. NEPM velocity would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, NEPM strikes would cause little or no physical damage to soft bottom benthic habitat and any damage would be localized.

The area affected by non-explosive practice bombs would increase under Alternative 1. The relative non-explosive practice bomb concentration would increase from 2.1 to 2.3 per 100 nm^2/year in W-72A/B. The probability of non-explosive practice bombs striking hard bottom or artificial habitats would increase under Alternative 1. However, the total area of benthic habitat affected would continue to be small. As shown in Table 3.6-4, the maximum area of benthic habitat affected by non-explosive practice bomb strikes would increase from 3,306 ft^2 per year to 3,619 ft^2 per year or 36,190 ft^2 over a ten-year period. Only a percentage of the total area affected (far less than 3,619 ft^2 per year) would be sensitive benthic habitat such as live hard bottom. Non-explosive practice bomb strikes under Alternative 1 could result in long-term, minor effects to benthic communities, but the effects would be localized and no long-term changes to community structure or function would be expected. NEPM strikes in territorial waters would have no significant impact on marine communities under Alternative 1. Similarly, NEPM strikes in non-territorial waters would not cause significant harm to marine communities under Alternative 1.

Underwater Detonations and High Explosive Ordnance

The number and location of explosions that would occur under Alternative 1 would be the same as the No Action Alternative, with the exception of increases in Hellfire missiles and 20-lb NEW underwater detonations (Tables 2.2-5 and 2.2-7). The number of explosions associated with Hellfire missile use would increase from 30 to 60 per year under Alternative 1. These explosions would continue to occur at or near the water's surface in relatively deep water (Air-K and W-72A). As discussed for the No Action Alternative, explosions at or near the surface are expected to have minimal effects on benthic communities and artificial habitats because the explosions' gas bubbles would not reach the bottom. These explosions would result in short-term and localized disturbances to the water column. Plankton in the immediate vicinity of explosions would be injured or killed. However, no measurable effects on plankton populations would occur because the number of organisms affected would be low relative to the total plankton biomass. Effects of explosions on *Sargassum* would be minimal because Navy mitigation measures (see Chapter 5) include avoidance of *Sargassum* mats.

The number of explosions associated with 20-lb NEW underwater detonations would increase from 12 to 24 in W-50 under Alternative 1 (Table 2.2-7). These changes would result in increased potential for explosions to disrupt soft bottom benthic habitat compared to baseline conditions. However, the amount of habitat affected would continue to be small (about 302 to 470 ft^2 per year) and the effects would be short-term and localized. Explosions in territorial waters would have no significant impact on marine communities under Alternative 1. Furthermore, explosions in non-territorial waters would not cause significant harm to marine communities under Alternative 1.

Military Expended Materials

The amount of military expended materials entering the marine environment would increase in the Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased exposure of benthic communities to military expended materials. However, the analysis presented in Section 3.2 indicates that no significant accumulations of expended materials would occur in any particular area and water quality would not be negatively affected by military expendable materials. Some of the materials would be colonized by benthic organisms that prefer hard substrate, resulting in localized increases in species richness and abundance. No significant changes in community structure or function would be anticipated based on the limited amount and dispersed nature of the materials. Military expended material use in territorial waters would have no significant impact on marine communities under Alternative 1. Furthermore, military expended material use in non-territorial waters would not cause significant harm to marine communities under Alternative 1.

3.6.3.3 Alternative 2 (Preferred Alternative)

Vessel Movements

Vessel movements that would occur under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2. Vessel movements in territorial waters would have no significant impact on marine communities under Alternative 2. Similarly, vessel movements in non-territorial waters would not cause significant harm to marine communities under Alternative 2.

Aircraft Overflights

Alternative 2 would include a 4.5 percent increase in fixed-wing aircraft sorties per year and a 92 percent increase in helicopter sorties per year in the VACAPES Study Area (Table 2.2-5). A majority of the new helicopter sorties would occur over the lower Chesapeake Bay and in W-50. The potential affects of aircraft noise on various marine community components are analyzed in detailed in Sections 3.7 – Marine

Mammals, 3.8 – Sea Turtles, and 3.9 – Fish and Essential Fish Habitat. Based on the analyses presented in those sections, aircraft overflights over territorial waters would have no significant impact on marine communities under Alternative 2. In addition, aircraft overflights over non-territorial waters would not cause significant harm to marine communities under Alternative 2.

Towed Mine Warfare Devices

Towed Mine Warfare device sorties would increase by 78 percent per year under Alternative 2. Similar to the No Action Alternative, use of towed Mine Warfare devices under Alternative 2 would result in short-term and localized disturbances to the water column, but benthic habitats would not be affected because the devices are not towed on the bottom. Training with these devices is conducted in areas where little or no *Sargassum* habitat is expected to occur. Plankton in the upper portions of the water column could be displaced, injured, or killed by towed devices. However, no measurable effects on plankton populations would occur because the number of organisms exposed would be low relative to total plankton biomass. The use of towed Mine Warfare devices in territorial waters under Alternative 2 would have no significant impact on marine communities. Furthermore, the use of towed Mine Warfare devices in non-territorial waters would not cause significant harm to marine communities.

Non-explosive Mine Shape Deployment/Recovery

As discussed in Chapter 2, Mine Warfare Training Areas would be designated in W-50A/C, W-72, W-386, and the lower Chesapeake Bay under Alternative 2 (Figures 2.2-1 through 2.2-4). This section addresses potential effects on marine communities associated with establishing and maintaining these training areas (*i.e.*, non-explosive mine shape deployment/recovery). The effects of conducting training exercises in these areas are the same as those analyzed under aircraft overflights, towed Mine Warfare devices, and underwater detonations and HE ordnance (for W-50C only).

As discussed in Chapter 2, the mine shape assembly would include a concrete anchor, mooring line (steel cable or chain), and the mine shape. In some cases the entire assembly (mine shape, mooring line, and anchor) would be deployed concurrently from a boat or aircraft and recovered immediately following the exercise. In other cases concrete anchors would be permanently placed on the sea floor and divers would attach the mooring lines and mine shapes for specific exercises. Mine shapes and mooring lines that would not pose a navigation or fishing hazard could be left in place for up to six months. Approximately 20 permanent concrete anchors would be placed in the proposed Mine Warfare Training Area in W-50A/C and approximately 60 would be placed in the proposed training areas in the lower Chesapeake Bay.

The process of deploying and recovering mine shape assemblies would result in localized disturbances to benthic habitat. Benthic organisms could be crushed, injured, or killed by the impact of the concrete anchor. Approximately 6.25 ft^2 of benthic habitat would be disturbed when a concrete anchor makes contact with the sea floor. A similar size area would be affected when a concrete anchor is recovered. The total area affected per year is not expected to exceed 1,700 ft^2 based on 270 deployments/recoveries per year. Soft bottom substrates occur in the proposed training areas. Mine shapes would not be deployed in areas with live/hard bottom, oyster reefs, submerged aquatic vegetation, artificial reefs, or shipwrecks. Therefore, disturbed benthic areas would be expected to quickly recover through natural sedimentation processes. The process of divers attaching mooring lines and mines shapes to permanent concrete anchors would not be expected to result in more than minor habitat disturbances.

The permanent concrete anchors would result in minor, long-term changes to benthic habitat. Each permanent anchor would provide about 31.25 ft^2 of exposed hard surface area. Similar to an artificial reef structure, the anchors would be colonized overtime by benthic organisms that prefer hard substrate and would provide structure that could attract some species of fish. Localized increases in species richness and abundance could occur, but significant changes in community structure or function would not be anticipated based on the small surface area provided (625 ft^2 for 20 anchors in W-50A/C and 1,875 ft^2 for 60 anchors in the lower Chesapeake Bay) and the dispersed nature of the anchors. Mine shape deployment/recovery in territorial waters under Alternative 2 would have no significant impact on marine communities. Furthermore, mine shape deployment/recovery in non-territorial waters would not cause significant harm to marine communities under Alternative 2.

<u>Non-explosive Practice Munitions</u>

The amount of NEPM used in the VACAPES Study Area would increase under Alternative 2 (Tables 2.2-5 and 2.2-6). The number of non-explosive practice bombs dropped in W-72A/B would increase from 295 to 537 per year (Table 3.6-3). These changes would result in increased potential for NEPM to strike benthic communities and artificial habitats compared to baseline conditions. NEPM velocity would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, NEPM strikes would cause little or no physical damage to soft bottom benthic habitat and any damage would be localized.

The area affected by non-explosive practice bombs would increase under Alternative 2. The relative non-explosive practice bomb concentration would increase from 2.1 to 3.8 per 100 nm^2/year in W-72A/B. The probability of non-explosive practice bombs striking hard bottom or artificial habitats would increase under Alternative 2. However, the total area of benthic habitat affected would continue to be small. As shown in Table 3.6-4, the maximum area of benthic habitat affected by non-explosive practice bomb strikes would increase from 3,306 ft^2 per year to 7,384 ft^2 per year or 73,840 ft^2 over a ten-year period. Only a percentage of the total area affected (far less than 7,384 ft^2 per year) would be sensitive benthic habitat such as live hard bottom. Non-explosive practice bomb strikes under Alternative 2 could result in long-term, minor effects to benthic communities, but the effects would be localized and no long-term changes to community structure or function would be expected. NEPM strikes in territorial waters would have no significant impact on marine communities under Alternative 2. Similarly, NEPM strikes in non-territorial waters would not cause significant harm to marine communities under Alternative 2.

<u>Underwater Detonations and High Explosive Ordnance</u>

As summarized in Tables 2.2-5 and 2.2-7, underwater detonations and HE ordnance use under Alternative 2 would be the same as Alternative 1, with the following exceptions:

- The number of HE bombs used would decrease from 465 to 20 per year.
- Use of the MK-103 system in W-50A and C would result in 50 underwater explosions per year (0.002-lbs NEW).
- Use of the Airborne Mine Neutralization System (AMNS) in W-50C would result in 30 underwater explosions (3.24-lbs NEW).

Water column disturbances and plankton mortality associated with explosions under Alternative 2 would be substantially lower than the No Action Alternative and Alternative 1 based on the reduction in HE bomb use.

Water column disturbances and plankton mortality would increase in W-50C under Alternative 2 based on underwater detonations associated with the MK-103 and AMNS Mine Warfare devices. Plankton in the immediate vicinity of explosions would be injured or killed. However, no measurable effects on plankton populations would occur because the number of organisms affected would be low relative to the total plankton biomass. Underwater detonations associated with the MK-103 and AMNS Mine Warfare devices are not expected to affect benthic habitats because the explosions occur in the water column and the charges are relatively small.

The effects of explosions associated with FIREX with IMPASS, MISSILEX, and 20-lb NEW underwater detonations under Alternative 2 would be the same as Alternative 1. FIREX with IMPASS and MISSILEX would continue to result in short-term and localized water column disturbances and plankton mortality. Underwater detonations would continue to impact up to 302 to 470 ft^2 per year of soft bottom benthic habitat, and the effects would be short-term and localized. Overall, the impacts from underwater detonations and HE ordnance use for Alternative 2 would be substantially lower than the No Action Alternative and Alternative 1 based on the reduction in HE bomb use. Underwater detonations and HE ordnance use in territorial waters would have no significant impact on marine communities under Alternative 2. Furthermore, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to marine communities under Alternative 2.

Military Expended Materials

The amount of military expended materials entering the marine environment under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2. Military expended material use in territorial waters would have no significant impact on marine communities under Alternative 2. Furthermore, military expended material use in non-territorial waters would not cause significant harm to marine communities under Alternative 2.

3.6.4 Unavoidable Significant Environmental Effects

The analysis presented above indicates that the No Action Alternative, Alternative 1, and Alternative 2 would not result in unavoidable significant adverse effects to marine communities.

3.6.5 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.6-5, the No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on marine communities in territorial waters. Furthermore, the No Action Alternative, Alternative 1, and Alternative 2 would not cause significant harm to marine communities in non-territorial waters.

TABLE 3.6-5
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON MARINE COMMUNITIES IN THE VACAPES EIS/OEIS STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (U.S. Territory)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
No Action		
Vessel Movements	Localized disturbance, injury, and mortality to plankton. No long-term population or community-level effects.	Localized disturbance, injury, and mortality to plankton. No long-term population or community-level effects.
Aircraft Overflights	Potential exposure to aircraft noise. No long-term population or community-level effects.	Potential exposure to aircraft noise. No long-term population or community-level effects.
Towed Mine Warfare Devices	Short-term localized disturbance to water column. No long-term population or community-level effects.	Short-term localized disturbance to water column. No long-term population or community-level effects.
Mine Shape Deployment/Recovery	No effect.	No effect.
Non-Explosive Practice Munitions	Localized disturbance to benthic communities. No long-term population or community-level effects.	Localized disturbance to benthic communities. No long-term population or community-level effects.

TABLE 3.6-5
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON MARINE COMMUNITIES IN THE VACAPES EIS/OEIS STUDY AREA (Continued)

Alternative and Stressor	Summary of Effects and Impact Conclusion	
	NEPA (U.S. Territory)	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Underwater Detonations and High Explosive Ordnance	Short-term, localized disturbance to soft bottom benthic communities. Localized disturbance, injury, and mortality to plankton. No long-term population or community-level effects.	Short-term, localized disturbance to soft bottom benthic communities. Localized disturbance, injury, and mortality to plankton. No long-term population or community-level effects.
Military Expended Materials	Long-term, minor, and localized accumulation of expended materials in soft bottom benthic communities. No long-term changes in community structure or function.	Long-term, minor, and localized accumulation of expended materials in soft bottom benthic communities. No long-term changes in community structure or function.
Impact Conclusion	No significant impact to marine communities.	No significant harm to marine communities.
Alternative 1		
Vessel Movements	Localized disturbance, injury, and mortality to plankton. Slight increase compared to No Action. No long-term population or community-level effects.	Localized disturbance, injury, and mortality to plankton. Slight increase compared to No Action. No long-term population or community-level effects.
Aircraft Overflights	Potential exposure to aircraft noise. Slight increase compared to No Action. No long-term population or community-level effects.	Potential exposure to aircraft noise. Slight increase compared to No Action. No long-term population or community-level effects.
Towed Mine Warfare Devices	Short-term localized disturbance to water column. Slight increase compared to No Action. No long-term population or community-level effects.	Short-term localized disturbance to water column. Slight increase compared to No Action. No long-term population or community-level effects.
Mine Shape Deployment/Recovery	Short-term and localized disturbance of benthic habitat. Creation of small areas of hard bottom habitat. No long-term population or community-level effects.	No effect.
Non-Explosive Practice Munitions	Localized disturbance to benthic communities. Slight increase compared to No Action. No long-term population or community-level effects.	Localized disturbance to benthic communities. Slight increase compared to No Action. No long-term population or community-level effects.
Underwater Detonations and High Explosive Ordnance	Short-term, localized disturbance to soft bottom benthic communities. Localized disturbance, injury, and mortality to plankton. Slight increase compared to No Action. No long-term population or community-level effects.	Short-term, localized disturbance to soft bottom benthic communities. Localized disturbance, injury, and mortality to plankton. Slight increase compared to No Action. No long-term population or community-level effects.
Military Expended Materials	Long-term, minor, and localized accumulation of expended materials in soft bottom benthic communities. Slight increase compared to No Action. No long-term changes in community structure or function.	Long-term, minor, and localized accumulation of expended materials in soft bottom benthic communities. Slight increase compared to No Action. No long-term changes in community structure or function.
Impact Conclusion	No significant impact to marine communities.	No significant harm to marine communities.

TABLE 3.6-5
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON MARINE COMMUNITIES IN THE VACAPES EIS/OEIS STUDY AREA (Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (U.S. Territory)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Alternative 2		
Vessel Movements	Localized disturbance, injury, and mortality to plankton. Slight increase compared to No Action. No long-term population or community-level effects.	Localized disturbance, injury, and mortality to plankton. Slight increase compared to No Action. No long-term population or community-level effects.
Aircraft Overflights	Potential exposure to aircraft noise. Slight increase compared to No Action. No long-term population or community-level effects.	Potential exposure to aircraft noise. Slight increase compared to No Action. No long-term population or community-level effects.
Towed Mine Warfare Devices	Short-term localized disturbance to water column. Slight increase compared to No Action. No long-term population or community-level effects.	Short-term localized disturbance to water column. Slight increase compared to No Action. No long-term population or community-level effects.
Mine Shape Deployment/Recovery	Short-term and localized disturbance of benthic habitat. Creation of small areas of hard bottom habitat. No long-term population or community-level effects.	Short-term localized disturbance to water column. Slight increase compared to No Action. No long-term population or community-level effects.
Non-Explosive Practice Munitions	Localized disturbance to benthic communities. Slight increase compared to No Action. No long-term population or community-level effects.	Localized disturbance to benthic communities. Slight increase compared to No Action. No long-term population or community-level effects.
Underwater Detonations and High Explosive Ordnance	Short-term, localized disturbance to soft bottom benthic communities. Localized disturbance, injury, and mortality to plankton. Slight increase compared to No Action. No long-term population or community-level effects.	Short-term, localized disturbance to soft bottom benthic communities. Localized disturbance, injury, and mortality to plankton. Decrease in HE BOMBEX compared to No Action. No long-term population or community-level effects.
Military Expended Materials	Long-term, minor, and localized accumulation of expended materials in soft bottom benthic communities. Slight increase compared to No Action. No long-term changes in community structure or function.	Long-term, minor, and localized accumulation of expended materials in soft bottom benthic communities. Slight increase compared to No Action. No long-term changes in community structure or function.
Impact Conclusion	No significant impact to marine communities.	No significant harm to marine communities.

3.7 MARINE MAMMALS

3.7.1 Introduction and Methods

3.7.1.1 Regulatory Framework

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 established, with limited exceptions, a moratorium on the "taking" of marine mammals in waters or on lands under U.S. jurisdiction. The act further regulates "takes" of marine mammals in the global commons (*i.e.*, the high seas) by vessels or persons under U.S. jurisdiction. The term "take," as defined in Section 3 (16 USC 1362) of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." "Harassment" was further defined in the 1994 amendments to the MMPA, which provided two levels of "harassment," Level A (potential injury) and Level B (potential disturbance).

The National Defense Authorization Act of Fiscal Year 2004 (Public Law 108-136) amended the definition of harassment as applied to military readiness activities or scientific research activities conducted by or on behalf of the federal government, consistent with Section 104(c)(3) [16 USC 1374 (c)(3)]. The Fiscal Year 2004 National Defense Authorization Act adopted the definition of "military readiness activity" as set forth in the Fiscal Year 2003 National Defense Authorization Act (Public Law 107-314). Military training activities within the VACAPES Study Area constitute military readiness activities as that term is defined in Public Law 107-314 because training activities constitute "training and operations of the Armed Forces that relate to combat" and constitute "adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use." For military readiness activities, the relevant definition of harassment is any act that:

- Injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild ("Level A harassment").
- Disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered ("Level B harassment") [16 USC 1362 (18)(B)(i)(ii)].

Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) taking of marine mammals by U.S. citizens who engage in a specified activity (exclusive of commercial fishing), if certain findings are made and regulations are issued. Authorization will be granted by the Secretary for the incidental take of marine mammals if the taking will have a negligible impact on the species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.

Several species of marine mammals may occur in the VACAPES Study Area. Accordingly, the Navy has completed an analysis to determine if the action would result in incidental harassment of individual marine mammals (Level A or B harassment, as defined by MMPA) or if the action would have more than a negligible impact on marine mammal populations. The Navy has initiated the MMPA compliance process with the National Marine Fisheries Service (NMFS).

Endangered Species Act

The Endangered Species Act (ESA) of 1973 established protection and conservation of threatened and endangered species and their ecosystems. An "endangered" species is a species in danger of extinction throughout all or a significant portion of its range, while a "threatened" species is likely to become endangered within the foreseeable future throughout all or in a significant portion of its range. The USFWS and NMFS jointly administer the ESA and are also responsible for the listing of species (*i.e.*, the labeling of a species as either threatened or endangered). The USFWS has primary management responsibility for management of terrestrial and freshwater species (including the West Indian manatee), while the NMFS has primary responsibility for marine species (including listed whales) and anadromous fish species (species that migrate from saltwater to freshwater to spawn). The ESA allows the designation of geographic areas as critical habitat for threatened or endangered species.

The ESA requires federal agencies to conserve listed species and consult with the USFWS and/or NMFS to ensure that proposed actions that may affect listed species or critical habitat are consistent with the requirements of the ESA. The ESA specifically requires agencies not to "take" or "jeopardize the continued existence of" any endangered or threatened species, or to destroy or adversely modify habitat critical to any endangered or threatened species. Under Section 9 of the ESA, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect. Harm is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by USFWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR §17.3). Under Section 7 of the ESA, "jeopardize the continued existence of" means to engage in any action that would be expected to reduce appreciably the likelihood of the survival and recovery of a listed species by reducing its reproduction, numbers, or distribution (50 CFR §402.02).

Seven marine mammal species that are listed as endangered under the ESA could potentially occur in the VACAPES Study Area. For purposes of ESA compliance, the Navy analyzed effects of the action to make a determination of effect for listed species (*e.g.*, no effect or may affect). The definitions used in making the determination of effect under Section 7 of the ESA are based on the USFWS and NMFS *Endangered Species Consultation Handbook* (USFWS and NMFS, 1998). "No effect" is the appropriate conclusion when a listed species will not be affected, either because the species will not be present or because the project does not have any elements with the potential to affect the species. "No effect" does not include a small effect or an effect that is unlikely to occur: if effects are insignificant (in size), discountable (extremely unlikely), or wholly beneficial a "may affect" determination is appropriate. Insignificant effects relate to the magnitude or extent of the impact (*i.e.*, they must be small and would not rise to the level of a take of a species). Discountable effects are those extremely unlikely to occur and based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

The Navy has completed the ESA Section 7 informal consultation process with USFWS for the West Indian manatee. The Navy has initiated the ESA Section 7 formal consultation process with NMFS to determine if the action would adversely affect ESA-listed whales or jeopardize the continued existence of a listed species. Critical habitat for listed species has not been designated under the ESA in the VACAPES Study Area. Copies of correspondence with NMFS and USFWS are provided in Appendices A and C of this EIS/OEIS.

National Environmental Policy Act and Executive Order 12114

In addition to addressing MMPA and ESA requirements, potential effects were analyzed in accordance with the National Environmental Policy Act (NEPA) to determine if the action would result in significant impacts to marine mammals in territorial waters and in accordance with Executive Order (EO) 12114 to determine if the action would result in significant harm to marine mammals in non-territorial waters.

For purposes of NEPA and EO 12114, the Navy considered context and intensity to determine the significance of effects. Context refers to the affected environment in which the action would occur and intensity refers to the severity of impacts. The Navy considered several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. The duration of effects (*e.g*., short-term, long-term, temporary, permanent); degree of controversy; degree of highly uncertain effects or unique or unknown risks; precedent-setting effects; cumulative effects; adverse effect on ESA-listed species or designated critical habitat; and whether the action threatens a violation of law or requirements imposed for the protection of the environment were also considered. The potential for adverse effects to be observed at the population, stock, or species level was a primary factor considered by the Navy in determining the significance of effects to marine mammals. While the factors outlined above for MMPA and ESA were considered in making NEPA and EO 12114 significance conclusions, it should be recognized that the terminology used to characterize effects varies under these Acts. For example, Level A or B harassment of an individual marine mammal under MMPA or take of an individual marine mammal under ESA do not necessarily equate to a significant impact under NEPA. Rather, the Navy considered context, intensity, and population-level effects in making its significance conclusions for marine mammals.

3.7.1.2 Assessment Methods and Data Used

General Approach to Analysis

Each alternative analyzed in this EIS/OEIS includes several warfare areas (*e.g.,* Mine Warfare, Anti-air Warfare, *etc*.) and most warfare areas include multiple types of training operations (*e.g.,* Mine Neutralization, Air-to-Surface Missile Exercise, *etc*.). Likewise, several activities (*e.g.,* vessel movements, aircraft overflights, weapons firing, *etc*.) are accomplished under each operation, and those activities typically are not unique to that operation. For example, many of the operations involve Navy vessel movements and aircraft overflights. Accordingly, the analysis for marine mammals is organized by specific activity and/or stressors associated with that activity, rather than warfare area or operations.

The following general steps were used to analyze the potential environmental consequences of the alternatives to marine mammals:

- Identify those aspects of the proposed action that are likely to act as stressors to biological resources by having a direct or indirect effect on the physical, chemical, and biotic environment. As part of this step, the spatial extent of these stressors, including changes in that spatial extent over time, were identified. The results of this step identified those aspects of the proposed action that required detailed analysis in this EIS/OEIS.
- Identify resources that may occur in the Study Area.
- Identify the biological resources that are likely to co-occur with the stressors in space and time, and the nature of that co-occurrence (exposure analysis).
- Determine whether and how biological resources are likely to respond given their exposure and available scientific knowledge of their responses (response analysis).
- Determine the risks those responses pose to biological resources and the significance of those risks.

Study Area

The Study Area for marine mammals is described in Section 1.5 and is shown in Figure 1.5-1. The Study Area is analogous to the "action area," for purposes of analysis under Section 7 of the ESA.

Data Sources

A comprehensive and systematic review of relevant literature and data has been conducted to complete this analysis for marine mammals. Of the available scientific literature (both published and unpublished), the following types of documents were utilized in the assessment: journals, books, periodicals, bulletins, Department of Defense operations reports, theses, dissertations, endangered species recovery plans, species management plans, stock assessment reports, Environmental Impact Statements, Range Complex Management Plans, and other technical reports published by government agencies, private businesses, or consulting firms. The scientific literature was also consulted during the search for geographic location data (geographic coordinates) on the occurrence of marine resources within the Study Area.

Information was collected from the following sources to summarize the occurrence patterns of and to evaluate the impacts to protected species in the Study Area and vicinity:

- Academic and educational/research institutions: College of William and Mary, Duke University, Los Angeles County Museum, New England Aquarium, Old Dominion University, Rutgers University, Texas A&M University, University of Rhode Island, and Virginia Institute of Marine Science;
- University on-line databases: Ingenta, Web of Science; Aquatic Sciences and Fisheries Abstracts, Science Direct, Synergy, BIOSIS previews;
- The Internet, including various databases and related websites: National Oceanic and Atmospheric Administration (NOAA)-Coastal Services Center, NMFS, Ocean Biogeographic Information System, U.S. Geological Survey, Mid-Atlantic Fishery Management Council, South Atlantic Fishery Management Council, New England Fishery Management Council, Atlantic States Marine Fisheries Commission, Gulf of Mexico Fishery Management Council, WhaleNet, Blackwell-Science, FishBase, Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute, Food and Agriculture Organization, Federal Register, Marine Turtle Newsletter, Proceedings of the Annual Sea Turtle Symposium, Caribbean Conservation Corporation, National Marine Mammal Laboratory Library, and Seaturtle.org;
- Federal and state agencies: the Navy, South Atlantic Fishery Management Council, Gulf of Mexico Fishery Management Council, Atlantic States Marine Fisheries Commission, Mid-Atlantic Fishery Management Council, New England Fishery Management Council, NMFS Highly Migratory Species Division, NMFS Southeast Fisheries Science Center, NMFS Southwest Fisheries Science Center, NMFS Southeast Regional Office, NMFS Northeast Fisheries Science Center, NMFS Northeast Regional Office, NMFS Office of Habitat Protection, NMFS Office of Protected Resources, NOAA: Marine Managed Areas Inventory, USFWS Ecological Services Field Offices, U.S. Environmental Protection Agency, U.S. Geological Survey: Sirenia Project, Bureau of Land Management, Minerals Management Service, Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, and Georgia Department of Natural Resources; and
- Marine resource experts and specialists.

Marine Resource Assessments

The information contained in this Chapter relies heavily on the data gathered in the Marine Resource Assessments (MRA). The Navy MRA Program was implemented by the U.S. Fleet Forces, to initiate collection of data and information concerning the protected and commercial marine resources found in the Navy's OPAREAs. Specifically, the goal of the MRA program is to describe and document the marine resources present in each of the Navy's OPAREAs. The final version MRA for the Virginia Capes OPAREA was completed in 2008 (DoN, 2008a).

The MRA data were used to provide a regional context for each species. The MRA represents a compilation and synthesis of available scientific literature (*e.g.*, journals, periodicals, theses, dissertations, project reports, and other technical reports published by government agencies, private businesses, or consulting firms), and NMFS reports including stock assessment reports, recovery plans, and survey reports.

Navy OPAREA Density Estimates Report

The density estimates that were used in previous Navy environmental documents have been recently updated to provide a compilation of the most recent data and information on the occurrence, distribution, and density of marine mammals. The updated density estimates presented in this EIS/OEIS are derived from the *Navy OPAREA Density Estimates (NODE) for the Southeast OPAREAs* report (DoN, 2007a).

Density estimates for cetaceans were either modeled using available line-transect survey data or derived using available data in order of preference: 1) through spatial models using line-transect survey data provided by NMFS; 2) using abundance estimates from Mullin and Fulling (2003); 3) or based on the cetacean abundance estimates found in the most current National Oceanic and Atmospheric Administration (NOAA) stock assessment report (SAR) (Waring *et al*., 2007).

For the model-based approach, density estimates were calculated for each species within areas containing survey effort. A relationship between these density estimates and the associated environmental parameters such as depth, slope, distance from the shelf break, sea surface temperature (SST), and chlorophyll a concentration were formulated using generalized additive models (GAM). This relationship was then used to generate a two-dimensional density surface for the region by predicting densities in areas where no survey data exist.

The analyses for cetaceans were based on sighting data collected through shipboard surveys conducted by NMFS-Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (NMFS-SEFSC) between 1998 and 2005. Species-specific density estimates derived through spatial modeling were compared with abundance estimates found in the most current NOAA SAR to ensure consistency. All spatial models and density estimates were reviewed by and coordinated with NMFS Science Center technical staff and scientists with the University of St. Andrews, Scotland, Centre for Environmental and Ecological Modeling (CREEM). For a more detailed description of the method involved in calculating the density estimates provided in this EIS/OEIS, please refer to the NODE report for the Southeast (DoN, 2007a). The report is available at:

http://www. www.vacapesrangecomplexeis.com /documents/DON_2007i_SE_NODE_Final_Report.pdf.

The following shows how density estimates were modeled or derived for species analyzed in this EIS/OEIS:

Model-Derived Density Estimates - Line Transect Survey Data

- Fin whale (*Balaenoptera physalus*)
- Sperm whale (*Physeter macrocephalus*)
- Beaked Whales (*Family Ziphiidae*)
- Bottlenose dolphin (*Tursiops truncatus*)
- Atlantic spotted dolphin (*Stenella frontalis*)
- Striped dolphin (*Stenella coeruleoalba*)
- Common dolphin (*Delphinus delphis*)
- Risso's dolphin (*Grampus griseus*)
- Pilot Whales (*Globicephala spp.)*

SAR or Literature-Derived Density Estimates

- North Atlantic Right Whale (*Eubalaena glacialis*)[1]
- Humpback whale (*Megaptera novaeangliae*)[1]
- Minke whale (*Balaenoptera acutorostrata*)[2]
- *Kogia* spp.[2]
- Rough-toothed dolphin (*Steno bredanensis*)[2]
- Pantropical spotted dolphin (*Stenella attenuata*)[2]
- Clymene dolphin (*Stenella clymene*)[2]

[1] Abundance estimates were geographically and seasonally partitioned
[2] Abundance estimates were uniformly distributed geographically and seasonally Source: DoN, 2008a

Table 3.7-1 shows the density estimates by species for training areas where explosive ordnance use may occur in the VACAPES Range Complex.

TABLE 3.7-1
SEASONAL DENSITY ESTIMATES FOR MARINE MAMMALS IN THE VACAPES RANGE COMPLEX TRAINING AREAS WHERE EXPLOSIVE ORDNANCE MAY OCCUR

Species and Training Area	Density (animals/km^2)			
	Winter (Dec-Feb)	**Spring** (Mar-May)	**Summer** (June-Aug)	**Fall** (Sept-Nov)
Threatened or Endangered Marine Mammal Species				
Blue Whale	Insufficient data to estimate density.			
Fin Whale				
W-50	0.00000	0.00000	0.00000	0.00000
W-72A(2)	0.00033	0.00033	0.00033	0.00033
Air-3B	0.00017	0.00017	0.00017	0.00017
1C1/2	<0.00001	<0.00001	<0.00001	<0.00001
Air-E, F, I, J	0.00013	0.00013	0.00013	0.00013
Air-K (No Action & Alt 1)	0.00154	0.00154	0.00154	0.00154
5C/D	0.00000	0.00000	0.00000	0.00000
7C/D and 8C/D	0.00182	0.00182	0.00182	0.00182
Air-K (Alt 2)	0.00082	0.00082	0.00082	0.00082
Humpback Whale				
W-50	0.00058	0.00116	0.00000	0.00116
W-72A(2)	0.00058	0.00116	0.00000	0.00116
Air-E, F, I, J	0.00058	0.00116	0.00000	0.00116
Air-K (No Action & Alt 1)	0.00058	0.00116	0.00000	0.00116
Air-3B	0.00058	0.00116	0.00000	0.00116
1C1/2	0.00058	0.00116	0.00000	0.00116
5C/D	0.00058	0.00116	0.00000	0.00116
7C/D and 8C/D	0.00058	0.00116	0.00000	0.00116
Air-K (Alt 2)	0.00058	0.00116	0.00000	0.00116
North Atlantic Right Whale				
W-50	0.00062	0.00035	0.00000	0.00017
W-72A (2)	0.00033	0.00019	0.00000	0.00009
Air-E, F, I, J	0.00006	0.00003	0.00000	0.00002
Air-K (No Action & Alt 1)	0.00044	0.00025	0.00000	0.00012
Air-3B	0.00012	0.00007	0.00000	0.00003
1C1/2	0.00000	0.00000	0.00000	0.00000
5C/D	0.00000	0.00000	0.00000	0.00000
7C/D and 8C/D	0.00045	0.00025	0.00000	0.00012
Air-K (Alt 2)	0.00049	0.00028	0.00000	0.00014
Sei Whale	Insufficient data to estimate density.			

TABLE 3.7-1
SEASONAL DENSITY ESTIMATES FOR MARINE MAMMALS IN THE VACAPES RANGE COMPLEX TRAINING AREAS WHERE EXPLOSIVE ORDNANCE MAY OCCUR (Continued)

Species and Training Area	Density (animals/km^2)			
	Winter (Dec-Feb)	**Spring** (Mar-May)	**Summer** (June-Aug)	**Fall** (Sept-Nov)
Sperm Whale				
W-50	<0.00001	<0.00001	<0.00001	<0.00001
W-72A(2)	0.00933	0.00933	0.00975	0.00933
Air-E, F, I, J	0.01586	0.01586	0.02255	0.01586
Air-K (No Action & Alt 1)	0.00054	0.00054	0.00078	0.00054
Air-3B	0.01467	0.01467	0.01067	0.01467
1C1/2	0.05959	0.05959	0.10951	0.05959
5C/D	0.00977	0.00977	0.01275	0.00977
7C/D and 8C/D	0.00072	0.00072	0.00116	0.00072
Air-K (Alt 2)	0.00004	0.00004	0.00012	0.00004
West Indian Manatee	Insufficient data to estimate density.			
Non-Threatened or Endangered Marine Mammal Species				
Atlantic Spotted Dolphin				
W-50	0.00110	0.00110	0.00110	0.00110
W-72A (2)	0.29281	0.29281	0.29281	0.29281
Air-E, F, I, J	0.07583	0.07583	0.07583	0.07583
Air-K (No Action & Alt 1)	0.00364	0.00364	0.00364	0.00364
Air-3B	0.82681	0.82681	0.82681	0.82681
1C1/2	1.05404	1.05404	1.05404	1.05404
5C/D	0.03612	0.03612	0.03612	0.03612
7C/D and 8C/D	0.00503	0.00503	0.00503	0.00503
Air-K (Alt 2)	0.00296	0.00296	0.00296	0.00296
Beaked Whales				
W-50	0.00000	0.00000	0.00000	0.00000
W-72A (2)	0.00010	0.00010	0.00065	0.00010
Air-E, F, I, J	0.00420	0.00420	0.00353	0.00420
Air-K (No Action & Alt 1)	0.00000	0.00000	0.00001	0.00000
Air-3B	0.00053	0.00053	0.00334	0.00053
1C1/2	0.00016	0.00016	0.00064	0.00016
5C/D	0.00488	0.00488	0.00353	0.00488
7C/D and 8C/D	0.00000	0.00000	0.00002	0.00000
Air-K (Alt 2)	<0.00001	<0.00001	<0.00001	<0.00001
Bottlenose Dolphin				
W-50	0.00436	0.00436	0.01526	0.00436
W-72A (2)	0.39010	0.39010	0.39261	0.39010

TABLE 3.7-1
SEASONAL DENSITY ESTIMATES FOR MARINE MAMMALS IN THE VACAPES RANGE COMPLEX TRAINING AREAS WHERE EXPLOSIVE ORDNANCE MAY OCCUR (Continued)

Species and Training Area	Density (animals/km^2)			
	Winter (Dec-Feb)	Spring (Mar-May)	Summer (June-Aug)	Fall (Sept-Nov)
Air-E, F, I, J	0.08107	0.08107	0.07070	0.08107
Air-K (No Action & Alt 1)	0.01420	0.01420	0.02195	0.01420
Air-3B	1.70024	1.70024	1.69141	1.70024
1C1/2	0.16022	0.16022	0.11849	0.16022
5C/D	0.00871	0.00871	0.00447	0.00871
7C/D and 8C/D	0.01862	0.01862	0.03358	0.01862
Air-K (Alt 2)	0.00428	0.00428	0.00979	0.00428
Bryde's Whale	Insufficient data to estimate density.			
Clymene Dolphin				
W-50	0.01063	0.01063	0.01063	0.01063
W-72A (2)	0.01063	0.01063	0.01063	0.01063
Air-E, F, I, J	0.01063	0.01063	0.01063	0.01063
Air-K (No Action & Alt 1)	0.01063	0.01063	0.01063	0.01063
Air-3B	0.01063	0.01063	0.01063	0.01063
1C1/2	0.01063	0.01063	0.01063	0.01063
5C/D	0.01063	0.01063	0.01063	0.01063
7C/D and 8C/D	0.01063	0.01063	0.01063	0.01063
Air-K (Alt 2)	0.01063	0.01063	0.01063	0.01063
Common Dolphin				
W-50	0.00000	0.00000	0.00000	0.00000
W-72A (2)	0.35755	0.35755	0.35755	0.35755
Air-E, F, I, J	0.40676	0.40676	0.40676	0.40676
Air-K (No Action & Alt 1)	0.86488	0.86488	0.86488	0.86488
Air-3B	1.94767	1.94767	1.94767	1.94767
1C1/2	0.00263	0.00263	0.00263	0.00263
5C/D	0.00345	0.00345	0.00345	0.00345
7C/D and 8C/D	0.89301	0.89301	0.89301	0.89301
Air-K (Alt 2)	0.71119	0.71119	0.71119	0.71119
False Killer whale	Insufficient data to estimate density.			
Fraser's Dolphin	Insufficient data to estimate density.			
Killer Whale	Insufficient data to estimate density.			
Melon-headed Whale	Insufficient data to estimate density.			
Minke Whale				
W-50	0.00004	0.00004	0.00004	0.00004
W-72A (2)	0.00004	0.00004	0.00004	0.00004
Air-E, F, I, J	0.00004	0.00004	0.00004	0.00004
Air-K (No Action & Alt 1)	0.00004	0.00004	0.00004	0.00004
Air-3B	0.00004	0.00004	0.00004	0.00004

TABLE 3.7-1
SEASONAL DENSITY ESTIMATES FOR MARINE MAMMALS IN THE VACAPES RANGE COMPLEX TRAINING AREAS WHERE EXPLOSIVE ORDNANCE MAY OCCUR (Continued)

Species and Training Area	Density (animals/km^2)			
	Winter (Dec-Feb)	Spring (Mar-May)	Summer (June-Aug)	Fall (Sept-Nov)
1C1/2	0.00004	0.00004	0.00004	0.00004
5C/D	0.00004	0.00004	0.00004	0.00004
7C/D and 8C/D	0.00004	0.00004	0.00004	0.00004
Air-K (Alt 2)	0.00004	0.00004	0.00004	0.00004
Pantropical Spotted Dolphin				
W-50	0.02225	0.02225	0.02225	0.02225
W-72A (2)	0.02225	0.02225	0.02225	0.02225
Air-E, F, I, J	0.02225	0.02225	0.02225	0.02225
Air-K (No Action & Alt 1)	0.02225	0.02225	0.02225	0.02225
Air-3B	0.02225	0.02225	0.02225	0.02225
1C1/2	0.02225	0.02225	0.02225	0.02225
5C/D	0.02225	0.02225	0.02225	0.02225
7C/D and 8C/D	0.02225	0.02225	0.02225	0.02225
Air-K (Alt 2)	0.02225	0.02225	0.02225	0.02225
Pilot Whales				
W-50	0.00004	0.00004	0.00004	0.00004
W-72A (2)	0.07438	0.07438	0.08958	0.07438
Air-E, F, I, J	0.07893	0.07893	0.07069	0.07893
Air-K (No Action & Alt 1)	0.01207	0.01207	0.00302	0.01207
Air-3B	0.21570	0.21570	0.27301	0.21570
1C1/2	0.11408	0.11408	0.23862	0.11408
5C/D	0.09277	0.09277	0.09583	0.09277
7C/D and 8C/D	0.01314	0.01314	0.00369	0.01314
Air-K (Alt 2)	0.00061	0.00061	0.00003	0.00061
Pygmy and Dwarf Sperm Whales				
W-50	0.00101	0.00101	0.00101	0.00101
W-72A (2)	0.00101	0.00101	0.00101	0.00101
Air-E, F, I, J	0.00101	0.00101	0.00101	0.00101
Air-K (No Action & Alt 1)	0.00101	0.00101	0.00101	0.00101
Air-3B	0.00101	0.00101	0.00101	0.00101
1C1/2	0.00101	0.00101	0.00101	0.00101
5C/D	0.00101	0.00101	0.00101	0.00101
7C/D and 8C/D	0.00101	0.00101	0.00101	0.00101
Air-K (Alt 2)	0.00101	0.00101	0.00101	0.00101
Pygmy Killer Whale	Insufficient data to estimate density.			

TABLE 3.7-1
SEASONAL DENSITY ESTIMATES FOR MARINE MAMMALS IN THE VACAPES RANGE COMPLEX TRAINING AREAS WHERE EXPLOSIVE ORDNANCE MAY OCCUR (Continued)

Species and Training Area	Density (animals/km^2)			
	Winter (Dec-Feb)	**Spring** (Mar-May)	**Summer** (June-Aug)	**Fall** (Sept-Nov)
Risso's Dolphin				
W-50	0.00000	0.00000	0.00000	0.00000
W-72A (2)	0.02277	0.02277	0.02277	0.02277
Air-E, F, I, J	0.03654	0.03654	0.03654	0.03654
Air-K (No Action & Alt 1)	0.01956	0.01956	0.01956	0.01956
Air-3B	0.00814	0.00814	0.00814	0.00814
1C1/2	0.01894	0.01894	0.01894	0.01894
5C/D	0.04967	0.04967	0.04967	0.04967
7C/D and 8C/D	0.02516	0.02516	0.02516	0.02516
Air-K (Alt 2)	0.00377	0.00377	0.00377	0.00377
Rough-toothed Dolphin				
W-50	0.00048	0.00048	0.00048	0.00048
W-72A (2)	0.00048	0.00048	0.00048	0.00048
Air-E, F, I, J	0.00048	0.00048	0.00048	0.00048
Air-K (No Action & Alt 1)	0.00048	0.00048	0.00048	0.00048
Air-3B	0.00048	0.00048	0.00048	0.00048
1C1/2	0.00048	0.00048	0.00048	0.00048
5C/D	0.00048	0.00048	0.00048	0.00048
7C/D and 8C/D	0.00048	0.00048	0.00048	0.00048
Air-K (Alt 2)	0.00048	0.00048	0.00048	0.00048
Spinner Dolphin	Insufficient data to estimate density.			
Striped Dolphin				
W-50	0.00034	0.00034	0.00034	0.00034
W-72A (2)	0.04396	0.04396	0.04396	0.04396
Air-E, F, I, J	0.53951	0.53951	0.53951	0.53951
Air-K (No Action & Alt 1)	0.24305	0.24305	0.24305	0.24305
Air-3B	0.00116	0.00116	0.00116	0.00116
1C1/2	0.40708	0.40708	0.40708	0.40708
5C/D	0.59383	0.59383	0.59383	0.59383
7C/D and 8C/D	0.33568	0.33568	0.33568	0.33568
Air-K (Alt 2)	0.00020	0.00020	0.00020	0.00020

Source: (DoN, 2007a)

Density estimates could not be calculated for all species due to the limited available data. Occurrence of these species in the VACAPES Range Complex is considered uncommon.

Species for Which Density Estimates Are Not Available

- Blue whale (*Balaenoptera musculus*)
- Sei whale (*Balaenoptera borealis*)
- Bryde's whale (*Balaenoptera brydei/edeni*)

- Killer whale (*Orcinus orca*)
- Pygmy killer whale (*Feresa attenuata*)
- False killer whale (*Pseudorca crassidens*)
- Melon-headed Whale (*Peponocephala electra*)
- Spinner dolphin (*Stenella longirostris*)
- Fraser's dolphin (*Lagenodelphis hosei*)
- Harbor porpoise (*Phocoena phocoena*)
- West Indian manatee (*Trichechus manatus*)

3.7.1.3 Warfare Areas and Associated Environmental Stressors

The Navy used a screening process to identify aspects of the proposed action that could act as stressors to marine mammals. Navy subject matter experts de-constructed the warfare areas and operations included in the proposed action to identify specific activities that could act as stressors. Public and agency scoping comments, previous environmental analyses, previous agency consultations, laws, regulations, Executive Orders, and resource-specific information were also evaluated. This process was used to focus the information presented and analyzed in the affected environment and environmental consequences sections of this EIS/OEIS. As shown in Table 3.7-2, potential stressors to marine mammals include vessel movements (disturbance or collisions), aircraft overflights (disturbance), towed Mine Warfare (MIW) devices (strikes), non-explosive mine shape deployment/recovery (habitat alteration), weapons firing/ordnance use (disturbance and strikes), explosions, and military expended materials (ordnance related materials, targets, chaff, self-protection flares, and marine markers). The potential effects of these stressors on marine mammals are analyzed in detail in Section 3.7.3.

As discussed in the EIS, Section 3.3 – Water Resources and Section 3.4 – Air Quality, some water and air pollutants would be released into the environment as a result of the proposed action. The analyses presented in Sections 3.3 and 3.4 indicate that any increases in water or air pollutant concentrations resulting from Navy training in the Study Area would be negligible and localized, and impacts to water and air quality would be less than significant. Based on the analyses presented in Sections 3.3 and 3.4, water and air quality changes would have no effect or negligible effects on marine mammals. Accordingly, the effects of water and air quality changes on marine mammals are not addressed further in this EIS/OEIS.

3.7.2 Affected Environment

3.7.2.1 Regional Overview

Table 3.7-3 provides a list of marine mammal species that have confirmed or potential occurrence in the VACAPES Range Complex. These include 33 cetacean species, three pinniped species, and one sirenian species (DoN, 2008a). Extralimital species in the Study Area include the northern bottlenose whale and the white-beaked dolphin. Extralimital indicates that there are one or more records of an animal's presence in the Study Area, but it is considered beyond the normal range of the species. Extralimital species will not be analyzed further in this study. Some cetacean species are resident year- round (*e.g.*, bottlenose dolphins [*Tursiops truncatus*] and beaked whales), while others (*e.g.*, North Atlantic right whales [*Eubalaena glacialis*] and humpback whales [*Megaptera novaeangliae*]) occur seasonally as they migrate through the area.

TABLE 3.7-2
SUMMARY OF POTENTIAL STRESSORS TO MARINE MAMMALS IN THE VACAPES EIS/OEIS STUDY AREA

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)								
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay			✓	✓	✓		
Mine Countermeasures Exercise (MCM)	W-50A/C W-386, W-72			✓	✓	✓	✓	✓
Mine Neutralization	W-50C	✓	✓		✓	✓	✓	✓
Surface Warfare (SUW)								
Bombing Exercise (Air-to-Surface) (at sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B			✓		✓	✓	✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A			✓		✓	✓	✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C			✓		✓		✓
GUNEX (Surface-to-Surface) Boat	W-50C, R-6606	✓	✓			✓		✓
GUNEX (Surface-to-Surface) Ship	W-386, W-72	✓	✓			✓		✓
Laser Targeting	W-386 (Air-K)			✓				
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA	✓	✓					
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓	✓				

TABLE 3.7-2
SUMMARY OF POTENTIAL STRESSORS TO MARINE MAMMALS IN THE VACAPES EIS/OEIS STUDY AREA (Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Air Warfare (AW)								
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)			✓				
GUNEX (Air-to-Air)	W-72A			✓				✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A			✓		✓	✓	✓
GUNEX (Surface-to-Air)	W-386, W-72	✓	✓	✓		✓		✓
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)	✓	✓	✓		✓		✓
Air Intercept Control (AIC)	W-386, W-72			✓				
Detect to Engage (DTE)	W-386, W-72			✓				
Strike Warfare (STW)								
HARM Missile Exercise	W-386 (Air E,F,I,J)			✓		✓		✓

TABLE 3.7-2
SUMMARY OF POTENTIAL STRESSORS TO MARINE MAMMALS IN THE VACAPES EIS/OEIS STUDY AREA
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Amphibious Warfare (AMW)								
Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓	✓			✓	✓	✓
Electronic Combat (EC)								
Chaff Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓				✓
Chaff Exercise- ship	W-386 and W-72	✓	✓					✓
Flare Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓				✓
Electronic Combat (EC) Operations- aircraft	W-386 (Air-K)			✓				
EC Operations- ship	VACAPES OPAREA	✓	✓					
Test and Evaluation								
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓	✓					

TABLE 3.7-3
MARINE MAMMAL SPECIES FOUND IN THE VACAPES EIS/OEIS STUDY AREA

Family and Scientific Name	Common Name	Federal Status
Order Cetacea Suborder Mysticeti (baleen whales) Family Balaenidae (right whales)		
Eubalaena glacialis	North Atlantic right whale	ENDANGERED
Family Balaenopteridae (rorquals)		
Megaptera novaeangliae	Humpback whale	ENDANGERED
Balaenoptera acutorostrata	Minke whale	
Balaenoptera brydei	Bryde's whale	
Balaenoptera boreali	Sei whale	ENDANGERED
Balaenoptera physalus	Fin whale	ENDANGERED
Balaenoptera musculus	Blue whale	ENDANGERED
Suborder Odontoceti (toothed whales) Family Physeteridae (sperm whale)		
Physeter macrocephalus	Sperm whale	ENDANGERED
Family Kogiidae (pygmy sperm whales)		
Kogia breviceps	Pygmy sperm whale	
Kogia sima	Dwarf sperm whale	
Family Ziphiidae (beaked whales)		
Ziphius cavirostris	Cuvier's beaked whale	
Mesoplodon mirus	True's beaked whale	
Mesoplodon europaeus	Gervais' beaked whale	
Mesoplodon bidens	Sowerby's beaked whale	
Mesoplodon densirostris	Blainville's beaked whale	
Family Delphinidae (dolphins)		
Steno bredanensis	Rough-toothed dolphin	
Tursiops truncatus	Bottlenose dolphin	
Stenella attenuata	Pantropical spotted dolphin	
Stenella frontalis	Atlantic spotted dolphin	
Stenella longirostris	Spinner dolphin	
Stenella clymene	Clymene dolphin	
Stenella coeruleoalba	Striped dolphin	
Delphinus delphis	Common dolphin	
Lagenodelphis hosei	Fraser's dolphin	
Lagenorhynchus acutus	Atlantic white-sided dolphin	
Grampus griseus	Risso's dolphin	
Peponocephala electra	Melon-headed whale	
Feresa attenuata	Pygmy killer whale	

TABLE 3.7-3
MARINE MAMMAL SPECIES FOUND IN THE VACAPES EIS/OEIS STUDY AREA
(Continued)

Family and Scientific Name	Common Name	Federal Status
Pseudorca crassidens	False killer whale	
Orcinus orca	Killer whale	
Globicephala melas	Long-finned pilot whale	
Globicephala macrorhynchus	Short-finned pilot whale	
Family Phocoenidae (porpoises)		
Phocoena phocoena	Harbor porpoise	
Order Carnivora Suborder Pinnipedia (seals, sea lions, walruses) Family Phocidae (true seals)		
Phoca vitulina	Harbor seal	
Halichoerus grypus	Gray seal	
Pagophilus groenlandicus	Harp seal	
Order Sirenia Family Trichechidae (manatees)		
Trichechus manatus	West Indian manatee	ENDANGERED

*Source: DoN, 2008a ; DoN, 2008b

Marine mammal distribution is affected by demographic, evolutionary, ecological, habitat-related, and anthropogenic factors (Bjørge, 2002; Bowen, *et al.,* 2002; Forcada, 2002; Stevick, *et al.,* 2002). Movement of individuals is generally associated with feeding or breeding activity (Stevick, *et al.,* 2002). Some baleen whale species, such as the humpback whale, make extensive annual migrations to low-latitude mating and calving grounds in the winter and to high-latitude feeding grounds in the summer (Corkeron and Connor, 1999). Migrations undoubtedly occur during these seasons due to the presence of highly productive waters and associated cetacean prey species at high latitudes and of warm water temperatures for calving at low latitudes (Corkeron and Connor, 1999; Stern, 2002). However, not all baleen whales migrate. Some individual fin, Bryde's, minke, and blue whales may stay in a specific area year-round. Cetacean movements can also reflect the distribution and abundance of prey (Gaskin, 1982; Payne, *et al.,* 1986; Kenney, *et al.,* 1996). Cetacean movements have been linked to indirect indicators of prey, such as temperature variations, sea-surface chlorophyll *a* concentrations, and features such as bottom depth (Fiedler, 2002). Oceanographic features, such as eddies associated with the Gulf Stream, are important factors determining cetacean distribution since cetacean prey occur in areas of increased primary productivity associated with some of these features (Biggs *et al.,* 2000; Wormuth *et al.,* 2000; Davis *et al.,* 2002). The warm Gulf Stream moves rapidly through the Florida Straits and extends northeast along the continental shelf. This current is the single most-influential oceanographic feature of the region and influences water temperature, salinity, and nutrient availability. These factors, in turn, are important in regulating primary productivity associated with phytoplankton growth in the region and the subsequent secondary productivity of zooplankton and other animal life that provide prey for marine mammals.

An association between cetaceans and cold-core and warm-core rings also exists (Griffin, 1999; Biggs *et al.,* 2000; Waring *et al.,* 2001). Both ring types are eddies that detach from the Gulf Stream; it is possible to find both types of rings near the VACAPES Study Area, increasing the likelihood of greater cetacean presence for the duration of these large-scale hydrographic features. It is likely that the upwelling associated with cold-core rings concentrate mesopelagic squid and fish for greater feeding efficiency by cetaceans.

Along the Virginia and North Carolina shoreline, upwelling and downwelling events are not limited to Gulf Stream or deep-sea canyon geography. Wind patterns and outflow from the Chesapeake Bay cause upwelling and downwelling features along the continental shelf on a regular basis (Cudaback and Largier, 2001), potentially increasing regional productivity and, therefore, local cetacean abundance. Disturbances, such as hurricanes, atmospheric frontal systems, and shifts in current patterns can also increase the before-mentioned oceanographic conditions to enhance local productivity. For example, increased sediment and nutrient loads are present in freshwater systems following heavy and prolonged rainfall, similarly enhancing primary productivity along the continental shelf near the system's effluence.

Waters off North Carolina have the greatest cetacean diversity along the eastern seaboard (Webster *et al.,* 1995). Cape Hatteras is generally considered a boundary between temperate and tropical species in the western North Atlantic and an area of overlap for many marine species (Ekman, 1953; Briggs, 1974; Garrison *et al.,* 2003b). Many marine mammals along North Carolina waters are year-round residents, but others migrate into inshore waters during summer/fall and winter/spring months (Webster *et al.,* 1995).

3.7.2.2 Endangered Species Act-Listed Marine Mammals

As identified in Table 3.7-2, seven marine mammal species listed as endangered under the ESA may occur within in the VACAPES Study Area. These mammals include five baleen whale species (blue, fin, humpback, North Atlantic right, and sei), one toothed whale species (sperm whale), and one sirenian species (West Indian manatee). Status, habitat, and distribution of each species are provided below.

3.7.2.3 Blue Whale

Blue whales are the largest living animals. Adult blue whales in the northern hemisphere reach 22.9 to 28 m in length (Jefferson *et al*., 1993). Blue whales feed primarily on euphausiids (krill) (Kenney *et al*., 1985; Nemoto and Kawamura, 1977). Like other rorquals, blue whales feed by "gulping" (Pivorunas, 1979).

Status and Management – The endangered blue whale was severely depleted by commercial whaling in the twentieth century (NMFS 1998a). At least two discrete populations are found in the North Atlantic. One ranges from West Greenland to New England and is centered in eastern Canadian waters; the other is centered in Icelandic waters and extends south to northwest Africa (Sears *et al.* 2005). There are no current estimates of abundance for the North Atlantic blue whale (Waring *et al.* 2008). However, the 308 photo-identified individuals from the Gulf of St. Lawrence area are considered to be a minimum population estimate for the western North Atlantic stock (Sears *et al.* 1987; Waring *et al.* 2008). The blue whale is under the jurisdiction of the NMFS. The recovery plan for the blue whale was issued in 1998 (NMFS 1998a).

Habitat - Blue whales inhabit both coastal and oceanic waters in temperate and tropical areas (Yochem and Leatherwood, 1985). Stranding and sighting data suggest blue whale occurrence in the Atlantic extended south to Florida and the Gulf of Mexico; however, the southern limit of this species' range is unknown (Yochem and Leatherwood, 1985). Blue whales in the Atlantic are primarily found in deeper, offshore waters and are rare in shallower, shelf waters (Wenzel *et al*., 1988). However, in the Gulf of St. Lawrence, blue whales show strong preferences for the nearshore regions where strong tidal and current mixing leads to high productivity and rich prey resources (Sears *et al*., 1990). Important foraging areas for this species include the edges of continental shelves and upwelling regions (Reilly and Thayer, 1990;

Schoenherr, 1991). Based on acoustic and tagging data from the North Pacific, relatively cold, productive waters and fronts attract feeding blue whales (Moore *et al*., 2002). Clark and Gagnon (2004) determined that vocalizing blue whales show strong preferences, even during summer months, for shelf breaks, seamounts, or other areas where food resources are known to occur.

Acoustics and Hearing – Blue whale vocalizations are typically long, patterned low-frequency sounds with durations up to 36 sec (Thomson and Richardson, 1995) repeated every 1 to 2 min (Mellinger and Clark, 2003). Their frequency range is 12 to 400 Hz, with dominant energy in the infrasonic range at 12 to 25 Hz (Ketten, 1998; Mellinger and Clark, 2003). The short-duration sounds are transient, frequency-modulated calls having a higher frequency range and shorter duration than song notes and often sweeping down in frequency (Di Iorio *et al*., 2005; Rankin *et al*., 2005). These short-duration sounds are less than 5 sec in duration (Di Iorio *et al*., 2005; Rankin *et al.*, 2005) and are high-intensity, broadband (858±148 Hz) pulses (Di Iorio *et al*., 2005). Source levels of blue whale vocalizations are up to 188 dB (Ketten, 1998; Moore, 1999; McDonald *et al.*, 2001). While no data on hearing availability are available for this species, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

Distribution - Blue whales are distributed from the ice edge to the tropics and subtropics in both hemispheres (Jefferson *et al*., 1993). Stranding and sighting data suggest blue whale occurrence in the Atlantic extended south to Florida and the Gulf of Mexico; however, the southern limit of this species' range is unknown (Yochem and Leatherwood, 1985). Blue whales now rarely occur in the U.S. Atlantic Exclusive Economic Zone (EEZ) and the Gulf of Maine from August to October, which may represent the limits of their feeding range (CETAP, 1982; Wenzel *et al*., 1988). Sightings in the Gulf of Maine and U.S. EEZ have been made during multiple studies in late summer and early fall (August and October) (CETAP, 1982; Wenzel *et al*., 1988). Researchers using the Navy integrated undersea surveillance system resources detected blue whales throughout the open Atlantic south to at least the Bahamas (Clark, 1995), suggesting that all North Atlantic blue whales may comprise a single stock (NMFS, 1998a).

Calving area is unknown and occurs primarily during the winter (Yochem and Leatherwood 1985; Jefferson *et al*. 2008). Breeding grounds are thought to be located in tropical/subtropical waters; however, exact locations are unknown (Jefferson *et al*. 2008).

VACAPES OPAREA Blue Whale Occurrence - The majority of western North Atlantic blue whale observations during the spring, summer, and fall take place around Newfoundland, the Gulf of St. Lawrence, and Nova Scotia (CETAP, 1982; Wenzel *et al*., 1988; Sears *et al*., 1990). The southern extent of its feeding range may be somewhere near 40° N latitude and records suggest occurrence of this species south to Florida and in the Gulf of Mexico. The information above suggests the blue whale is less likely to be present during summer months, but may occur any time of the year.

Lower Chesapeake Bay Blue Whale Occurrence - The blue whale is considered extralimital in the lower Chesapeake Bay.

VACAPES OPAREA Blue Whale Density - There were not sufficient data available to estimate a density for the Study Area, nor is there an abundance estimate in the NOAA SAR (DoN, 2007a).

Fin Whale

The fin whale is the second-largest whale species, with adults reaching 24 m in length (Jefferson *et al*., 1993). Fin whales feed by "gulping" a wide variety of small, schooling prey (especially herring, capelin, and sand lance) including squid and crustaceans (krill and copepods) (Kenney *et al*., 1985; NMFS, 2006a).

Status and Management - The NOAA SAR estimates that there are 2,269 individual fin whales in the U.S. Atlantic waters (Waring *et al.* 2008); this is probably an underestimate, however, as survey coverage of known and potential fin whale habitat was incomplete. The fin whale is listed as endangered under the ESA and is managed under jurisdiction of the NMFS. The draft recovery plan for the fin whale was released in June 2006 (NMFS 2006a). NMFS recently initiated a 5-yr review for the fin whale under the ESA (NMFS 2007a).

Habitat - The fin whale is found in continental shelf, slope, and oceanic waters. Off the U.S. east coast, the fin whale appears to be scarce in slope and Gulf Stream waters (CETAP, 1982; Waring *et al*., 1992). Waring *et al*. (1992) reported sighting fin whales along the edge of a warm core eddy and a remnant near Wilmington Canyon, along the northern wall of the Gulf Stream. Globally, this species tends to be aggregated in locations where populations of prey are most plentiful, irrespective of water depth, although those locations may shift seasonally or annually (Payne *et al*., 1986; 1990; Kenney *et al*., 1997; Notarbartolo-di-Sciara *et al*., 2003). Clark and Gagnon (2004) determined that vocalizing fin whales show strong preferences, even during summer months, for shelf breaks, seamounts, or other areas where food resources are known to occur.

Acoustics and Hearing – Fin and blue whales produce calls with the lowest frequency and some of the highest source levels of all cetaceans. Infrasonic, pattern sounds have been documented for fin whales (Watkins *et al*., 1987; Clark and Fristrup, 1997; McDonald and Fox, 1999). Fin whales produce a variety of sounds with a frequency range up to 750 Hz. The long, patterned 15 to 30 Hz vocal sequence is most typically recorded; only males are known to produce these (Croll *et al*., 2002). The most typical fin whale sound is a 20 Hz infrasonic pulse (actually an FM sweep from about 23 to 18 Hz) with durations of about 1 sec and can reach source levels of 184 to 186 dB (Watkins *et al*., 1987; Thomson and Richardson, 1995; Charif *et al*., 2002). While no data on hearing availability are available for this species, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

Distribution - Fin whales are broadly distributed throughout the world's oceans, including temperate, tropical, and polar regions (Jefferson *et al*., 2008). The overall range of fin whales in the North Atlantic extends from the Gulf of Mexico/Caribbean and Mediterranean north to Greenland, Iceland, and Norway (Gambell, 1985; NMFS, 1998b). In the western North Atlantic, the fin whale is the most commonly sighted large whale in continental shelf waters from the mid-Atlantic coast of the U.S. to eastern Canada (CETAP, 1982; Hain *et al*., 1992).

Relatively consistent sighting locations for fin whales off the U.S. Atlantic coast include the banks on the Nova Scotian Shelf, Georges Bank, Jeffreys Ledge, Cashes Ledge, Stellwagen Bank, Grand Manan Bank, Newfoundland Grand Banks, the Great South Channel, the Gulf of St. Lawrence, off Long Island and Block Island, Rhode Island, and along the shelf break of the northeastern United States (CETAP, 1982; Hain *et al*., 1992; Waring *et al*., 2004). Hain *et al*. (1992) reported that the single most important habitat identified in their study was a region of the western Gulf of Maine, to Jeffreys Ledge, Cape Ann, Stellwagen Bank, and to the Great South Channel, in approximately 50 m of water. This was an area of high prey (sand lance) density during the 1970s and early 1980s (Kenney and Winn 1986). Secondary areas of important fin whale habitat included the mid- to outer shelf from the northeast area of Georges Bank through the mid-Atlantic Bight.

Based on passive acoustic detection using Navy Sound Surveillance System (SOSUS) hydrophones in the western North Atlantic (Clark, 1995), fin whales are believed to move southward in the fall and northward in spring. The location and extent of the wintering grounds are poorly known (Aguilar, 2002). Fin whales have been seen feeding as far south as the coast of Virginia (Hain *et al*., 1992).

Fin whales are not completely absent from northeastern U.S. continental shelf waters in winter, indicating that not all members of the population conduct seasonal migrations. Perhaps a fifth to a quarter of the spring/summer peak population remains in this area year-round (CETAP, 1982; Hain *et al*., 1992).

Peak calving is in October through January (Hain *et al*. 1992); however, location of breeding grounds is unknown.

VACAPES OPAREA Fin Whale Occurrence - Fin whales are more commonly encountered north of Cape Hatteras (CETAP, 1982; Hain *et al*., 1992; Waring *et al*., 2007). Fin whales are the most commonly sighted large whale during the winter in the U.S. Atlantic continental shelf waters. As much as a quarter of the spring/summer peak population stay in continental shelf waters year-round (CETAP, 1982). During the spring, summer, and fall, fin whales occur along the Atlantic coasts of the U.S. and Canada, with smaller numbers of animals remaining through the winter. Sightings are almost exclusively limited to continental shelf waters inshore of the 6000 foot isobath, from the Gulf of Maine south to Cape Hatteras (CETAP, 1982; Agler *et al*., 1993). The greatest abundance and widest occupation of fin whales in the northeast U.S. has been shown to occur in the spring (Hain *et al*., 1985).

Lower Chesapeake Bay Fin Whale Occurrence - The Chesapeake Bay region is considered a normal part of the fin whale's range. Documented occurrences for the fin whale in the Chesapeake Bay area are from February through May, with the greatest likelihood of encounter during the winter months. However, a review of the offshore sighting suggests that fin whales could be encountered year-round in this region (DoN, 2007b). Blaylock (1985) noted that the fin whale is the most abundant large whale in Virginia's waters. Fin whales could occur in the lower Chesapeake Bay region year-round.

VACAPES OPAREA Fin Whale Density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Report (DoN, 2007a). The Navy does not consider estimates of zero density to mean that this species does not occur in the area only that they generally occur in low numbers or infrequently based on the best available data. It may be reasonable to assume that a number of the sightings recorded as unidentified rorquals might be of fin whales.

3.7.2.4 Humpback Whale

Adult humpback whales are 11 to 16 m in length. The body is black or dark gray, with very long (about one-third of the body length) flippers that are usually at least partially white (Jefferson *et al*., 1993; Clapham and Mead, 1999). Humpback whales feed on a wide variety of invertebrates and small schooling fish, including euphausiids (krill), herring, mackerel, sand lance, sardines, anchovies, and capelin (Clapham and Mead, 1999).

Status and Management - An estimated 11,570 humpback whales occur in the entire North Atlantic (Stevick *et al.* 2003a). Humpback whales in the western North Atlantic are thought to belong to five different stocks based on feeding locations (Katona and Beard 1990; Waring *et al.* 2008): Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, and Iceland. There appears to be very little exchange between these separate feeding stocks (Katona and Beard 1990). The best estimate of abundance for the Gulf of Maine Stock is 847 individuals (Waring *et al.* 2008) based on a 2006 aerial survey. The humpback whale is listed as endangered under the ESA and management of the species is under the jurisdiction of the NMFS. The recovery plan for the humpback whale was issued in 1991 (NMFS 1991).

Habitat - Although humpback whales typically travel over deep, oceanic waters during migration, their feeding and breeding habitats are mostly in shallow, coastal waters over continental shelves (Clapham and Mead, 1999). Shallow banks or ledges with high sea-floor relief characterize feeding grounds (Payne *et al*., 1990; Hamazaki, 2002). The habitat requirements of wintering humpbacks appear to be determined by the conditions necessary for calving. Optimal calving conditions are warm water (24° to 28° C) and relatively shallow, low-relief ocean bottom in protected areas (*i.e.*, behind reefs) (Sanders *et al*., 2005).

Females with calves occur in significantly shallower waters than other groups of humpback whales, and breeding adults use deeper, more offshore waters (Smultea, 1994; Ersts and Rosenbaum, 2003).

Acoustics and Hearing – Humpback whales produce sounds from 20 Hz to over 10 kHz, with dominant frequencies below 3 kHz (Silber, 1986). Houser *et al* (2001a) produced the first humpback whale audiogram (using a mathematical model). The predicted audiogram indicates sensitivity to frequencies from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 and 6 kHz. Au *et al*. (2006) noted that if the popular notion that animals generally hear the totality of the sounds they produce is applied to humpback whales, this suggests that its upper frequency limit of hearing is as high as 24 kHz.

Distribution - Humpback whales are globally distributed in all major oceans and most seas. They are generally found during the summer on high-latitude feeding grounds and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs. Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep water during migration (Clapham and Mattila, 1990; Calambokidis *et al*., 2001).

In the North Atlantic Ocean, humpbacks are found from spring through fall on feeding grounds that are located from south of New England to northern Norway (NMFS, 1991). During the winter, most of the North Atlantic population of humpback whales is believed to migrate south to calving grounds in the West Indies region (Whitehead and Moore, 1982; Smith *et al*., 1999; Stevick *et al*., 2003b).

There has been an increasing occurrence of humpbacks, which appear to be primarily juveniles, during the winter along the U.S. Atlantic coast from Florida north to Virginia (Clapham *et al*., 1993; Swingle *et al*., 1993; Wiley *et al*., 1995; Laerm *et al*., 1997). It was recently proposed that the mid-Atlantic region primarily represents a supplemental winter feeding ground, which is also an area of mixing of humpback whales from different feeding stocks (Barco *et al*., 2002).

VACAPES OPAREA Humpback Whale Occurrence - Humpback whales occur on the continental shelf and in deep waters of the VACAPES OPAREA in fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. During the summer, humpback whales are found farther north at the feeding grounds. Several studies noted an increasing occurrence of humpback whale sightings and strandings during the winter (particularly January through April) along the U.S. Atlantic coast from Florida north to Virginia (Clapham *et al*., 1993; Swingle *et al*., 1993; Wiley *et al*., 1995; Laerm *et al*., 1997). Humpback whales may occur throughout much of the nearshore and shelf waters of the VACAPES OPAREA. The area of greatest concentration includes shelf and slope waters off the coast of the Virginia/North Carolina border, as well as nearshore and shelf waters near Cape Hatteras (DoN, 2008a), and reflects the increased use of this region during the winter months. The concentration of whales here also supports the notion of the mid-Atlantic region as a supplemental winter feeding ground for humpbacks (Barco *et al*., 2002). During spring and fall, humpback whales may occur on the shelf, as well as farther offshore, during migrations.

Lower Chesapeake Bay Humpback Whale Occurrence - An increase in the number of humpback whale sightings in the vicinity of Chesapeake Bay was noted in the early 1990s (Swingle *et al.,* 1993) along with increases in strandings in the mid-Atlantic region (Wiley *et al.,*1995; Barco *et al.,*2002). It is now considered that mid-Atlantic waters serve as a supplemental feeding ground used by both juvenile and adult humpback whales, primarily during January through March (Swingle *et al.,* 1993; Barco *et al.,* 2002). The humpback whale is a species also affected by ship strikes; for example, an incident involving a humpback whale took place near the mouth of Chesapeake Bay during February 1992 (Jensen and Silber, 2003). The greatest likelihood for encountering humpback whales in the Chesapeake Bay is between January and March. However, year-round usage of the area is likely based on sighting and stranding data also from the fall and summer (Barco *et al.,* 2002; Swingle *et al.,* 2007).

VACAPES OPAREA Humpback Whale Density **-** The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Report (DoN, 2007a). Density estimates for the OPAREA reflect the migration patterns of the humpback whale with higher density predicted during spring and fall migration, lower densities during the winter when animals should be largely in calving grounds farther south, and zero density during the summer season when humpbacks should be on feeding grounds to the north.

3.7.2.5 North Atlantic Right Whale

Adults are robust and may reach 18 m in length (Jefferson *et al*., 1993). North Atlantic right whales feed on zooplankton, particularly large calanoid copepods such as *Calanus* (Kenney *et al*., 1985; Beardsley *et al*., 1996; Baumgartner *et al*., 2007).

Status and Management **-** The North Atlantic right whale is one of the world's most endangered large whale species (Clapham *et al*., 1999; Perry *et al.*, 1999; IWC, 2001).

According to the North Atlantic right whale report card released annually by the North Atlantic Right Whale Consortium, approximately 393 individuals are thought to occur in the western North Atlantic (NARWC, 2007). The most recent NOAA SAR states that in a review of the photo-id recapture database for June 2006, 313 individually recognized whales were known to be alive during 2001 (Waring *et al*., 2008). This is considered the minimum population size. The North Atlantic right whale is under the jurisdiction of the NMFS. The recovery plan for the North Atlantic right whale was published in 2005 (NMFS, 2005b).

This species showed a decline in survival during the 1990's (Best *et al.*, 2001; Waring *et al*., 2008). In recent years, there has been in increase in the number of catalogued individuals (Waring *et al*., 2008); however, Kraus *et al.* (2005) noted that the recent increases in birth rate were insufficient to counter the observed spike in human-caused mortality that has recently occurred.

One calving and two feeding areas in U.S. waters are designated as critical habitat for the North Atlantic right whale (NMFS, 1994; NMFS, 2005b)

In an effort to reduce ship collisions with critically endangered North Atlantic right whales, the Early Warning System (EWS) was started in 1994 for the calving region along the southeastern U.S. coast. This system, known as the Northeast U.S. Right Whale Sighting Advisory System in the northeast, was extended in 1996 to the feeding areas off New England (NMFS-NEFSC, 2008).

In 1999, a Mandatory Ship Reporting System was implemented by the U.S. Coast Guard (USCG) (USCG, 1999; USCG, 2001). This reporting system requires vessels larger than 300 gross registered tons (Navy ships are exempt) to report their location when entering the nursery and feeding areas of the right whale (Ward-Geiger *et al*., 2005). At the same time, ships receive information on locations of North Atlantic right whale sightings in order to avoid whale collisions. Reporting takes place in the southeastern U.S. from 15 November through 15 April. In the northeastern U.S., the reporting system is year-round and the geographical boundaries include the waters of Cape Cod Bay, Massachusetts Bay, and the Great South Channel east and southeast of Massachusetts.

In October 2008, NMFS published the final rule to implement speed restrictions to reduce the threat of ship collisions with NARW. The final rule includes a speed restriction of 10 knots or less during certain times of the year along the U.S. east coast and modification of key shipping routes into Boston. These restrictions only apply to vessels greater than 20 m in length and are not mandatory for any Federal agency (NOAA, 2008). However, the Navy is consulting with NMFS regarding potential impacts from vessel collisions.

Habitat - North Atlantic right whales on the winter calving grounds are most often found in very shallow, nearshore waters in cooler sea surface temperatures inshore of a mid-shelf front (Kraus *et al*., 1993; Ward, 1999). High whale densities can extend more northerly than the current defined boundary of the calving critical habitat in response to interannual variability in regional sea surface temperature distribution (Garrison *et al*., 2005; Glass *et al*., 2005). Warm Gulf Stream waters appear to represent a thermal limit (both southward and eastward) for right whales (Keller *et al*., 2006).

The feeding areas are characterized by bottom topography, water column structure, currents, and tides that combine to physically concentrate zooplankton into extremely dense patches (Wishner *et al*., 1988; Murison and Gaskin, 1989; Macaulay *et al*., 1995; Beardsley *et al*., 1996; Baumgartner *et al*., 2003).

Acoustics and Hearing - Most of the sounds produced by right whales range in frequency from 0.02 to 15 kHz (dominant frequency range from 0.02 to less than 2 kHz; durations typically range from 0.01 to multiple seconds) with some sounds having multiple harmonics (Parks and Tyack, 2005). Recent morphometric analyses of northern right whale inner ears estimates a hearing range of approximately 0.01 to 22 kHz based on established marine mammal models (Parks *et al*., 2004; Parks and Tyack, 2005; Parks *et al.*, 2007). In addition, Parks *et al*. (2007) estimated the functional hearing range for right whales to be 15 Hz to 18 kHz. Nowacek *et al* (2004) observed that exposure to short tones and down sweeps, ranging in frequency from 0.5 to 4.5 kHz, induced an alteration in behavior (received levels of 133 to 148 dB), but exposure to sounds produced by vessels (dominant frequency range of 0.05 to 0.5 kHz) did not produce any behavioral response (received levels of 132 to 142 dB).

Distribution - Right whales occur in sub-polar to temperate waters. The North Atlantic right whale was historically widely distributed, ranging from latitudes of 60° N to 20° N, prior to serious declines in abundance due to intensive whaling (NMFS, 2006b; Reeves *et al*., 2007). North Atlantic right whales are found primarily in continental shelf waters between Florida and Nova Scotia. Most sightings are concentrated within five high-use areas: coastal waters of the southeastern U.S. (Georgia and Florida), Cape Cod and Massachusetts bays, the Great South Channel, the Bay of Fundy, and the Nova Scotian Shelf (Winn *et al*., 1986; NMFS, 2005a). Of these, one calving and two feeding areas in U.S. waters are designated as critical habitat for North Atlantic right whales under the ESA (NMFS, 1994; NMFS, 2005a) (Figure 3.7-1). The critical habitat designated waters off Georgia and northern Florida are the only known calving ground for western North Atlantic right whales, with use concentrated in the winter (as early as November and through March) (Winn *et al*., 1986), although, according to NMFS, some calving also takes place off of southern North Carolina. The feeding grounds of Cape Cod Bay, which have individuals in February through April (Winn *et al*., 1986; Hamilton and Mayo, 1990), and the Great South Channel east of Cape Cod, with use in April through June (Winn *et al*., 1986; Kenney *et al*., 1995), have also been designated as critical habitat for the North Atlantic right whale (Figure 3.7-1).

Most North Atlantic right whale sightings follow a well-defined seasonal migratory pattern through several consistently utilized habitats (Winn *et al*., 1986). It should be noted, however, that some individuals may be sighted in these habitats outside the typical time of year and that migration routes are poorly known (there may be a regular offshore component).

During the spring through early summer, North Atlantic right whales are found on feeding grounds off the northeastern U.S. and Canada. During the winter (as early as November and through March), North Atlantic right whales may be found in coastal waters off North Carolina, Georgia, and northern Florida (Winn *et al*., 1986).

VACAPES OPAREA North Atlantic Right Whale Occurrence - During winter, North Atlantic right whales may occur inshore of the shelf break throughout the VACAPES OPAREA. Sightings observed during spring and fall are likely of right whales transiting the area on their migration to and from breeding grounds farther south or feeding grounds farther north. Therefore, North Atlantic right whales would be

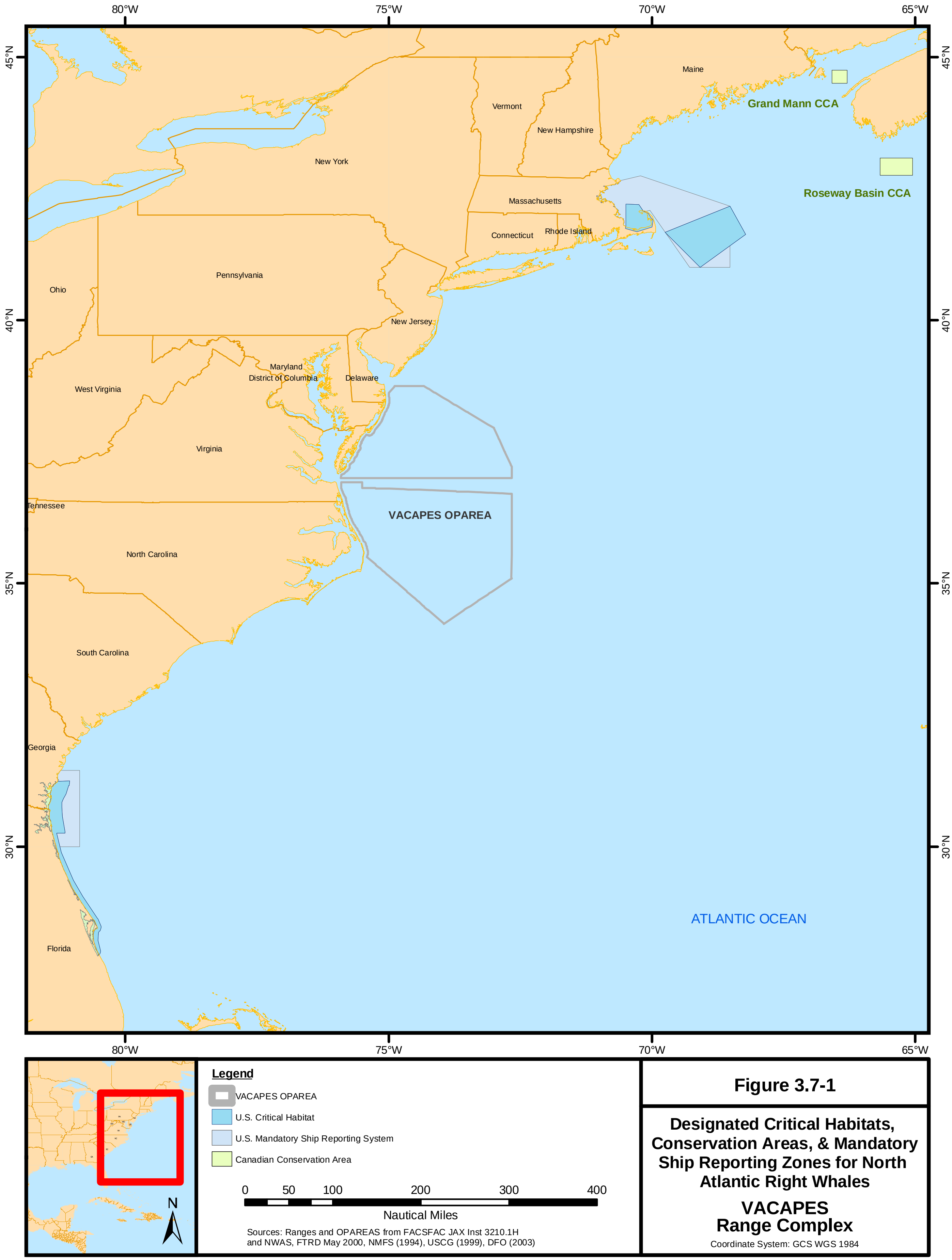


Figure 3.7-1

Designated Critical Habitats, Conservation Areas, & Mandatory Ship Reporting Zones for North Atlantic Right Whales

VACAPES Range Complex

Coordinate System: GCS WGS 1984

expected to occur throughout the nearshore waters of the VACAPES OPAREA during these seasons. North Atlantic right whales should occur farther north on their feeding grounds during summer and are not expected in the Study Area. However, they can occasionally occur here during summer as evidenced by the few sighting and stranding records near the VACAPES OPAREA (DoN, 2008a). As noted by Gaskin (1982), North Atlantic right whales might be seen anywhere off the Atlantic U.S. throughout the year. North Atlantic right whale sightings in very deep offshore waters of the western North Atlantic are infrequent (Knowlton *et al*., 2002). However, there is limited evidence suggesting that a regular offshore component exists to their distributional and migratory cycle. This evidence includes a rare occurrence at Bermuda; off-shelf excursions by satellite-tracked individuals (Mate *et al*., 1997); disappearance of right whales from most coastal habitats in winter; genetic and sighting data, indicating there are additional summer grounds; and right whale individuals sighted past the continental shelf break off Florida.

Lower Chesapeake Bay North Atlantic Right Whale Occurrence - Year-round sightings of the North Atlantic right whale near the mouth of Chesapeake Bay should be anticipated based on available sighting data from the mid-Atlantic region (DoN, 2007b). Knowlton, *et al.* (2002) reported that sightings near the Chesapeake Bay primarily occur in October through December, February, and March, and noted that the slight peaks they detected in November, December, and March coincide with the migratory time frame.

VACAPES OPAREA North Atlantic Right Whale Density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). The low density estimates, which likely reflect the low number of animals, do not signify there will be no animals in those areas. Although rare, North Atlantic right whales may occur in any warning area at any given time. Similarly, the summer estimates reflect right whale migration patterns since animals are likely to be on northern feeding grounds in this season. However, North Atlantic right whales may occur any where in the U.S. Atlantic throughout the year (Gaskin, 1982).

3.7.2.6 Sei Whale

Adult sei whales are up to 18 m in length and are mostly dark gray in color with a lighter belly, often with mottling on the back (Jefferson *et al*., 1993). In the North Atlantic Ocean, the major prey species are copepods and krill (Kenney *et al*., 1985).

Status and Management - The International Whaling Commission (IWC) recognizes three sei whale stocks in the North Atlantic: Nova Scotia, Iceland-Denmark Strait, and Northeast Atlantic (Perry *et al.* 1999). The Nova Scotia Stock occurs in U.S. Atlantic waters (Waring *et al.* 2008). The best abundance estimate for sei whales in the western North Atlantic is 207; however this is considered conservative due to uncertainties in population movements and structure (Waring *et al.* 2008). The sei whale is under the jurisdiction of the NMFS. A draft recovery plan for fin and sei whales was released in 1998 (NMFS 1998b). It has since been determined that the two species should have separate recovery plans. The independent recovery plan for the sei whale has not yet been issued; however, the species is listed as endangered under the ESA.

Habitat - Sei whales are most often found in deep, oceanic waters of the cool temperate zone. Sei whales appear to prefer regions of steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges (Kenney and Winn, 1987; Schilling *et al*., 1992; Gregr and Trites, 2001; Best and Lockyer, 2002). These areas are often the location of persistent hydrographic features, which may be important factors in concentrating prey, especially copepods. On the feeding grounds, the distribution is largely associated with oceanic frontal systems (Horwood, 1987). Characteristics of preferred breeding grounds are unknown. Horwood (1987) noted that sei whales prefer oceanic waters and are rarely found in marginal seas; historical whaling catches were usually from deep water, and land station catches were usually taken from along or just off the edges of the continental shelf.

Acoustics and Hearing – Sei whale vocalizations have been recorded only on a few occasions. During winter months off Hawaii, Rankin and Barlow (2007a) recorded downsweep calls exhibiting two distinct frequency ranges that were attributed to sei whales: the frequency ranges were from 100 to 44 Hz and from 39 to 21 Hz with the former range usually shorter in duration. Baumgartner *et al*. (2008) documented a down sweep call attributed to sei whales in the Great South Channel of the northwest Atlantic which are similar to the frequency-modulated (100 Hz to 44 Hz) calls recorded by Ranken and Barlow (2007a) from sei whales in the Pacific Ocean. Recordings from the North Atlantic consisted of paired sequences (0.5 to 0.8 sec, separated by 0.4 to 1.0 sec) of 10 to 20 short (4 milliseconds [msec]) frequency-modulated (FM) sweeps between 1.5 and 3.5 kHz; source level was not known (Thomson and Richardson, 1995). While no data on hearing availability are available for this species, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

Distribution - Sei whales have a worldwide distribution but are found primarily in cold temperate to subpolar latitudes rather than in the tropics or near the poles (Horwood, 1987). Sei whales spend the summer months feeding in the subpolar higher latitudes and return to the lower latitudes to calve in the winter. For the most part, the location of winter breeding areas remains a mystery (Rice, 1998; Perry *et al*., 1999).

In the western North Atlantic Ocean, sei whales occur primarily from Georges Bank north to Davis Strait (northeast Canada, between Greenland and Baffin Island) (Perry *et al*., 1999). Sei whales are not known to be common in most U.S. Atlantic waters (NMFS, 1998b). Peak abundance in U.S. waters occurs from winter through spring (mid-March through mid-June), primarily around the edges of Georges Bank (CETAP, 1982; Stimpert *et al*., 2003). The distribution of the Nova Scotia stock might extend along the U.S. coast at least to North Carolina (NMFS, 1998b). The hypothesis is that the Nova Scotia stock moves from spring feeding grounds on or near Georges Bank, to the Scotian Shelf in June and July, eastward to perhaps Newfoundland and the Grand Banks in late summer, then back to the Scotian Shelf in fall, and offshore and south in winter (Mitchell and Chapman, 1977).

VACAPES OPAREA Sei Whale Occurrence - The winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). During the summer, sei whales are generally farther north on feeding grounds around the eastern Scotian Shelf or Grand Banks; however, sightings within the VACAPES OPAREA during this time of year may represent individuals making early or late migrations to the feeding grounds (DoN, 2008a). Sei whales may occur throughout the VACAPES OPAREA year-round, but are probably more likely to occur in deeper offshore waters.

Lower Chesapeake Bay Sei Whale Occurrence - Sei whales are considered extralimital in the lower Chesapeake Bay region.

VACAPES OPAREA Sei Whale Density - There were not sufficient data available to estimate a density for the Study Area, nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a). Lack of sighting data for density estimates is not indicative of the absence of sei whales as they are difficult to distinguish from other rorquals at sea.

3.7.2.7 Sperm Whale

The sperm whale is the largest toothed whale species. Adult females can reach 12 m in length, while adult males measure as much as 18 m in length (Jefferson *et al*., 1993). Sperm whales prey on large mesopelagic squids and other cephalopods, as well as demersal fish and benthic invertebrates (Fiscus and Rice, 1974; Rice, 1989; Clarke, 1996).

Status and Management - Sperm whales are classified as endangered under the ESA (NMFS 2006d), although they are globally not in any immediate danger of extinction. The current combined best estimate of sperm whale abundance from Florida to the Bay of Fundy in the western North Atlantic Ocean is 4,804 individuals (Waring *et al.* 2008). Stock structure for sperm whales in the North Atlantic is unknown (Dufault *et al.* 1999). The sperm whale is under the jurisdiction of the NMFS. The draft recovery plan for the sperm whale was released in June 2006 for public comment (NMFS 2006d). In January 2007, NMFS initiated a 5-yr review for the sperm whale under the ESA (NMFS 2007a).

Habitat - Sperm whale distribution can be variable but is generally associated with waters over the continental shelf edge, continental slope, and offshore waters (CETAP, 1982; Hain *et al*., 1985; Smith *et al*., 1996; Waring *et al*., 2001; Davis *et al*., 2002). Rice (1989) noted a strong offshore preference by sperm whales.

In some areas, sperm whale densities have been correlated with high secondary productivity and steep underwater topography (Jaquet and Whitehead, 1996). Data from the Gulf of Mexico suggest that sperm whales adjust their movements to stay in or near cold-core rings (Davis *et al*., 2000; 2002), which demonstrate that sperm whales can shift their movements in response to prey density.

Off the eastern U.S., sperm whales are found in regions of pronounced horizontal temperature gradients, such as along the edges of the Gulf Stream and within warm-core rings (Waring *et al*., 1993; Jaquet and Whitehead 1996; Griffin, 1999). Fritts *et al*. (1983) reported sighting sperm whales associated with the Gulf Stream. Waring *et al*. (2003) conducted a deepwater survey south of Georges Bank in 2002 and examined fine-scale habitat use by sperm whales. Sperm whales were located in waters characterized by sea-surface temperatures of 23.2º to 24.9º C and bottom depths of 325 to 2,300 m (Waring *et al*., 2003).

Acoustics and Hearing – Sperm whales typically produce short-duration (less than 30 ms), repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges (Thomson and Richardson, 1995). It has been shown that sperm whales may produce clicks during 81 percent of their dive period, specifically 64 percent of the time during their descent phases (Watwood *et al*., 2006). The anatomy of the sperm whale's inner and middle ear indicates an ability to best hear high-frequency to ultrasonic frequency sounds. They may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten, 1992). The auditory brainstem response (ABR) technique used on a stranded neonatal sperm whale indicated it could hear sounds from 2.5 to 60 kHz with best sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder, 2001).

Distribution - Sperm whales are found from tropical to polar waters in all oceans of the world between approximately 70º N and 70º S (Rice, 1998). Females are normally restricted to areas with SSTs greater than approximately 15° C, whereas males, and especially the largest males, can be found in waters as far poleward as the pack ice with temperatures close to 0° (Rice, 1989). The thermal limits on female distribution correspond approximately to the 40° parallels (50° in the North Pacific) (Whitehead, 2003).

Sperm whales are the most-frequently sighted whale seaward of the continental shelf off the eastern U.S. (CETAP, 1982; Kenney and Winn, 1987; Waring *et al*., 1993). In Atlantic Exclusive Economic Zone waters, sperm whales appear to have a distinctly seasonal distribution (CETAP, 1982; Scott and Sadove, 1997). Although concentrations shift depending on the season, sperm whales generally occur in Atlantic EEZ waters year-round.

Mating may occur December through August, with the peak breeding season falling in the spring (NMFS 2006d); however location of specific breeding grounds is unknown.

VACAPES OPAREA Sperm Whale Occurrence - Worldwide, sperm whales exhibit a strong affinity for deep waters beyond the continental shelf break (Rice, 1989). Sighting records in the VACAPES OPAREA support this habitat preference (DoN, 2008a). Areas of greatest concentration are expected in waters over the continental slope and the continental rise near the center of the VACAPES OPAREA

(DoN, 2008a). These area concentrations are likely influenced by localized prey concentrations, due to upwelling associated within the Gulf Stream meanders and eddies, as well as areas of steep bottom topography. Sperm whales may occur seaward of the shelf break throughout the VACAPES OPAREA during all seasons.

Lower Chesapeake Bay Sperm Whale Occurrence - Sperm whales are considered extralimital in the lower Chesapeake Bay region.

VACAPES OPAREA Sperm Whale Density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning area. Sperm whales will likely be concentrated in waters near and seaward of the shelf break based on habitat preferences. The higher density estimated for summer likely reflects greater survey effort in offshore areas during the summer as compared to other seasons.

3.7.2.8 West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is a rotund, slow-moving animal, which reaches a maximum length of 3.9 m (Jefferson*, et al.,* 1993). They have an unusually low metabolic rate and a high thermal conductance that leads to energetic stress in winter (Bossart *et al.,* 2002). Manatees are herbivores that feed on a wide variety of submerged, floating, and emergent vegetation, but they also ingest invertebrates (USFWS, 2001; Courbis and Worthy, 2003; Reich and Worthy, 2006).

Status and Management - Manatees are classified as endangered under the ESA, and managed under the jurisdiction of the US Fish and Wildlife Service. In the most recent revision of the manatee recovery plan, it was concluded that, based on movement patterns, manatees around Florida should be divided into four relatively discrete management units or subpopulations, each representing a significant portion of the species' range (USFWS, 2001). Manatees found along the Atlantic U.S. coast make up two subpopulations: the Atlantic Region and the Upper St. Johns River Region (USFWS, 2001). Manatees from the western coast of Florida make up the other two subpopulations: the Northwest Region and the Southwest Region (USFWS, 2001).

Manatee numbers are assessed by aerial surveys during the winter months when manatees are concentrated in warm-water refuges. Aerial surveys conducted in February 2007 produced a preliminary abundance estimate of 2,812 individuals (FMRI, 2007). Along Florida's Gulf Coast, observers counted 1,400 manatees, while observers on the Atlantic coast counted 1,412.

Habitat - Sightings of manatees are restricted to warm freshwater, estuarine, and extremely nearshore coastal waters. Manatees occur in very shallow waters of 2 to 4 m in depth (7 to 13 feet) generally close to shore (approximately less than 1 km) (Beck *et al.,* 2004). Shallow seagrass beds close to deep channels are preferred feeding areas in coastal and riverine habitats (Lefebvre*, et al.,* 2000; USFWS, 2001). West Indian manatees are frequently located in secluded canals, creeks, embayments, and lagoons near the mouths of coastal rivers and sloughs. These areas serve as locations of feeding, resting, mating, and calving (USFWS, 2001). Estuarine and brackish waters with access to natural and artificial freshwater sources, are typical West Indian manatee habitat (USFWS, 2001). When ambient water temperatures drop below about 20° C in fall and winter, migration to natural or anthropogenic warm-water sources takes place (Irvine, 1983). Effluents from sewage treatment plants are important sources of freshwater for West Indian manatees in the Caribbean Sea (Rathbun*, et al.,* 1985). Manatees are also observed drinking fresh water that flows out of the mouths of rivers (Lefebvre *et al.,* 2001) and out of offered hoses at harbors (Fertl *et al.,* 2005).

Acoustics and Hearing

West Indian manatees produce a variety of squeak-like sounds that have a typical frequency range of 0.6 to 12 kHz (dominant frequency range from 2 to 5 kHz), and last 0.25 to 0.5 s (Steel and Morris, 1982; Thomson and Richardson, 1995; Niezrecki *et al*., 2003). Recently, vocalizations below 0.1 kHz have also been recorded (Frisch and Frisch, 2003; Frisch, 2006). Overall, West Indian manatee vocalizations are considered relatively stereotypic, with little variation between isolated populations examined (*i.e*., Florida and Belize; Nowacek *et al*., 2003). However, vocalizations have been newly shown to possess nonlinear dynamic characteristics (e.g., subharmonics or abrupt, unpredictable transitions between frequencies), which could aid in individual recognition and mother-calf communication (Mann *et al*., 2006). Average source levels for vocalizations have been calculated to range from 90 to 138 dB re: 1 µPa (average: 100 to 112 dB re 1 µPa) (Nowacek *et al*., 2003; Phillips *et al*., 2004). Behavioral data on two animals indicate an underwater hearing range of approximately 0.4 to 46 kHz, with best sensitivity between 16 and 18 kHz (Gerstein *et al.*, 1999), while earlier electrophysiological studies indicated best sensitivity from 1 to 1.5 kHz (Bullock *et al*., 1982).

Distribution - Manatees occur in warm, subtropical, and tropical waters of the western North Atlantic Ocean, from the southeastern U.S. to Central America, northern South America, and the West Indies (Lefebvre *et al.,* 2001). Manatees occur along both the Atlantic and Gulf coasts of Florida. Manatees are sometimes reported in the Florida Keys; these sightings are typically in the upper Florida Keys, with some reports as far south as Key West (Moore, 1951a, 1951b; Beck, 2006a). During winter months, the manatee population confines itself to inshore and inner shelf waters of the southern half of peninsular Florida and to springs and warm water outfalls (*e.g*., power plant cooling water outfalls) as far north as the Florida/Georgia border along the U.S. east coast. As water temperatures rise in spring, West Indian manatees disperse from winter aggregation areas. Manatees are frequently reported in coastal rivers of Georgia and South Carolina during warmer months (Lefebvre *et al.,* 2001).

Historically, manatees were likely restricted to southernmost Florida during winter and expanded their distribution northward during summer. However, industrial development has made warm-water refuges available (*e.g.*, power plant effluent plumes), and the introduction of several exotic aquatic plant species has expanded the available food supply. These factors have enabled an expansion of West Indian manatee winter range (USFWS, 2001; Laist and Reynolds III, 2005).

Several patterns of seasonal movement are known along the Atlantic coast ranging from year-round residence to long-distance migration (Deutsch *et al.,* 2003). Individuals may be highly consistent in seasonal movement patterns and show strong fidelity to warm and winter ranges, both within and across years (Deutsch *et al.,* 2003).

Perhaps the most famous long distance movements of any West Indian manatee were exhibited by the animal known as "Chessie," who gained fame in the summer of 1995 by swimming to Rhode Island, returning to Florida for the winter, and traveling north again to Virginia where he was seen in 1996. In early September 2001, "Chessie" was once again sighted in Virginia. More recently, in August 2006, a West Indian manatee was sighted in waters off Rhode Island, Delaware, New Jersey, Massachusetts, and in the Hudson River (Beck, 2006b; Anonymous, 2006, Kenney, 2007)

VACAPES OPAREA Manatee Occurrence - Manatees are considered extralimital in the VACAPES OPAREA.

Lower Chesapeake Bay Manatee Occurrence - Individual manatees are known to make long distance movements up the Atlantic coast, as noted earlier. The manatee is considered to be a regular part of the marine fauna of Chesapeake Bay (Barco, 2007). One of the first published accounts for a manatee was provided by McAtee (1950); however, not enough information was available to determine the date or exact location of its occurrence. There are occurrence records for manatees in Virginia and North Carolina area during May through November. Based on this species' known sensitivity to cool water temperatures, it is not surprising that there are no documented occurrences during the winter.

The manatee is well-known to make its way into rivers, including up tributaries and creeks. The northernmost sighting in Chesapeake Bay is from the Potomac River at Washington, D.C., during August 1980 (Rathbun *et al.,* 1982). During late June 2002, a manatee made its way up the James River and was sighted in Richmond. There were multiple manatee sightings during late September/early October 1992 up the Elizabeth River; based on the temporal and spatial proximity of the records, it was likely the same individual. Likewise, Schwartz (1995) mentioned a sighting of three individuals during August-September 1993 in the Elizabeth River Intracoastal Canal to Currituck Sound in North Carolina. Movements by manatees might take place either in nearshore waters or through inland waterways. There is only one documented stranding of a manatee in Chesapeake Bay – an October 1980 stranding at Buckroe Beach (Blaylock, 1985).

Of special interest is an apparently unintentional capture of a manatee in a seine by fishermen in late September 1908 at Ocean View (Duncan, 1908; Rathbun *et al.,* 1982) and a recent – late July 2007 – sighting of a manatee at Rock Hall Marina in upper Chesapeake Bay (Beck, 2007).

VACAPES Study Area Manatee Density - Sufficient data does not exist to calculate density estimates in the lower Chesapeake Bay.

3.7.2.9 Non-Endangered Species Act-Listed Marine Mammals

Twenty-seven non-threatened/non-endangered marine mammal species identified in Table 3.7-3 may be affected by the proposed activities in the VACAPES OPAREA and six within the Lower Chesapeake Bay. Affected species include those identified as having a regular or rare occurrence within the Study Area. Within the OPAREA these species include two baleen whale species and 25 toothed whale species. Within the Chesapeake Bay three toothed whale species and three pinniped species (seals) occur.

Atlantic Spotted Dolphin

Atlantic spotted dolphin adults are up to 2.3 m long and can weigh as much as 143 kilograms (kg) (Jefferson *et al*., 1993). Atlantic spotted dolphins are born spotless and develop spots as they age (Perrin *et al*., 1994b; Herzing, 1997). There is marked regional variation in adult body size (Perrin *et al*., 1987). There are two forms: a robust, heavily spotted form that inhabits the continental shelf, usually found within 250 to 350 km of the coast and a smaller, less-spotted form that inhabits offshore waters (Perrin *et al*., 1994b). Atlantic spotted dolphins feed on small cephalopods, fish, and benthic invertebrates (Perrin *et al*., 1994b).

Status and management— The best estimate of Atlantic spotted dolphin abundance in the U.S. Atlantic Exclusive Economic Zone (EEZ) is 50,978 individuals (Waring *et al.* 2008). Recent genetic evidence suggests that there are at least two populations in the western North Atlantic (Adams and Rosel 2006), as well as possible continental shelf and offshore segregations. Atlantic populations are divided along a latitudinal boundary corresponding roughly to Cape Hatteras (Adams and Rosel 2006). The Atlantic spotted dolphin is under the jurisdiction of NMFS.

Habitat— Atlantic spotted dolphins occupy both continental shelf and offshore habitats. The large, heavily spotted coastal form typically occurs over the continental shelf inshore of or near the 185-m isobath, 8 to 20 km from shore (Perrin *et al*., 1994b; Davis *et al*., 1998; Perrin, 2002b). There are also frequent sightings beyond the continental shelf break in the Caribbean Sea, Gulf of Mexico, and off the U.S. Atlantic Coast (Mills and Rademacher, 1996; Roden and Mullin, 2000; Fulling *et al*., 2003; Mullin and Fulling, 2003; Mullin *et al*., 2004). Atlantic spotted dolphins are found commonly in inshore waters south of Chesapeake Bay as well as over continental shelf break and slope waters north of this region (Payne *et al*., 1984; Mullin and Fulling, 2003). Sightings have also been made along the northern wall of the Gulf Stream and its associated warm-core ring features (Waring *et al*., 1992).

Acoustics and Hearing— A variety of sounds including whistles, echolocation clicks, squawks, barks, growls, and chirps have been recorded for the Atlantic spotted dolphin (Thomson and Richardson, 1995). Whistles have dominant frequencies below 20 kHz (range: 7.1 to 14.5 kHz) but multiple harmonics extend above 100 kHz, while burst pulses consist of frequencies above 20 kHz (dominant frequency of approximately 40 kHz) (Lammers *et al.*, 2003). Other sounds, such as squawks, barks, growls, and chirps, typically range in frequency from 0.1 to 8 kHz (Thomson and Richardson, 1995). Recently recorded echolocation clicks have two dominant frequency ranges at 40 to 50 kHz and 110 to 130 kHz, depending on source level (*i.e.*, lower source levels typically correspond to lower frequencies and higher frequencies to higher source levels (Au and Herzing, 2003). Echolocation click source levels as high as 210 dB re 1 μPa-m peak-to-peak have been recorded (Au and Herzing, 2003). Spotted dolphins in The Bahamas were frequently recorded during agonistic/aggressive interactions with bottlenose dolphins (and their own species) to produce squawks (0.2 to 12 kHz broad band burst pulses; males and females), screams (5.8 to 9.4 kHz whistles; males only), barks (0.2 to 20 kHz burst pulses; males only), and synchronized squawks (0.1-15 kHz burst pulses; males only in a coordinated group) (Herzing, 1996). There has been no data collected on Atlantic spotted dolphin hearing ability. However, odontocetes are generally adapted to hear high-frequencies (Ketten, 1997).

Distribution - Atlantic spotted dolphins are distributed in warm-temperate and tropical Atlantic waters from approximately 45º N to 35º S; in the western North Atlantic, this translates to waters from New England to Venezuela, including the Gulf of Mexico and the Caribbean Sea (Perrin *et al*., 1987).

Peak calving periods in The Bahamas are early spring and late fall (Herzing, 1997); however in the western Atlantic breeding times and locations are largely unknown.

VACAPES OPAREA Atlantic spotted dolphin Occurrence - Atlantic spotted dolphins may occur in both continental shelf and offshore waters of the Study Area year-round. Atlantic spotted dolphins are commonly found in inshore waters south of Chesapeake Bay (Payne *et al*. 1984; Mullin and Fulling, 2003). The northern wall of the Gulf Stream and its associated warm-core ring features likely influences occurrence of Atlantic spotted dolphins in this region.

Lower Chesapeake Bay Atlantic spotted dolphin occurrence - The Atlantic spotted dolphin is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area Atlantic spotted dolphin density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a).

Atlantic White-sided Dolphin

The Atlantic white-sided dolphin has a stocky body with a short, thick beak and tall, falcate dorsal fin. Adults reach 2.5 to 2.8 m in length (Jefferson *et al*., 1993). This species feeds on pelagic and benthipelagic fish, such as capelin, herring, hake, sand lance, smelt, and cod, as well as squids (Katona *et al*., 1978; Sergeant *et al*., 1980; Kenney *et al*., 1985; Selzer and Payne, 1988; Waring *et al*., 1990; Weinrich *et al*., 2001).

Status and management— Based on the distribution of sightings, strandings, and bycatch records, three stocks have been suggested for Atlantic white-sided dolphins in the western North Atlantic: Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea (Palka *et al.*, 1997). However, recent mitochondrial DNA analyses indicate no definite stock structure exists (Amaral *et al.*, 2001). The total number of Atlantic white-sided dolphins along the U.S. and Canadian Atlantic coast is unknown. The best estimate of abundance for the western North Atlantic is 63,368 individuals (Waring *et al.*, 2008). The Atlantic white-sided dolphin is under the jurisdiction of NMFS.

Habitat — The Atlantic white-sided dolphin is found primarily in continental shelf waters up to 100 m deep (CETAP, 1982; Selzer and Payne, 1988; Mate *et al*., 1994). Atlantic white-sided dolphin occurrence in the northeastern U.S. probably reflects fluctuations in food availability, as well as oceanographic conditions (Selzer and Payne, 1988).

Acoustics and Hearing — The only information available on Atlantic white-sided vocalizations is that the dominant frequency is 6 to 15 kHz (Thomson and Richardson, 1995). There are no hearing data available for this species.

Distribution — Atlantic white-sided dolphins are found in cold-temperate to subpolar waters of the North Atlantic, from New England to France, north to southern Greenland, Iceland, and southern Norway (Jefferson *et al*., 1993). This species is most common over the continental shelf from Hudson Canyon north to the Gulf of Maine (Palka *et al*., 1997). Virginia and North Carolina appear to represent the southern edge of their range (Testaverde and Mead, 1980).

Calving occurs during the summer with peaks in the months of June and July (Jefferson et.al. 2008); however, locations are largely unknown.

VACAPES OPAREA Atlantic white-sided dolphin Occurrence - Due to this species' preference for colder waters, the Gulf Stream may be a southern boundary for Atlantic white-sided dolphin distribution. This species may occur primarily in waters over the continental shelf throughout the VACAPES OPAREA year-round. However, distribution may also range farther offshore, which is evidenced by the sighting records offshore in waters over the continental slope in and near the VACAPES OPAREA (DoN, 2008a).

Lower Chesapeake Bay Atlantic white-sided dolphin occurrence - The Atlantic white-sided dolphin is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area Atlantic white-sided dolphin density - There were not sufficient data available to estimate a density for the Study Area. Nor was there an abundance estimate in the NOAA stock assessment used to derive density (DoN, 2007a). Lack of density estimates is not indicative of the absence of animals.

Beaked Whales

Based on available data, the following five beaked whale species may be affected by the proposed activities in the VACAPES Study Area: Cuvier's beaked whales and four members of the genus *Mesoplodon* (True's, Gervais', Blainville's, and Sowerby's beaked whales). There is one extralimital stranding record of a northern bottlenose whale (*Hyperoodon ampullatus*) inshore of the VACAPES OPAREA (DoN, 2008a); however, this species is expected to occur in cold temperate to subarctic waters which are found much farther north of the VACAPES Study Area and are not likely to be affected by the proposed activities. Therefore, the northern bottlenose whale is not discussed further.

Cuvier's beaked whales are relatively robust compared to other beaked whale species. Male and female Cuvier's beaked whales may reach 7.5 and 7.0 m in length, respectively (Jefferson *et al*., 1993). *Mesoplodon* species have maximum reported adult lengths of 6.2 m (Mead, 1989). Stomach content analyses of captured and stranded individuals suggest beaked whales are deep divers that feed by suction on mesopelagic fish, squids, and deepwater benthic invertebrates (Heyning, 1989; Heyning and Mead, 1996; Santos *et al*., 2001; MacLeod *et al*., 2003). Stomach contents of Cuvier's beaked whales rarely contain fish, while stomach contents of *Mesoplodon* species frequently do (MacLeod *et al*., 2003).

Status and management— The best estimate of *Mesoplodon* spp. and Cuvier's beaked whale abundance combined in the western North Atlantic is 3,513 individuals (Waring *et al.* 2008). A recent study of global phylogeographic structure of Cuvier's beaked whales suggested that some regions show a high level of differentiation (Dalebout *et al.* 2005); however, Dalebout *et al.*, (2005) could not discern finer-scale population differences within the North Atlantic. Beaked whales are under the jurisdiction of NMFS.

Habitat - World-wide, beaked whales normally inhabit continental slope and deep oceanic waters (>200 m) (Waring *et al*., 2001; Cañadas *et al*., 2002; Pitman, 2002; MacLeod *et al*., 2004; Ferguson *et al*., 2006; MacLeod and Mitchell, 2006). Beaked whales are only occasionally reported in waters over the continental shelf (Pitman, 2002). Distribution of *Mesoplodon* spp. in the North Atlantic may relate to water temperature (MacLeod, 2000a). The Blainville's and Gervais' beaked whales occur in warmer southern waters, in contrast to Sowerby's and True's beaked whales that are more northern (MacLeod, 2000b). Beaked whale abundance off the eastern U.S. may be highest in association with the Gulf Stream and the warm-core rings it develops (Waring *et al*., 1992). In summer, the continental shelf break off the northeastern U.S. is primary habitat (Waring *et al*., 2001).

Acoustics and Hearing - Sounds recorded from beaked whales are divided into two categories: whistles and pulsed sounds (clicks); whistles likely serve a communicative function and pulsed sounds are important in foraging and/or navigation (Johnson *et al.*, 2004; Madsen *et al.*, 2005b; MacLeod and D'Amico, 2006; Tyack *et al.*, 2006). Whistle frequencies are about 2 to 12 kHz, while pulsed sounds range in frequency from 300 Hz to 135 kHz; however, as noted by MacLeod and D'Amico (2006), higher frequencies may not be recorded due to equipment limitations. Whistles recorded from free-ranging Cuvier's beaked whales off Greece ranged in frequency from 8 to 12 kHz, with an upsweep of about 1 sec (Manghi *et al.*, 1999), while pulsed sounds had a narrow peak frequency of 13 to 17 kHz, lasting 15 to 44 sec in duration (Frantzis *et al.*, 2002). Short whistles and chirps from a stranded subadult Blainville's beaked whale ranged in frequency from slightly less than 1 to almost 6 kHz (Caldwell and Caldwell, 1971a).

Recent studies incorporating DTAGs (miniature sound and orientation recording tag) attached to Blainville's beaked whales in the Canary Islands and Cuvier's beaked whales in the Ligurian Sea recorded high-frequency echolocation clicks (duration: 175 microseconds (μs) for Blainville's and 200 to 250 μs for Cuvier's) with dominant frequency ranges from about 20 to over 40 kHz (limit of recording system was 48 kHz) and only at depths greater than 200 m (656 ft) (Johnson *et al.*, 2004; Madsen *et al.*, 2005b; Zimmer *et al.*, 2005; Tyack *et al.*, 2006). The source level of the Blainville's beaked whales' clicks were estimated to range from 200 to 220 dB re 1 μPa-m peak-to-peak (Johnson *et al.*, 2004), while they were 214 dB re 1 μPa-m peak-to-peak for the Cuvier's beaked whale (Zimmer *et al.*, 2005). Mid-frequency sounds including a frequency-modulated pure tone, and three FM and AM pulsed sounds (between 6 and 16 kHz) were attributed to three cow/calf pairs of Blainville's beaked whales during shipboard visual/acoustic surveys near the Hawaiian islands (Rankin and Barlow, 2007b).

From anatomical examination of their ears, it is presumed that beaked whales are predominantly adapted to best hear ultrasonic frequencies (MacLeod, 1999; Ketten, 2000). Beaked whales have well-developed semi-circular canals (typically for vestibular function but may function differently in beaked whales) compared to other cetacean species, and they may be more sensitive than other cetaceans to low-frequency sounds (MacLeod, 1999; Ketten, 2000). Ketten (2000) remarked on how beaked whale ears (computerized tomography (CT) scans of Cuvier's, Blainville's, Sowerby's, and Gervais' beaked whale heads) have anomalously well-developed vestibular elements and heavily reinforced (large bore, strutted) Eustachian tubes and noted that they may impart special resonances and acoustic sensitivities. The only direct measure of beaked whale hearing is from a stranded juvenile Gervais' beaked whale using auditory evoked potential techniques (Cook *et al.*, 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook *et al.*, 2006).

Distribution - Cuvier's beaked whales are the most widely distributed of the beaked whales and are present in most regions of all major oceans (Heyning, 1989; MacLeod *et al*., 2006). This species occupies almost all temperate, subtropical, and tropical waters, as well as subpolar and even polar waters in some areas (MacLeod *et al*., 2006). Blainville's beaked whales are thought to have a continuous distribution throughout tropical, subtropical, and warm-temperate waters of the world's oceans; they occasionally occur in cold-temperate areas (MacLeod *et al*., 2006). The Gervais' beaked whale is restricted to warm-temperate and tropical Atlantic waters with records throughout the Caribbean Sea (MacLeod *et al*., 2006). The Sowerby's beaked whale is endemic to the North Atlantic; this is considered to be more of a temperate species (MacLeod *et al*., 2006). In the western North Atlantic, confirmed strandings of True's beaked whales are recorded from Nova Scotia to Florida and also in Bermuda (MacLeod *et al*., 2006). There is also a sighting made southeast of Hatteras Inlet, North Carolina (Tove, 1995).

The continental shelf margins from Cape Hatteras to southern Nova Scotia were recently identified as known "key areas" for beaked whales in a global review by MacLeod and Mitchell (2006).

Beaked whale life histories are poorly known, reproductive biology is generally undescribed, and the locations of specific breeding grounds are unknown.

VACAPES OPAREA beaked whale Occurrence - Beaked whale may occur seaward of the continental shelf break throughout the VACAPES Study Area year-round. Beaked whale sightings in the western North Atlantic Ocean appear to be concentrated in waters between the 200-m isobath and those just beyond the 2,000-m isobath (DoN, 2008a, 2008b); however this may be an artifact of survey effort and occurrence may extend into deeper waters as well.

Lower Chesapeake Bay beaked whale occurrence - All beaked whale species are considered extralimital in the Chesapeake Bay region.

VACAPES Study Area beaked whale density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning area. Beaked whales will likely be concentrated in waters near and seaward of the shelf break based on habitat preferences. The higher density estimated for summer likely reflects greater survey effort in offshore areas during the summer as compared to other seasons.

Bottlenose Dolphin

Bottlenose dolphins are large and robust with striking regional variations in body size; adult body lengths range from 1.9 to 3.8 m (Jefferson *et al*., 1993). Bottlenose dolphins are opportunistic feeders that utilize numerous feeding strategies to prey on a variety of fish, cephalopod, and shrimp (Shane, 1990; Wells and Scott, 1999).

Status and management— Two forms of bottlenose dolphins are recognized in the western North Atlantic Ocean: nearshore (coastal) and offshore (Waring *et al.* 2008). The best estimate for the western North Atlantic coastal stock of bottlenose dolphins is 15,620 (Waring *et al.*, 2008). Currently, a single western North Atlantic offshore stock is recognized seaward of 34 km from the U.S. coastline (Waring *et al.* 2008). The best population estimate for this stock is 81,588 individuals (Waring *et al.*, 2008).

Habitat— Coastal bottlenose dolphins occur in coastal embayments and estuaries as well as in waters over the continental shelf; individuals may exhibit either resident or migratory patterns in coastal areas (Kenney, 1990). Read *et al*. (2003) found the dolphins occurring in North Carolina bays, sounds, and estuaries to contribute substantially to the coastal bottlenose dolphin population in the area. Bays, sounds, and estuaries are high-use habitats for bottlenose dolphins due to their importance as nursery and feeding areas (Read *et al*., 2003).

Coastal bottlenose dolphins show a temperature-limited distribution, occurring in significantly warmer waters than the offshore stock, and having a distinct northern boundary (Kenney, 1990). A study of the Chesapeake Bay/Virginia coast area showed a much greater probability of sightings with SSTs of 16° to 28°C (Armstrong *et al*., 2005). SST may significantly influence seasonal movements of migrating coastal dolphins along the western Atlantic coast (Barco *et al*., 1999); these seasonal movements are likely also influenced by movements of prey resources.

The nearshore waters of the Outer Banks serve as winter habitat for coastal bottlenose dolphins (Read *et al*., 2003). Cape Hatteras represents important habitat for bottlenose dolphins, particularly in winter, as evidenced from concentrations of bottlenose dolphins during recent aerial surveys (Torres *et al*., 2005).

In the western North Atlantic, the greatest concentrations of the offshore stock are along the continental shelf break (Kenney, 1990). Evidence suggests that there is a distinct spatial separation pf the coastal and offshore stocks during the summer; however the morphotypes overlap in the winter (Garrison *et al*., 2003; Torres et. al., 2003). During CETAP surveys, offshore bottlenose dolphins generally were distributed between the 200 and 2,000-m isobaths in waters with a mean bottom depth of 846 m from Cape Hatteras to the eastern end of Georges Bank. Geography and temperature also influence the distribution of offshore bottlenose dolphins (Kenney, 1990).

Acoustics and Hearing— Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated. Clicks and whistles have a dominant frequency range of 110 to 130 kHz and a source level of 218 to 228 dB re 1 µPa-m peak-to-peak (Au, 1993) and 3.4 to 14.5 kHz and 125 to 173 dB re 1 µPa-m, respectively (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (*i.e.*, signature whistles) (Caldwell and Caldwell, 1965; Janik *et al.*, 2006). Up to 52 percent of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles (Cook *et al.*, 2004). Sound production is also influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fishes, specifically sea trout (*Salmo trutta*) and Atlantic salmon (*Salmo salar*), in some regions (*i.e.*, Moray Firth, Scotland) (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutiérrez and Stienessen, 2004; Cook *et al.*, 2004). Furthermore, both whistles and clicks have been demonstrated to vary geographically in terms of overall vocal activity, group size, and specific context (*e.g.*, feeding, milling, traveling, and socializing) (Jones and Sayigh, 2002; Zaretsky *et al.*, 2005; Baron, 2006). For example, preliminary research indicates that characteristics of whistles from populations in the northern Gulf of Mexico significantly differ (*i.e.*, in frequency and duration) from those in the western north Atlantic (Zaretsky *et al.*, 2005; Baron, 2006).

Bottlenose dolphins can typically hear within a broad frequency range of 0.04 to 160 kHz (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall *et al.*, 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at the some lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Temporary threshold shifts in hearing have been experimentally induced in captive bottlenose dolphins using a variety of noises (*i.e.*, broad-band, pulses) (Ridgway *et al.*, 1997; Schlundt *et al.*, 2000; Nachtigall *et al.*, 2003; Finneran *et al.*, 2005; Mooney *et al.*, 2005; Mooney, 2006). For example, TTS has been induced with exposure to a 3 kHz, one-second pulse with sound exposure level (SEL) of 195 dB re 1 µPa2-s (Finneran *et al.*, 2005), one-second pulses from 3 to 20 kHz at 192 to 201 dB re 1µPa-m (Schlundt *et al.*, 2000), and octave band noise (4 to 11 kHz) for 50 minutes at 179 dB re 1 µPa-m (Nachtigall *et al.*, 2003). Preliminary research indicates that TTS and recovery after noise exposure are frequency dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney *et al.*, 2005; Mooney, 2006). Observed changes in behavior were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 µPa-m (Ridgway *et al.*, 1997; Schlundt *et al.*, 2000). Finneran *et al.* (2005) concluded that a SEL of 195 dB re 1 µPa2 s is a reasonable threshold for the onset of TTS in bottlenose dolphins exposed to mid-frequency tones.

Distribution— In the western North Atlantic, bottlenose dolphins occur as far north as Nova Scotia but are most common in coastal waters from New England to Florida, the Gulf of Mexico, the Caribbean, and southward to Venezuela and Brazil (Würsig *et al*., 2000). Bottlenose dolphins occur seasonally in estuaries and coastal embayments as far north as Delaware Bay (Kenney, 1990) and in waters over the outer continental shelf and inner slope, as far north as Georges Bank (CETAP, 1982; Kenney, 1990).

In North Carolina, there is significant overlap between distributions of coastal and offshore dolphins during the summer. North of Cape Lookout, there is a separation of the offshore and coastal ecotypes by bottom depth; the coastal form occurs in nearshore waters (<20 m deep) while the offshore form is in deeper waters (>40 m deep) (Garrison and Hoggard, 2003); however, south of Cape Lookout to northern Florida, there is significant spatial overlap between the two stocks. In this region, coastal dolphins may be found in waters as deep as 31 m and 75 km from shore while offshore dolphins may occur in waters as shallow as 13 m (Garrison *et al*., 2003b). Additional aerial surveys and genetic sampling are required to better understand the distribution of the stocks throughout the year.

Populations exhibit seasonal migrations regulated by temperature and prey availability (Torres *et al*., 2005), traveling as far north as New Jersey in summer and as far south as central Florida in winter (Urian *et al*., 1999).

Coastal bottlenose dolphins along the western Atlantic coast may exhibit either resident or migratory patterns (Waring et.al. 2007). Photo-identification studies support evidence of year-round resident bottlenose dolphin populations in Beaufort and Wilmington, North Carolina (Koster *et al*., 2000; Waring *et al*., 2007); these are the northernmost documented sites of year-round residency for bottlenose dolphins in the western North Atlantic (Koster *et al*., 2000). Migratory dolphins may enter these areas seasonally as well, as evidenced by a bottlenose dolphin tagged in 2001 in Virginia Beach who overwintered in waters between Cape Hatteras and Cape Lookout (NMFS-SEFSC, 2001).

Bottlenose dolphins are flexible in their timing of reproduction. Seasons of birth for bottlenose dolphin populations are likely responses to seasonal patterns of availability of local resources (Urian *et al*. 1996). There are no specific breeding locations for this species.

VACAPES OPAREA bottlenose dolphin Occurrence— Bottlenose dolphins are abundant continental shelf and inner slope waters throughout the western North Atlantic (CETAP, 1982; Kenney, 1990; Waring *et al*., 2007). The greatest concentrations of offshore animals are along the continental shelf break and between the 200 and 2,000-m isobaths (Kenney, 1990; Waring *et al*., 2007); however, survey effort biases may underestimate occurrence in deeper, offshore waters. Sighting records and tagging data suggest that the range of offshore bottlenose dolphins may actually extend into deeper waters (Kenney, 1990; Wells *et al*., 1999a), possibly even over the Hatteras Abyssal Plain just southeast of the VACAPES OPAREA. Bottlenose dolphins also occur in nearshore waters of North Carolina year-round and in Virginia waters seasonally from late April to November (Blaylock, 1988; Barco *et al*., 1999; NMFS-SEFSC, 2001).

Lower Chesapeake Bay bottlenose dolphin occurrence - Bottlenose dolphins are known to utilize the Chesapeake Bay region between September and November (Barco *et al*. 1999). A recurring nearshore front occurs near Cape Henry in the mouth of the Bay (Marmorino *et al*. 2000); dolphins may use this area as feeding habitat, particularly during the fall.

Bottlenose dolphins occurring in Chesapeake Bay are part of the coastal migratory stock. Virginia is the southernmost state on the coast whose nearshore population consists exclusively of this stock (Swingle 1994). The Cape Charles/Fisherman Island area to the north, and the Cape Henry area to the south represent important "nursery areas" for the coastal migratory stock (Swingle 1994; Swingle *et al*. 1995; Barco *et al*. 1999).

Bottlenose dolphins may occur in Chesapeake Bay beginning in about mid-April (Swingle 1994) and are prevalent in lower Chesapeake Bay from May thru October (Swingle 1994; Foss and Reed 2003). Only sporadic occurrences are noted during the remainder of the year.

VACAPES Study Area bottlenose dolphin density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7.1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Lower density estimates offshore are not necessarily indicative of fewer animals, but may reflect lower survey efforts in deep water areas.

Bryde's Whale

Bryde's whales usually have three prominent ridges on the rostrum (other rorquals generally have only one) (Jefferson *et al*., 1993). Adults can be up to 15.5 m in length (Jefferson *et al*., 1993). Bryde's whales can be easily confused with sei whales. Bryde's whales are lunge-feeders, feeding on schooling fish and krill (Nemoto and Kawamura, 1977; Siciliano *et al*., 2004; Anderson, 2005).

Status and management— No abundance information is currently available for Bryde's whales in the western North Atlantic (Waring *et al.*, 2008). Bryde's whales are under the jurisdiction of NMFS.

Habitat— Bryde's whales are found both offshore and near the coasts in many regions. The Bryde's whale appears to have a preference for water temperatures between approximately 15° and 20°C (Yoshida and Kato, 1999). Bryde's whales are more restricted to tropical and subtropical waters than other rorquals.

Acoustics and Hearing
Bryde's whales produce low frequency tonal and swept calls similar to those of other rorquals (Oleson *et al*., 2003). Calls vary regionally, yet all but one of the call types have a fundamental frequency below 60 Hz. They last from one-quarter of a second to several seconds and are produced in extended sequences. Heimlich *et al*. (2005) recently described five tone types. These include two types of alternating tonal "phrases," a wideband "burst" followed by a tone that occurred in either lower (19 to 30 Hz) or higher (42 Hz) frequencies depending on the area, and an "harmonic tone phrase" with a fundamental frequency of 26 Hz. No vocalization exceeded 80 Hz. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

Distribution— Bryde's whales are found in subtropical and tropical waters and generally do not range north of 40° in the northern hemisphere or south of 40° in the southern hemisphere (Jefferson *et al.*, 1993).

The Bryde's whale does not have a well-defined breeding season in most areas and locations of specific breeding areas are unknown.

VACAPES OPAREA Bryde's whale occurrence - There is a general lack of knowledge of this species, particularly in the North Atlantic, although records support a tropical occurrence for the species here (Mead 1977). A few unidentified Bryde's/sei whale records are also documented near the shelf break off the coast of Virginia (DoN, 1995). Bryde's whales may occur seaward of the shoreline in the Study Area year-round based on occurrences both in coastal and offshore waters in other locales.

Lower Chesapeake Bay Bryde's whale occurrence **-** One Bryde's whale stranding is recorded from the winter of 1927 well within Chesapeake Bay (Mead 1977); however, Bryde's whales are considered extralimital in Chesapeake Bay.

VACAPES Study Area Bryde's whale density **-** There were not sufficient data available to estimate a density for the Study Area, nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a). Lack of sighting data for density estimates is not indicative of the absence of Bryde's whales as they are difficult to distinguish from other rorquals at sea.

Clymene Dolphin

Due to similarity in appearance, Clymene dolphins are easily confused with spinner and short-beaked common dolphins (Fertl *et al*., 2003). The Clymene dolphin, however, is smaller and more robust, with a much shorter and stockier beak. The Clymene dolphin can reach at least 2 m in length and weights of at least 85 kg (Jefferson *et al*., 1993). Clymene dolphins feed on small pelagic fish and squid (Perrin *et al*., 1981; Perrin and Mead, 1994; Fertl *et al*., 1997).

Status and management — The population in the western North Atlantic is currently considered a separate stock for management purposes although there is not enough information to distinguish this stock from the Gulf of Mexico stock(s) (Waring *et al.* 2008). The best estimate of abundance for the western North Atlantic stock of Clymene dolphins is 6,086 individuals (Waring *et al.* 2008). The Clymene dolphin is under NMFS jurisdiction.

Habitat— Clymene dolphins are a tropical to subtropical species, primarily sighted in deep waters well beyond the edge of the continental shelf (Fertl *et al*., 2003). Biogeographically, the Clymene dolphin is found in the warmer waters of the North Atlantic and is often associated with the North Equatorial Current, the Gulf Stream, and the Canary Current (Fertl *et al*., 2003). In the western North Atlantic, Clymene dolphins were identified primarily in offshore waters east of Cape Hatteras over the continental slope and are likely to be strongly influenced by oceanographic features of the Gulf Stream (Mullin and Fulling, 2003).

Acoustics and Hearing— The only data available for this species is a description of their whistles. Clymene dolphin whistle structure is similar to that of other stenellids, but it is generally higher in frequency (range of 6.3 to 19.2 kHz) (Mullin *et al*., 1994a). There is no empirical data on the hearing ability of Clymene dolphins; however, the most sensitive hearing range for odontocetes generally includes high frequencies (Ketten, 1997).

Distribution— In the western Atlantic Ocean, Clymene dolphins are distributed from New Jersey to Brazil, including the Gulf of Mexico and Caribbean Sea (Fertl *et al*., 2003; Moreno *et al*., 2005).

Seasonality and location of Clymene dolphin breeding is unknown.

VACAPES OPAREA Clymene dolphin Occurrence—The oceanographic features of the Gulf Stream likely influence the distribution of Clymene dolphins in the Study Area. Based on confirmed sightings and the preference of this species for warm, deep waters, Clymene dolphins may occur in waters seaward of the shelf break south of the northern wall of the Gulf Stream. Clymene dolphins may occur north of the Gulf Stream's warm water influence, particularly during summer when water temperatures are generally warmer.

Lower Chesapeake Bay Clymene dolphin occurrence **-** The Clymene dolphin is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area Clymene dolphin density **-** The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning areas. Clymene dolphins will likely be concentrated in deeper waters seaward of the shelf break and/or near the Gulf Stream based on habitat preferences.

Common Dolphin

There are two types of common dolphin, only the short-beaked common dolphin is expected to occur in the VACAPES Study Area. The short-beaked common dolphin is a moderately robust dolphin, with a moderate-length beak, and a tall, slightly falcate dorsal fin. Length ranges up to about 2.3 m (females) and 2.6 m (males); however, there is substantial geographic variation (Jefferson *et al*., 1993). Common dolphins feed on a wide variety of epipelagic and mesopelagic schooling fish and squids, such as the long-finned squid, Atlantic mackerel, herring, whiting, pilchard, and anchovy (Waring *et al*., 1990; Overholtz and Waring, 1991).

Status and management -- The best estimate of abundance for the Western North Atlantic *Delphinus* spp. stock is 120,743 individuals (Waring *et al.* 2008). There is no information available for western North Atlantic common dolphin stock structure (Waring *et al.* 2008). The common dolphin is under the jurisdiction of NMFS.

Habitat - Common dolphins occupy a variety of habitats, including shallow continental shelf waters, waters along the continental shelf break, and continental slope and oceanic areas. Along the U.S. Atlantic coast, common dolphins typically occur in temperate waters on the continental shelf between the 100 and 200-m isobaths, in association with the Gulf Stream, along the edge of the continental shelf (CETAP, 1982; Selzer and Payne, 1988; Waring and Palka, 2002).

Acoustics and Hearing— Recorded *Delphinus* spp. vocalizations include whistles, chirps, barks, and clicks (Ketten, 1998). Clicks range from 0.2 to 150 kHz with dominant frequencies between 23 and 67 kHz and estimated source levels of 170 dB re 1 μPa. Chirps and barks typically have a frequency range from less than 0.5 to 14 kHz, and whistles range in frequency from 2 to 18 kHz (Fish and Turl, 1976; Thomson and Richardson, 1995; Ketten, 1998; Oswald *et al*., 2003). Maximum source levels are approximately 180 dB 1 μPa-m (Fish and Turl, 1976). This species' hearing range extends from 10 to 150 kHz; sensitivity is greatest from 60 to 70 kHz (Popov and Klishin, 1998).

Distribution— Common dolphins occur from southern Norway to West Africa in the eastern Atlantic and from Newfoundland to Florida in the western Atlantic (Perrin, 2002a), although this species more commonly occurs in temperate, cooler waters in the northwestern Atlantic (Waring and Palka, 2002). This species is abundant within a broad band paralleling the continental slope from 35ºN to the northeast peak of Georges Bank (Selzer and Payne, 1988). Short-beaked common dolphin sightings are known to occur along the continental shelf break south of 40ºN in spring and north of this latitude in fall. Throughout all seasons common dolphins occur along the shelf edge in a wide band, with occurrence extending onto the shelf (CETAP, 1982). During fall, this species is particularly abundant along the northern edge of Georges Bank (CETAP, 1982). The common dolphin is less abundant south of Cape Hatteras (Waring *et al*., 2007).

Calving peaks differ between stocks, and have been reported in spring and autumn as well as in spring and summer (Jefferson *et al*. 1993); however, locations of breeding areas are unknown.

VACAPES OPAREA common dolphin occurrence - Common dolphins may primarily occur in a broad band along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP 1982). This species is less common south of Cape Hatteras (Waring *et al*. 2007). As noted in CETAP (1982), the common dolphin may occur shoreward, and they are found over the shelf throughout the year.

Lower Chesapeake Bay common dolphin occurrence - Records for the Chesapeake region are all from the lower part of lower Chesapeake Bay from December through June, including a pound net capture.

Westgate (2005) lists common dolphin records for the North Atlantic, including strandings and biopsy efforts, also for approximately the same temporal pattern. Stranding records of common dolphins have increased dramatically in the last 10 yrs; this is now one of most common offshore species in the Chesapeake region (Barco, 2007). Groups of common dolphin have been reported on a few occasions at the Bay mouth (Barco, 2007).

VACAPES Study Area common dolphin density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a).

False Killer Whale

The false killer whale has a long slender body, a rounded overhanging forehead, and little or no beak (Jefferson *et al*., 1993). Individuals reach maximum lengths of 6.1 m (Jefferson *et al*., 1993). The flippers have a characteristic hump on the S-shaped leading edge—this is perhaps the best characteristic for distinguishing this species from the other "blackfish" (an informal grouping that is often taken to include pygmy killer, melon-headed, and pilot whales; Jefferson *et al*., 1993). Deepwater cephalopods and fish are their primary prey (Odell and McClune, 1999), but large pelagic species, such as dorado, have been taken. False killer whales are known to attack marine mammals such as other delphinids, (Perryman and Foster, 1980; Stacey and Baird, 1991), sperm whales (Palacios and Mate, 1996), and baleen whales (Hoyt, 1983; Jefferson, 2006).

Status and management - There are no abundance estimates available for this species in the western North Atlantic (Waring *et al.* 2008). The false killer whale is under the jurisdiction of NMFS.

Habitat - False killer whales are primarily offshore animals, although they do come close to shore, particularly around oceanic islands (Baird 2002). Inshore movements are occasionally associated with prey movement and the movement of warm ocean currents toward the shore (Stacey *et al*. 1994).

Acoustics and Hearing - Dominant frequencies of false killer whale whistles are from 4 to 9.5 kHz, and those of their echolocation clicks are from either 20 to 60 kHz or 100 to 130 kHz depending on ambient noise and target distance (Thomson and Richardson, 1995). Click source levels typically range from 200 to 228 dB re 1 μPa-m (Ketten, 1998). Recently, false killer whales recorded in the Indian Ocean produced echolocation clicks with dominant frequencies of about 40 kHz and estimated source levels of 201-225 dB re 1 μPa-m peak-to-peak (Madsen *et al.*, 2004b). False killer whales can hear frequencies ranging from approximately 2 to 115 kHz with best hearing sensitivity ranging from 16 to 64 kHz (Thomas *et al.*, 1988). Additional behavioral audiograms of false killer whales support a range of best hearing sensitivity between 16 and 24 kHz, with peak sensitivity at 20 kHz (Yuen *et al.*, 2005). The same study also measured audiograms using the ABR technique, which came to similar results, with a range of best hearing sensitivity between 16 and 22.5 kHz, peaking at 22.5 kHz (Yuen *et al.*, 2005). Behavioral audiograms in this study consistently resulted in lower thresholds than those obtained by ABR.

Distribution - False killer whales are found in tropical and temperate waters, generally between 50°S and 50°N latitude with a few records north of 50°N in the Pacific and the Atlantic (Baird *et al*., 1989; Odell and McClune, 1999).

Seasonality and location of false killer whale breeding are unknown.

VACAPES OPAREA false killer whale occurrence - False killer whales occur in offshore, warm waters worldwide (Baird 2002). The warm waters of the Gulf Stream likely influence occurrence in the southern VACAPES OPAREA. A small number of sightings and strandings are recorded near the Study Area; the sightings reflect the preference of this species for offshore waters (DoN, 2008a). False killer whales may occur seaward of the shelf break throughout the OPAREA year-round.

Lower Chesapeake Bay false killer whale occurrence - The false killer whale is considered extralimital to the Chesapeake Bay region.

VACAPES Study Area false killer whale density - There were not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Fraser's Dolphin

The Fraser's dolphin reaches a maximum length of 2.7 m and is generally more robust than other small delphinids (Jefferson *et al*., 1993). They feed on mesopelagic fish, squid, and shrimp (Jefferson and Leatherwood, 1994; Perrin *et al*., 1994a).

Status and management-- No abundance estimate of Fraser's dolphins in the western North Atlantic is available (Waring *et al.* 2008). Fraser's dolphins are under the jurisdiction of NMFS.

Habitat - The Fraser's dolphin is an oceanic species, except in places where deepwater approaches a coastline (Dolar 2002).

Acoustics and Hearing - Fraser's dolphin whistles have been recorded having a frequency range of 7.6 to 13.4 kHz in the Gulf of Mexico (duration less than 0.5 sec) (Leatherwood *et al.*, 1993). There are no empirical hearing data hearing data available for this species.

Distribution - Fraser's dolphins are found in subtropical and tropical waters around the world, typically between 30ºN and 30ºS (Jefferson *et al*., 1993). Few records are available from the Atlantic Ocean (Leatherwood *et al*., 1993; Watkins *et al*., 1994; Bolaños and Villarroel-Marin, 2003).

Location of Fraser's dolphin breeding is unknown, and available data do not support calving seasonality.

VACAPES OPAREA Fraser's dolphin occurrence - Only one sighting is documented in the VACAPES Study Area; this sighting was recorded in deep waters (>3,000 m in depth) offshore of Cape Hatteras (NMFS-SEFSC 1999). Fraser's dolphins may occur in the OPAREA in waters seaward of the continental shelf, and distribution is assumed to be similar year-round.

Lower Chesapeake Bay Fraser's dolphin occurrence - The Fraser's dolphin is considered extralimital in the lower Chesapeake Bay region.

VACAPES Study Area Fraser's dolphin density - There were not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Harbor Porpoise

Harbor porpoises are the smallest cetaceans in the North Atlantic with a maximum length of 2.0 m (Jefferson *et al*., 1993). They feed on a variety of small, schooling clupeoid (herring-like) and gadid (cod-like) fish usually less than 30cm in length (Read, 1999).

Status and management - There are four proposed harbor porpoise populations in the western North Atlantic: Gulf of Maine and Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland stocks (Gaskin, 1992) with additional studies supporting this hypothesis (Wang et.al., 1996; Rosel et.al., 1999). Abundance estimates given in the SAR are based on the four population structure. The best estimate of abundance for the Gulf of Maine and Bay of Fundy stock is 89,054 individuals (Waring *et al.*, 2008). The harbor porpoise is under the jurisdiction of NMFS.

Habitat - Harbor porpoises appear restricted to relatively cool waters where prey aggregations are concentrated (Watts and Gaskin, 1985). Harbor porpoises are seldom found in waters warmer than 17ºC (Read, 1999) and closely mirror the movements of their primary prey, Atlantic herring (Gaskin, 1992). Harbor porpoises are generally scarce in areas without significant coastal fronts or topographically generated upwellings (Gaskin, 1992; Skov *et al*., 2003). Harbor porpoises occur most frequently in shallow and shelf waters (Jefferson et. al., 2008; Read, 1999). However, pelagic drift net bycatches and movements of a satellite-tracked individual, which swam offshore into water over 1,800 m deep, indicate a potential offshore distribution (Read *et al*., 1996; Westgate *et al*., 1998).

Acoustics and Hearing - Harbor porpoise vocalizations include clicks and pulses (Ketten, 1998), as well as whistle-like signals (Verboom and Kastelein, 1995). The dominant frequency range is 110 to 150 kHz, with source levels between 135 and 205 dB re 1 µPa-m (Ketten, 1998) (Villadsgaard, 2007). Echolocation signals include one or two low-frequency components in the 1.4 to 2.5 kHz range (Verboom and Kastelein, 1995).

A behavioral audiogram of a harbor porpoise indicated the range of best sensitivity is 8 to 32 kHz at levels between 45 and 50 dB re 1 µPa-m (Andersen, 1970); however, auditory-evoked potential studies showed a much higher frequency of approximately 125 to 130 kHz (Bibikov, 1992). The auditory-evoked potential method suggests that the harbor porpoise actually has two frequency ranges of best sensitivity. More recent psycho-acoustic studies found the range of best hearing to be 16 to 140 kHz, with a reduced sensitivity around 64 kHz (Kastelein *et al*., 2002a). Maximum sensitivity occurs between 100 and 140 kHz (Kastelein *et al*., 2002a).

Distribution - Harbor porpoises occur in subpolar to cool-temperate waters in the North Atlantic and Pacific (Read, 1999). Off the northeastern U.S., harbor porpoise distribution is strongly concentrated in the Gulf of Maine/Georges Bank region, with more scattered occurrences to the mid-Atlantic (CETAP, 1982; Northridge, 1996). Stranding data indicate that the southern limit is northern Florida (Polacheck, 1995; Read, 1999).

From January through March, harbor porpoises can be found in moderate densities in waters off New Jersey to North Carolina (Waring et. al. 2007). Densities of this species are lower in waters off New York to New Brunswick, Canada during this same time (Waring et. al., 2007). A satellite tagged harbor porpoise was rehabilitated and released off the coast of Maine and followed the continental slope south to near Cape Hatteras between January and March of 2004 (WhaleNet, 2004). During this time of year, significant numbers of porpoises occur along the mid-Atlantic shore from New Jersey to North Carolina, where they are subject to incidental mortality in a variety of coastal gillnet fisheries (Cox *et al*., 1998; Waring *et al*., 2007). Harbor porpoises are not tied to shallow, nearshore waters during winter, as evidenced by a harbor porpoise caught in a pelagic drift net off North Carolina (Read *et al*., 1996).

In the Gulf of Maine, calves are born in late spring (Read, 1990; Read and Hohn 1995). Generally, most calves are born April through August (Jefferson *et al*. 2008). The location of breeding areas is unknown.

VACAPES OPAREA harbor porpoise occurrence - The harbor porpoise primarily occurs on the continental shelf in cool temperate to subpolar waters (Read 1999) that are at higher latitudes than the VACAPES Study Area. Occurrences of harbor porpoises in the mid-Atlantic are scattered (CETAP 1982; Northridge 1996). Based on distribution records and known habitat preferences, harbor porpoises may occur throughout the Study Area during most of the year (DoN, 2008a). During summer, harbor porpoises are concentrated in the northern Gulf of Maine and lower Bay of Fundy region and are not expected to occur as far south as the Study Area.

Lower Chesapeake Bay harbor porpoise occurrence - The harbor porpoise occurs regularly in Chesapeake Bay (Prescott and Fiorelli 1980; Polacheck *et al*. 1995), including the upper reaches. The vast majority of harbor porpoise strandings in Virginia waters (including Chesapeake Bay) are between January and May, with a peak between March and May (Polacheck *et al*. 1995; Cox *et al*. 1998; Morgan *et al*. 2002; Swingle *et al*. 2007); this is when water temperatures are coldest. There are documented occurrences still through mid-July in the Bay, including a mid-July 1984 sighting near the mouth of the Bay and an early July 1996 stranding on the shore of the James River. Harbor porpoises may occur year-round in the lower Chesapeake Bay region.

VACAPES Study Area harbor porpoise density - There were not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Killer Whale

Killer whales are probably the most instantly recognizable of all the cetaceans. The black-and-white color pattern of the killer whale is striking, as is the tall, erect dorsal fin of the adult male (1.0 to 1.8 m in height). This is the largest member of the dolphin family. Females may reach 7.7 m in length and males 9.0 m (Dahlheim and Heyning, 1999). Killer whales feed on fish, cephalopods, seabirds, sea turtles, and other marine mammals (Katona *et al*., 1988; Jefferson *et al*., 1991; Jefferson *et.al.* 2008).

Status and management - There are no estimates of abundance for killer whales in the western North Atlantic (Waring *et al.* 2008). Most cetacean taxonomists agree that multiple killer whale species or subspecies occur worldwide (Krahn *et al.* 2004; Waples and Clapham 2004). However, at this time, further information is not available, particularly for the western North Atlantic. The killer whale is under the jurisdiction of NMFS.

Habitat - Killer whales have the most ubiquitous distribution of any species of marine mammal, and they have been observed in virtually every marine habitat from the tropics to the poles and from shallow, inshore waters (and even rivers) to deep, oceanic regions (Dahlheim and Heyning, 1999). In coastal areas, killer whales often enter shallow bays, estuaries, and river mouths (Leatherwood *et al*., 1976). Based on a review of historical sighting and whaling records, killer whales in the northwestern Atlantic are found most often along the shelf break and farther offshore (Katona *et al*., 1988; Mitchell and Reeves, 1988). Killer whales in the Hatteras-Fundy region probably respond to the migration and seasonal distribution patterns of prey species, such as bluefin tuna, herring, and squids (Katona *et al*., 1988; Gormley, 1990).

Acoustics and Hearing - Killer whales produce a wide variety of clicks and whistles, but most of this species' social sounds are pulsed, with frequencies ranging from 0.5 to 25 kHz (dominant frequency range: 1 to 6 kHz) (Thomson and Richardson, 1995). Echolocation clicks recorded for Canadian killer whales foraging on salmon have source levels ranging from 195 to 224 dB re: 1 μPa-m peak-to-peak, a center frequency ranging from 45 to 80 kHz, and durations of 80 to 120 μs (Au *et al.*, 2004). Echolocation clicks from Norwegian killer whales were considerably lower than the previously mentioned study and ranged from 173 to 202 re: 1 μPa-m peak-to-peak. The clicks had a center frequency ranging from 22 to 49 kHz and durations of 31 to 203 μs (Simon *et al.*, 2007). Source levels associated with social sounds have been calculated to range from 131 to 168 dB re 1 μPa-m and have been demonstrated to vary with vocalization type (*e.g.*, whistles: average source level of 140.2 dB re 1 μPa-m, variable calls: average source level of 146.6 dB re 1 μPa-m, and stereotyped calls: average source level 152.6 dB re 1 μPa-m) (Veirs, 2004). Additionally, killer whales modify their vocalizations depending on social context or ecological function (*i.e.*, short-range vocalizations [less than 10 km [5 nm] range] are typically associated with social and resting behaviors and long-range vocalizations [10 to 16 km [5 to 9 nm) range] are associated with travel and foraging) (Miller, 2006). Likewise, echolocation clicks are adapted to the type of fish prey (Simon *et al.*, 2007).

Acoustic studies of resident killer whales in British Columbia have found that they possess dialects, which are highly stereotyped, repetitive discrete calls that are group-specific and are shared by all group members (Ford, 2002). These dialects likely are used to maintain group identity and cohesion and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales (Ford, 1991 and 2002). Dialects have been documented in northern Norway (Ford, 2002) and southern Alaskan killer whales populations (Yurk *et al.*, 2002) and are likely occur in other regions as well.

Both behavioral and ABR techniques indicate killer whales can hear a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz, which is one of the lowest maximum-sensitivity frequency known among toothed whales (Szymanski *et al.*, 1999).

Distribution - Killer whales are found throughout all oceans and contiguous seas, from equatorial regions to polar pack ice zones of both hemispheres. In the western North Atlantic, killer whales are known from the polar pack ice, off of Baffin Island, and in Labrador Sound southward to Florida, the Bahamas, and the Gulf of Mexico (Dahlheim and Heyning, 1999), where they have been sighted year-round (Jefferson and Schiro, 1997; O’Sullivan and Mullin, 1997; Würsig *et al*., 2000). A year-round killer whale population in the western North Atlantic may exist south of around 35°N (Katona *et al*., 1988).

In the Atlantic, calving takes place in late fall to mid-winter (Jefferson *et al*. 2008); however, location of killer whale breeding in the North Atlantic is unknown.

VACAPES OPAREA killer whale occurrence - Several killer whale sightings are recorded in both shallow and deep waters of the OPAREA and vicinity (DoN, 2008a). Strandings are also reported along the Outer Banks (DoN, 2008a). There is photo-identification evidence that a small population moves through parts of the Hatteras-Fundy region on a seasonal basis (Katona *et al*. 1988). Killer whales may occur seaward of the shoreline year-round based on available sighting data and the diverse habitat preferences of this species.

Lower Chesapeake Bay killer whale occurrence - The killer whale is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area killer whale density - There were not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Melon-headed Whale

Melon-headed whales at sea closely resemble pygmy killer whales; both species have a blunt head with little or no beak. Melon-headed whales have pointed (versus rounded) flippers and a more triangular head shape than pygmy killer whales (Jefferson *et al*., 1993). Melon-headed whales reach a maximum length of 2.75 m (Jefferson *et al*., 1993). Melon-headed whales prey on squids, pelagic fish, and occasionally crustaceans. Most fish and squid prey are mesopelagic in waters up to 1,500 m deep, suggesting that feeding takes place deep in the water column (Jefferson and Barros, 1997).

Status and management - There are no abundance estimates for melon-headed whales in the western North Atlantic (Waring *et al.,* 2008). The melon-headed whale is under the jurisdiction of NMFS.

Habitat - Melon-headed whales are most often found in offshore waters. Sightings off Cape Hatteras, North Carolina are reported in waters greater than 2,500 m (Waring *et al*., 2007) , and most in the Gulf of Mexico have been well beyond the edge of the continental shelf break (Mullin *et al*., 1994; Davis and Fargion, 1996b; Davis *et al*., 2000) and out over the abyssal plain (Waring *et al*., 2004). Nearshore sightings are generally from areas where deep, oceanic waters approach the coast (Perryman, 2002).

Acoustics and Hearing - The only published acoustic information for melon-headed whales is from the southeastern Caribbean (Watkins *et al.*, 1997). Sounds recorded included whistles and click sequences.

Recorded whistles have dominant frequencies between 8 and 12 kHz; higher level whistles were estimated at no more than 155 dB re 1 µPa-m (Watkins *et al.*, 1997). Clicks had dominant frequencies of 20 to 40 kHz; higher-level click bursts were judged to be about 165 dB re 1 µPa-m (Watkins *et al.*, 1997). No empirical data on hearing ability for this species are available.

Distribution - Melon-headed whales occur worldwide in subtropical and tropical waters. There are very few records for melon-headed whales in the North Atlantic (Ross and Leatherwood, 1994; Jefferson and Barros, 1997). Maryland is thought to represent the extreme of the northern distribution for this species in the northwest Atlantic (Perryman *et al*., 1994; Jefferson and Barros, 1997).

Seasonality and location of melon-headed whale breeding are unknown.

VACAPES OPAREA melon-headed whale occurrence - The melon-headed whale is an oceanic species; it may occur seaward of the shelf break year-round throughout the Study Area. Based on warm water preferences, melon-headed whale occurrence in the Study Area during winter is likely influenced by the Gulf Stream. Two sightings of melon-headed whales are recorded in deep (>2,500 m) offshore waters along the path of the Gulf Stream in the southern VACAPES OPAREA (DoN, 2008a).

Lower Chesapeake Bay melon-headed whale occurrence - The melon-headed whale is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area melon-headed whale density - There were not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Minke Whale

Minke whales are small rorquals; adults reach lengths of just over 9 m (Jefferson *et al*., 1993). In the western North Atlantic, minke whales feed primarily on schooling fish, such as sand lance, capelin, herring, and mackerel (Kenney *et al*., 1985), as well as copepods and krill (Horwood, 1990).

Status and management - There are four recognized populations in the North Atlantic Ocean: Canadian East Coast, West Greenland, Central North Atlantic, and Northeastern North Atlantic (Donovan 1991). Minke whales off the eastern U.S. are considered to be part of the Canadian East Coast stock which inhabits the area from the western half of the Davis Strait to 45º W and south to the Gulf of Mexico (Waring *et al.* 2008). The best estimate of abundance for the Canadian East Coast stock is 3,312 individuals (Waring *et al.* 2008). The minke whale is under the jurisdiction of NMFS.

Habitat - Off eastern North America, minke whales generally remain in waters over the continental shelf, including inshore bays and estuaries (Mitchell and Kozicki, 1975; Murphy, 1995; Mignucci-Giannoni, 1998). However, based on whaling catches and global surveys, there is an offshore component to minke whale distribution (Slijper *et al*., 1964; Horwood, 1990; Mitchell, 1991).

Acoustics and Hearing - Recordings of minke whale sounds indicate the production of both high- and low-frequency sounds (range of 0.06 to 20 kHz) (Beamish and Mitchell, 1973; Winn and Perkins, 1976; Thomson and Richardson, 1995; Mellinger *et al.*, 2000). Minke whale sounds have a dominant frequency range of 0.06 to greater than 12 kHz, depending on sound type (Thomson and Richardson, 1995; Edds-Walton, 2000). “Boings” are produced by minke whales and are suggested to be a breeding display, consisting of a brief pulse at 1.3 kHz followed by an amplitude-modulated call with greatest energy at 1.4 kHz, with slight frequency modulation over a duration of 2.5 sec (Rankin and Barlow, 2005). While no empirical data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes are most adapted to hear low to infrasonic frequencies.

Distribution - Minke whales are distributed in polar, temperate, and tropical waters (Jefferson *et al*., 1993); they are less common in the tropics than in cooler waters. This species is more abundant in New

England waters than in the mid-Atlantic (Hamazaki, 2002; Waring *et al*., 2006). The southernmost sighting in recent NMFS shipboard surveys was of one individual offshore of the mouth of Chesapeake Bay, in waters with a bottom depth of 3,475 m (Mullin and Fulling, 2003). Minke whales off the U.S. Atlantic coast apparently migrate offshore and southward in winter (Mitchell, 1991). Minke whales are known to occur during the winter months (November through March) in the western North Atlantic from Bermuda to the West Indies (Winn and Perkins, 1976; Mitchell, 1991; Mellinger *et al*., 2000).

Mating is thought to occur in October to March but has never been observed (Stewart and Leatherwood 1985); however, location of specific breeding grounds is unknown although it is thought to be in areas of low latitude (Jefferson *et al*. 2008).

VACAPES OPAREA minke whale occurrence **-** Minke whales are assumed to have a similar life history as the other rorquals, with seasonal offshore/inshore movements and a population shift north into summer feeding grounds. Minke whales generally occupy the continental shelf and are widely scattered in the mid-Atlantic region (CETAP 1982). There is a more common occurrence farther north of the Study Area. The dynamics of the Gulf Stream in the Cape Hatteras region probably play a role in the zoogeography of minke whales throughout much of the year.

Most sightings in the VACAPES Study Area and vicinity are recorded over the continental shelf; few are scattered in slope waters just beyond the shelf break (DoN, 2008a). Minke whales may occur in shelf and deep waters north of Cape Hatteras during winter. South of Cape Hatteras, minke whales may occur just inshore of the shelf break and seaward of the shelf break in the Study Area. The change in occurrence patterns just south of Cape Hatteras takes into consideration the steep bathymetric gradient. Minke whales may occur in shelf and offshore waters of the OPAREA during spring and fall. During summer, minke whales may occur in shelf and offshore waters of the OPAREA, but are more likely to be at higher latitudes on their feeding grounds.

Lower Chesapeake Bay minke whale occurrence **-** The minke whale is considered extralimital to the Chesapeake Bay region.

VACAPES Study Area minke whale density **-** The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a).

Pantropical Spotted Dolphin

The pantropical spotted dolphin is a rather slender dolphin. Adults may reach 2.6 m in length (Jefferson *et al*., 1993). Pantropical spotted dolphins are born spotless and develop spots as they age although the degree of spotting varies geographically (Perrin and Hohn, 1994). North and offshore of Cape Hatteras, adults may bear only a few small, dark, ventral spots whereas individuals over the continental shelf become so heavily spotted that they appear nearly white (Perrin and Hohn, 1994. Pantropical spotted dolphins prey on epipelagic fish, squids, and crustaceans (Perrin and Hohn, 1994; Robertson and Chivers, 1997; Wang *et al*., 2003).

Status and management **-** The best estimate of abundance of the western North Atlantic stock of pantropical spotted dolphins is 4,439 individuals (Waring *et al.* 2008). There is no information on stock differentiation for pantropical spotted dolphins in the U.S. Atlantic (Waring *et al.* 2008). The pantropical spotted dolphin is under the jurisdiction of NMFS.

Habitat **-** Pantropical spotted dolphins tend to associate with bathymetric relief and oceanographic interfaces. Pantropical spotted dolphins may rarely be sighted in shallower waters (*e.g*., Peddemors, 1999; Gannier, 2002; Mignucci-Giannoni *et al*., 2003; Waring *et al*., 2007). Along the northeastern U.S., Waring*, et al.,* (1992) found that *Stenella spp.* were distributed along the Gulf Stream's northern wall.

Stenella sightings also occurred within the Gulf Stream, which is consistent with the oceanic distribution of this genus and its preference for warm water (Waring *et al*., 1992; Mullin and Fulling, 2003).

Acoustics and Hearing - Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson, 1995). Clicks typically have two frequency peaks (bimodal) at 40 to 60 kHz and 120 to 140 kHz with estimated source levels up to 220 dB re:1 µPa peak-to-peak (Schotten *et al.*, 2004). No direct measures of hearing ability are available for pantropical spotted dolphins, but ear anatomy has been studied and indicates that this species should be adapted to hear the lower range of ultrasonic frequencies (less than 100 kHz) (Ketten, 1992 and 1997).

Distribution - Pantropical spotted dolphins occur in subtropical and tropical waters worldwide (Perrin and Hohn 1994).

In the eastern tropical Pacific, where this species has been best studied, there are two (possibly three) calving peaks: one in spring, (one possibly in summer), and one in fall (Perrin and Hohn 1994). However, in the western Atlantic breeding times and locations are largely unknown.

VACAPES OPAREA pantropical spotted dolphin occurrence - Pantropical spotted dolphins have been sighted along the Florida shelf and slope waters and offshore in Gulf Stream waters southeast of Cape Hatteras (Waring *et al*. 2007). In the Atlantic, this species is considered broadly sympatric with Atlantic spotted dolphins (Perrin and Hohn 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Based on sighting data and known habitat preferences, pantropical spotted dolphins may occur seaward of the shelf break throughout the OPAREA year-round.

Lower Chesapeake Bay pantropical spotted dolphin occurrence - The pantropical spotted dolphin is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area pantropical spotted dolphin density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density will likely not be uniform across the Study Area. Based on habitat preferences, pantropical dolphins are anticipated to be found seaward of the shelf break. Given estimates may reflect lower survey efforts in offshore waters or the difficulty in distinguishing pantropical spotted dolphins from the offshore form of the Atlantic spotted dolphin.

Pilot Whales

Pilot whales are among the largest dolphins, with long-finned pilot whales potentially reaching 5.7 m (females) and 6.7 m (males) in length. Short-finned pilot whales may reach 5.5 m (females) and 6.1 m (males) in length (Jefferson *et al*., 1993). The flippers of long-finned pilot whales are extremely long, sickle shaped, and slender, with pointed tips, and an angled leading edge that forms an “elbow.” Long-finned pilot whale flippers range from 18 to 27 percent of length. Short-finned pilot whales have flippers that are somewhat shorter than long-finned pilot whale at 16 to 22 percent of the total body length (Jefferson *et al*., 1993). Both pilot whale species feed primarily on squids but also take fish (Bernard and Reilly, 1999).

Status and management - The best estimate of pilot whale abundance (combined short-finned and long-finned) in the western North Atlantic is 31,139 individuals (Waring *et al.* 2008). Pilot whales are under the jurisdiction of NMFS.

Habitat - Pilot whales occur along the continental shelf break, in continental slope waters, and in areas of high-topographic relief (Olson and Reilly, 2002). While typically distributed along the continental shelf break, they are also commonly sighted on the continental shelf and inshore of the 100-m isobath (CETAP, 1982; Payne and Heinemann, 1993). Sightings of pilot whales also frequently occur seaward of the 2,000-m isobath north of Cape Hatteras (CETAP, 1982; Payne and Heinemann, 1993).

Waring, *et al*. (1992) sighted pilot whales principally along the northern wall of the Gulf Stream and along the shelf break at thermal fronts. A few of these sightings were also made in the mid-portion of the Gulf Stream near Cape Hatteras (Abend and Smith, 1999).

Pilot whales occur close to shore at oceanic islands where the shelf is narrow and deeper waters are nearby (Mignucci-Giannoni, 1998; Gannier, 2000; Anderson, 2005). Long-finned pilot whale sightings extend south to near Cape Hatteras through the VACAPES OPAREA (Abend and Smith, 1999) along the continental slope.

Acoustics and Hearing - Pilot whale sound production includes whistles and echolocation clicks. Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz, respectively, at an estimated source level of 180 dB re:1 µPa-m (Fish and Turl, 1976; Ketten, 1998). Rendell and Gordan (1999) recorded vocalizations from a group of approximately 50 long-finned pilot whales in the Ligurian Sea in conjunction with the presence of military sonar signals, which facilitated an examination of this species short-term response to external sound sources. Whistle production was examined in relation to sonar pulses: frequency ranged from 4.1 to 8.7 kHz with a mean duration of .93 s, and showed varying contour patterns spectrographically (Rendell and Gordon, 1999). Preliminary results from these data suggest that certain whistles were associated with sonar signals; however, the functional meaning of how these signals might be correlated to external sonar is unclear.Long-finned pilot whales have been shown to modify their whistle characteristics in the presence of sonar transmissions in the Ligurian sea (Rendell and Gorden, 1999). There are no hearing data available for either pilot whale species. However, the most sensitive hearing range for odontocetes generally includes high frequencies (Ketten, 1997).

Distribution - Long-finned pilot whales are distributed in subpolar to temperate North Atlantic waters offshore and in some coastal waters. The short-finned pilot whale usually does not range north of 50°N or south of 40°S (Jefferson *et al*., 1993); short-finned pilot whales have stranded as far north as Rhode Island. Strandings of long-finned pilot whales have been recorded as far south as South Carolina (Waring *et al*., 2007). Short-finned pilot whales are common south of Cape Hatteras (Caldwell and Golley, 1965; Irvine *et al*., 1979). Long-finned pilot whales appear to concentrate during winter along the continental shelf break primarily between Cape Hatteras and Georges Bank (Waring *et al*., 1990). The apparent ranges of the two pilot whale species overlap in shelf/shelf-edge and slope waters of the northeastern U.S. between 35°N and 38° to 39°N (New Jersey to Cape Hatteras, North Carolina) (Payne and Heinemann, 1993). However, incidents of strandings of short-finned pilot whales as far north as Block Island, RI and Nova Scotia indicate that area of overlap may be larger than previously thought (Waring et. al. 2007).

Pilot whales concentrate along the continental shelf break from during late winter and early spring north of Cape Hatteras (CETAP, 1982; Payne and Heinemann, 1993). This corresponds to a general movement northward and onto the continental shelf from continental slope waters (Payne and Heinemann, 1993). Short-finned pilot whales seem to move from offshore to continental shelf break waters and then northward to approximately 39ºN, east of Delaware Bay during summer (Payne and Heinemann, 1993). Sightings coalesce into a patchy continuum and, by December, most short-finned pilot whales occur in the mid-Atlantic slope waters east of Cape Hatteras (Payne and Heinemann, 1993). Although pilot whales appear to be seasonally migratory, sightings indicate common year-round occurrence in some continental shelf areas, such as the southern margin of Georges Bank (CETAP, 1982; Abend and Smith, 1999).

The calving peak for long-finned pilot whales is from July to September in the northern hemisphere (Bernard and Reilly 1999). Short-finned pilot whale calving peaks in the northern hemisphere are in the fall and winter for the majority of populations (Jefferson *et al*. 2008). Locations of breeding areas are unknown.

VACAPES OPAREA pilot whale occurrence - The VACAPES OPAREA is located in a region of range overlap between both pilot whale species (Payne and Heinemann 1993). As a deep-water species, pilot whales may occur seaward of the shelf break throughout the OPAREA year-round. They may also occur between the shore and shelf break (CETAP 1982; Kenney 1990) which is supported by opportunistic sightings and bycatch records inshore of the shelf break in the OPAREA (DoN, 2008a). Concentrated areas of occurrence are likely influenced by high levels of productivity generated by warm-core rings from the Gulf Stream as well as the steep sloping bottom topography of the area (DoN, 2008a).

Lower Chesapeake Bay pilot whale occurrence - Pilot whales are considered extralimital in the Chesapeake Bay region.

VACAPES Study Area pilot whale density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning area. Pilot whales will likely be concentrated in waters near and seaward of the shelf break based on habitat preferences; however, they may also occur in shelf waters in smaller numbers.

Pygmy and Dwarf Sperm Whales

Dwarf and pygmy sperm whales are difficult for the inexperienced observer to distinguish from one another at sea, and sightings of either species are often categorized as *Kogia* spp. The difficulty in identifying pygmy and dwarf sperm whales is exacerbated by their avoidance reaction toward ships and change in behavior toward approaching survey aircraft (Würsig *et al*., 1998). *Kogia* spp. feed on cephalopods and, less often, on deep-sea fish and shrimp (Caldwell and Caldwell, 1989; McAlpine *et al*., 1997; Willis and Baird, 1998; Santos *et al*., 2006).

Status and management - There is currently no information to differentiate Atlantic stock(s) (Waring *et al.* 2008). The best estimate of abundance for both species combined in the western North Atlantic is 395 individuals (Waring *et al.* 2008). Species-level abundance estimates cannot be calculated due to uncertainty of species identification at sea (Waring *et al.* 2008). Pygmy and dwarf sperm whales are under the jurisdiction of NMFS.

Habitat - *Kogia* spp. occurs in waters along the continental shelf break and over the continental slope (*e.g*., Baumgartner *et al*., 2001; McAlpine, 2002). Data from the Gulf of Mexico suggest that *Kogia* spp. may associate with frontal regions along the continental shelf break and upper continental slope, where their primary prey of squid may concentrate due to higher epipelagic zooplankton biomass (Baumgartner *et al*., 2001).

Acoustics and Hearing- There is little published information on sounds produced by *Kogia* spp, although they are categorized as non-whistling smaller toothed whales. Recently, free-ranging dwarf sperm whales off La Martinique (Lesser Antilles) were recorded producing clicks at 13 to 33 kHz with durations of 0.3 to 0.5 sec (Jérémie *et al*., 2006). The only sound recordings for the pygmy sperm whale are from two stranded individuals. The only sound recordings for the pygmy sperm whale are from two stranded individuals. A stranded individual being prepared for release in the western North Atlantic emitted clicks of narrow band pulses with a mean duration of 119 µsec, interclick intervals between 40 and 70 msec, centroid frequency of 129 kHz (centroid is the frequency which divides the energy in the click into two equal portions), peak frequency of 130 kHz, and apparent peak-peak source level up to 175 dB re 1 µPa-m (Madsen *et al*., 2005). Another individual found stranded in Monterey Bay produced echolocation clicks ranging from 60 to 200 kHz, with a dominant frequency of 120 to 130 kHz (Ridgway and Carder, 2001). No information on sound production or hearing is available for the dwarf sperm whale.

Distribution **-** Both *Kogia* species apparently have a worldwide distribution in tropical and temperate waters (Jefferson *et al*., 1993). In the western Atlantic Ocean, stranding records have documented the pygmy sperm whale as far north as the northern Gulf of St. Lawrence, New Brunswick and parts of eastern Canada (Piers, 1928, Measures *et al*., 2004; McAlpine et. al. 1997; Baird, 1996) and as far south as Colombia and around to Brazil (in the southern Atlantic) (Carvalho, 1967; Geise and Borobia 1987; Muñoz-Hincapié *et al*., 1998). Pygmy sperm whales are also found in the Gulf of Mexico (Hysmith, 1976; Gunter et. al. 1955; Baumgartner *et al*., 2001) and in the Caribbean (MacLeod and Hauser 2002).

The northern range of the dwarf sperm whale is largely unknown; however, multiple stranding records exist on the eastern coast of the U.S. as far north as North Carolina (Hohn *et al*. 2006) and Virginia (Morgan *et al*. 2002; Potter 1979). Records of strandings and incidental captures indicate the dwarf sperm whale may range as far south as the Northern Antilles in the northern Atlantic (Muñoz-Hincapié *et al*., 1998); although records continue south along Brazil in the southern Atlantic (Muñoz-Hincapié *et al*., 1998). Dwarf sperm whales occur in the Caribbean (Caldwell et. al. 1973; Cardona-Maldonado and Mignucci-Giannoni 1999) and the Gulf of Mexico (Davis *et. al*. 2002; Jefferson and Schiro 1997).

Births have been recorded between December and March for dwarf sperm whales in South Africa (Plön, 2004); however, the breeding season and locations of specific are unknown.

VACAPES OPAREA Kogia spp. occurrence **-** *Kogia* spp. generally occurs along the continental shelf break and over the continental slope (*e.g*., Baumgartner *et al*. 2001; McAlpine 2002). Few sightings are recorded in the OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during winter and fall) as well as their avoidance reactions toward ships (DoN, 2008a). However, strandings are recorded inshore of the OPAREA boundaries during all seasons and support the likelihood of *Kogia* spp. occurrence in the OPAREA year-round (DoN, 2008a). *Kogia* spp. may occur seaward of the shelf break throughout the OPAREA year-round.

Lower Chesapeake Bay Kogia spp. occurrence **-** *Kogia* spp. is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area Kogia spp. density **-** The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning area. *Kogia* spp. will likely be concentrated in waters near and seaward of the shelf break based on habitat preferences. Density estimates may reflect the lower amount of survey effort in offshore waters as well as their documented avoidance reactions to ships.

<u>Pygmy Killer Whale</u>

The pygmy killer whale is often confused with the melon-headed whale and less often with the false killer whale. Flipper shape is the best distinguishing characteristic; pygmy killer whales have rounded flipper tips (Jefferson *et al*., 1993). Pygmy killer whales reach lengths of up to 2.6 m (Jefferson *et al*., 1993). Pygmy killer whales eat predominantly fish and squids, and sometimes take large fish. They are known to occasionally attack other dolphins (Perryman and Foster, 1980; Ross and Leatherwood, 1994).

Status and management **-** There are no abundance estimates for pygmy killer whales in the western North Atlantic (Waring *et al.* 2008). Pygmy killer whales are under the jurisdiction of NMFS.

Habitat **-** Pygmy killer whales generally occupy offshore habitats. In the northern Gulf of Mexico, this species is found primarily in deeper waters off the continental shelf (Davis and Fargion, 1996a; Davis *et al*., 2000) out to waters over the abyssal plain (Jefferson, 2006). Pygmy killer whales were sighted in waters deeper than 1,500 m off Cape Hatteras (Hansen *et al*., 1994).

Acoustics and Hearing - The pygmy killer whale emits short duration, broadband signals similar to a large number of other delphinid species (Madsen *et al.*, 2004b). Clicks produced by pygmy killer whales have centroid frequencies (centroid is the frequency which divides the energy in the click into two equal portions) between 70 and 85 kHz; there are bimodal peak frequencies between 45 and 117 kHz. The estimated source levels are between 197 and 223 dB re 1 µPa-m peak-to-peak (Madsen *et al.*, 2004b). These clicks possess characteristics of echolocation clicks (Madsen *et al.*, 2004b). There are no empirical hearing data available for this species.

Distribution - Pygmy killer whales have a worldwide distribution in tropical and subtropical waters, generally not ranging north of 40ºN or south of 35ºS (Jefferson *et al*., 1993). There are few records of this species in the western North Atlantic (*e.g*., Caldwell and Caldwell, 1971; Ross and Leatherwood, 1994). Most records from outside the tropics are associated with unseasonable intrusions of warm water into higher latitudes (Ross and Leatherwood, 1994).

Seasonality and location of pygmy killer whale breeding are unknown.

VACAPES OPAREA pygmy killer whale occurrence - Only one confirmed record, a fall stranding north of Cape Hatteras, is documented for pygmy killer whales in the OPAREA and vicinity (DoN, 2008a). The pygmy killer whale is an oceanic species which may occur seaward of the shelf break year-round throughout the OPAREA. Based on warm water preferences, pygmy killer whale occurrence in the OPAREA during winter is likely influenced by the Gulf Stream.

Lower Chesapeake Bay pygmy killer whale occurrence - The pygmy killer whale is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area pygmy killer whale density - There were not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Risso's Dolphin

Risso's dolphins are moderately large, robust animals reaching at least 3.8 m in length (Jefferson *et al*. 1993). Cephalopods are their primary prey (Clarke 1996).

Status and management - The best estimate of Risso's dolphin abundance in the western North Atlantic is 20,479 individuals (Waring *et al.* 2008). Risso's dolphins are under the jurisdiction of NMFS.

Habitat - Several studies have noted that Risso's dolphins are found offshore, along the continental slope, and over the continental shelf (CETAP, 1982; Green *et al*., 1992; Baumgartner, 1997; Davis *et al*., 1998; Mignucci-Giannoni, 1998; Kruse *et al*., 1999). Baumgartner (1997) hypothesized that the fidelity of Risso's dolphins to the steeper portions of the upper continental slope in the Gulf of Mexico is most likely the result of cephalopod prey distribution in the same area.

Acoustics and Hearing - Risso's dolphin vocalizations include broadband clicks, barks, buzzes, grunts, chirps, whistles, and combined whistle and burst-pulse sounds that range in frequency from 0.4 to 22 kHz and in duration from less than a second to several seconds (Corkeron and Van Parijs, 2001). The combined whistle and burst pulse sound (2 to 22 kHz, mean duration of 8 seconds) appears to be unique to Risso's dolphin (Corkeron and Van Parijs, 2001). Risso's dolphins also produce echolocation clicks (40 to 70 µs duration) with a dominant frequency range of 50 to 65 kHz and estimated source levels up to 222 dB re 1 µPa-m peak-to-peak (Thomson and Richardson, 1995; Philips *et al*., 2003; Madsen *et al*., 2004a). Baseline research on the hearing ability of this species was conducted by Nachtigall *et al.* (1995) in a natural setting (included natural background noise) using behavioral methods on one older individual. This individual could hear frequencies ranging from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. Recently, the auditory brainstem response technique has been used to measure hearing in a stranded infant (Nachtigall *et al.*, 2005). This individual could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz. This study demonstrated that this species can hear higher frequencies than previously reported.

Distribution - Risso's dolphins are distributed worldwide in cool-temperate to tropical waters from roughly 60ºN to 60ºS, where SSTs are generally greater than 10ºC (Kruse *et al*., 1999). In the western North Atlantic, this species is found from Newfoundland (Jefferson *et al*. 2008) southward to the Gulf of Mexico (Baumgartner, 1997; Jefferson and Schiro 1997), throughout the Caribbean, and around the equator (van Bree, 1975; Ward *et al*. 2001).

Risso's dolphins are distributed along the continental shelf break and slope waters from Cape Hatteras north to Georges Bank in spring, summer, and fall (CETAP, 1982; Payne *et al*., 1984). In the winter the range shifts to mid-Atlantic Bight and offshore waters (Payne *et al*., 1984). Risso's dolphins may also occur in the waters from the mid-shelf to over the slope from Georges Bank south to, and including, the mid-Atlantic Bight, primarily in the summer and fall (Payne *et al*. 1984). Only rare occurrences are noted in the Gulf of Maine (Payne *et al*. 1984).

In the North Atlantic, there appears to be a summer calving peak (Jefferson *et al*., 1993); however, locations of breeding areas are unknown.

VACAPES OPAREA Risso's dolphin occurrence - As mentioned above, Risso's dolphins are most commonly found in areas with steep bottom topography and are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Records of this species in the Study Area generally follow this pattern of distribution with patches of sightings recorded along the path of the Gulf Stream and over steep portions of the continental slope (DoN, 2008a). Risso's dolphins may occur just inshore of the shelf break and seaward of the shelf break throughout the OPAREA year-round based on sighting data and the preference of this species for deep waters.

Lower Chesapeake Bay Risso's dolphin occurrence - The Risso's dolphin is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area Risso's dolphin density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning area. Risso's dolphins will likely be concentrated in waters near and seaward of the shelf break based on habitat preferences.

Rough-toothed Dolphin

The rough-toothed dolphin is relatively robust with a cone-shaped head with no demarcation between the melon and beak (Jefferson *et al*., 1993). Rough-toothed dolphins reach 2.8 m in length (Jefferson *et al*., 1993). They feed on cephalopods and fish, including large fish such as dorado (Miyazaki and Perrin, 1994; Reeves *et al*., 1999; Pitman and Stinchcomb, 2002).

Status and management - No abundance estimate is available for rough-toothed dolphins in the western North Atlantic (Waring *et al.* 2008). The rough-toothed dolphin is under the jurisdiction of NMFS.

Habitat - The rough-toothed dolphin is regarded as an offshore species that prefers deep waters; however, it can occur in shallower waters as well (*e.g*., Gannier and West, 2005). Tagging data for this species from the Gulf of Mexico and western North Atlantic provide important information on habitat preferences. Three dolphins with satellite-linked transmitters released in 1998 off the Gulf Coast of Florida were tracked off the Florida panhandle in average water depths of 195 m (Wells *et al*., 1999b). Dolphins released in March of 2005 after a mass stranding were tagged with satellite-linked transmitters and released southeast of Fort Pierce moved within the Gulf Stream and parallel to the continental shelf off

Florida, Georgia, and South Carolina, in waters with a depth of 400 to 800 m (Manire and Wells, 2005). They later moved northeast into waters with a depth greater than 4,000 m (Manire and Wells, 2005). Another tagged dolphin from released after the 2005 mass stranding moved north as far as Charleston, South Carolina, before returning to the Miami area, remaining in relatively shallow waters (Wells, 2007). During May 2005, seven more rough-toothed dolphins (stranded in the Florida Keys in March 2005 and rehabilitated) were tagged and released by the Marine Mammal Conservancy in the Florida Keys (Wells, 2007). During an initial period of apparent disorientation in the shallow waters west of Andros Island, they continued to the east, then moved north through Crooked Island Passage, and paralleled the West Indies (Wells, 2007). The last signal placed them northeast of the Lesser Antilles (Wells, 2007). During September 2005, two more individuals (from the same mass stranding) were satellite-tagged and released east of the Florida Keys and proceeded south to a deep trench close to the north coast of Cuba (Wells, 2007).

Acoustics and Hearing - The rough-toothed dolphin produces a variety of sounds, including broadband echolocation clicks and whistles. Echolocation clicks (duration less than 250 microseconds [µsec]) typically have a frequency range of 0.1 to 200 kHz, with a dominant frequency of 25 kHz (Miyazaki and Perrin, 1994; Yu *et al.*, 2003; Chou, 2005). Whistles (duration less than 1 sec) have a wide frequency range of 0.3 to greater than 24 kHz but dominate in the 2 to 14 kHz range (Miyazaki and Perrin, 1994; Yu *et al.*, 2003).

Auditory evoked potential measurements were performed on six individuals involved in a mass stranding event on Hutchinson Island, Florida in August 2004 (Cook *et al.*, 2005). The rough-toothed dolphin can detect sounds between 5 and 80 kHz and is most likely capable of detecting frequencies much higher than 80 kHz (Cook *et al.*, 2005).

Distribution - Rough-toothed dolphins are found in tropical to warm-temperate waters globally, rarely ranging north of 40°N or south of 35°S (Miyazaki and Perrin, 1994). This species is not a commonly encountered species in the areas where it is known to occur (Jefferson, 2002). Not many records for this species exist from the western North Atlantic, but they indicate that this species occurs from Virginia south to Florida, the Gulf of Mexico, the West Indies, and along the northeastern coast of South America (Leatherwood *et al*., 1976; Jefferson *et al*. 2008).

Seasonality and location of rough-toothed dolphin breeding is unknown.

VACAPES OPAREA rough-toothed dolphin occurrence - A few strandings and two sightings have been recorded in or near the OPAREA (DoN, 2008a). Rough-toothed dolphins may occur seaward of the shelf break based on this species' preference for deep waters. During the winter, the rough-toothed dolphin's occurrence is expected in warmer waters so occurrence in the OPAREA may follow the western edge of the standard deviation of the Gulf Stream. The rough-toothed dolphin may occur in the OPAREA year-round.

Lower Chesapeake Bay rough-toothed dolphin occurrence - The rough-toothed dolphin in considered extralimital in the Chesapeake Bay region.

VACAPES Study Area rough-toothed dolphin occurrence - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning area. Risso's dolphins will likely be concentrated in waters near and seaward of the shelf break and/or along the Gulf Stream based on habitat preferences.

Spinner Dolphin

The spinner dolphin generally has a dark eye-to-flipper stripe and dark lips and beak tip (Jefferson *et al*., 1993). This species typically has a three-part color pattern (dark gray cape, light gray sides, and white belly). Adults can reach 2.4 m in length (Jefferson *et al*., 1993). Spinner dolphins feed primarily on small mesopelagic fish, squid, and sergestid shrimp (Perrin and Gilpatrick, 1994).

Status and management - No abundance estimates are currently available for the western North Atlantic stock of spinner dolphins (Waring *et al.* 2008). Stock structure in the western North Atlantic is unknown (Waring *et al.* 2008). The spinner dolphin is under the jurisdiction of NMFS.

Habitat - Spinner dolphins occur in both oceanic and coastal environments. Most sightings of this species in tropical waters have been associated with inshore waters, islands, or banks (Perrin and Gilpatrick, 1994).

Spinner dolphin distribution in the Gulf of Mexico and off the northeastern U.S. coast is primarily in offshore waters. Along the northeastern U.S. and in the Gulf of Mexico, they are distributed in waters with a depth greater than 2,000 m (CETAP, 1982; Davis *et al*., 1998). Off the eastern U.S. coast, spinner dolphins were sighted within the Gulf Stream, which is consistent with the oceanic distribution and warm-water preference of this genus (Waring *et al*., 1992).

Acoustics and Hearing - Pulses, whistles, and clicks have been recorded from this species. Pulses and whistles have dominant frequency ranges of 5 to 60 kHz and 8 to 12 kHz, respectively (Ketten, 1998). Spinner dolphins consistently produce whistles with frequencies as high as 16.9 to 17.9 kHz with a maximum frequency for the fundamental component at 24.9 kHz (Bazúa-Durán and Au, 2002; Lammers *et al*., 2003). Clicks have a dominant frequency of 60 kHz (Ketten, 1998). The burst pulses are predominantly ultrasonic, often with little or no energy below 20 kHz (Lammers *et al.*, 2003). Source levels between 195 and 222 dB re 1 µPa-s peak-to-peak have been recorded for spinner dolphin clicks (Schotten *et al.*, 2004).

Distribution - Spinner dolphins are found in subtropical and tropical waters worldwide, with different geographical forms in various ocean basins. The range of this species extends to near 40°N latitude (Jefferson *et al*., 1993). Distribution in the western North Atlantic is thought to extend from North Carolina south to Venezuela (Schmidly, 1981), including the Gulf of Mexico (Davis *et al*. 2002).

Breeding occurs across all season with calving peaks that may range from late spring to fall for different populations (Jefferson *et al*. 2008); however, location of breeding areas is unknown.

VACAPES OPAREA spinner dolphin occurrence - Several stranding, sighting, and bycatch records are documented in or near the OPAREA (DoN, 2008a). Spinner dolphins prefer warm, offshore waters as evidenced by the sighting and bycatch records associated with the Gulf Stream in the winter and spring months (DoN, 2008a). Spinner dolphins may occur from the vicinity of the continental shelf break to eastward of the OPAREA boundary in association with the Gulf Stream's northern boundary. No seasonal differences in occurrence are anticipated.

Lower Chesapeake Bay spinner dolphin occurrence - The spinner dolphin is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area spinner dolphin density - There were not sufficient data available to estimate a density for the Study Area; nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Striped Dolphin

The striped dolphin is uniquely marked with black lateral stripes from eye to flipper and eye to anus. There is also a light gray spinal blaze originating above and behind the eye and narrowing below and behind the dorsal fin (Jefferson *et al*., 2008). This species reaches 2.6 m in length. Small, mid-water fish (in particular, myctophids or lanternfish) and squids are the dominant prey (Perrin *et al*., 1994c; Ringelstein *et al*., 2006).

Status and management - The best estimate of striped dolphin abundance in the western North Atlantic is 94,462 individuals (Waring *et al.* 2008). The striped dolphin is under the jurisdiction of NMFS.

Habitat - Striped dolphins are usually found beyond the continental shelf, typically over the continental slope out to oceanic waters and are often associated with convergence zones and waters influenced by upwelling (Au and Perryman, 1985). This species also occurs in conjunction with the shelf edge in the northeastern U.S. (between Cape Hatteras and Georges Bank (Hain *et al*. 1985). Striped dolphins are known to associate with the Gulf Stream's northern wall and warm-core ring features (Waring *et al*., 1992).

Acoustics and Hearing - Striped dolphin whistles range from 6 to greater than 24 kHz, with dominant frequencies ranging from 8 to 12.5 kHz (Thomson and Richardson, 1995). A single striped dolphin's hearing range, determined by using standard psycho-acoustic techniques, was from 0.5 to 160 kHz with best sensitivity at 64 kHz (Kastelein *et al.*, 2003).

Distribution - Striped dolphins are distributed worldwide in cool-temperate to tropical zones. In the western North Atlantic, this species occurs from Nova Scotia southward to the Caribbean Sea, Gulf of Mexico, and Brazil (Baird *et al*. 1993; Jefferson *et al*. 2008). Off the northeastern U.S., striped dolphins are distributed along the continental shelf break from Cape Hatteras to the southern margin of Georges Bank, as well as offshore over the continental slope and continental rise in the mid-Atlantic region (CETAP, 1982).

Off Japan, where their biology has been best studied, there are two calving peaks: one in summer and one in winter (Perrin *et al*. 1994c). However, in the western Atlantic breeding times and locations are largely unknown.

VACAPES OPAREA striped dolphin occurrence - The striped dolphin is a deep water species that is generally distributed north of Cape Hatteras (CETAP 1982), which is supported by the known distribution of sightings in the OPAREA (DoN, 2008a). The southern edge of this species' predicted occurrence in the VACAPES OPAREA appears to be influenced by meanderings of the Gulf Stream (DoN, 2008a). Sightings predominately occur along the Gulf Stream's northern wall, where it travels through the southern part of the VACAPES OPAREA. Striped dolphins may occur near and seaward of the shelf break throughout the OPAREA year-round.

Lower Chesapeake Bay striped dolphin occurrence - The striped dolphin is considered extralimital in the Chesapeake Bay region.

VACAPES Study Area striped dolphin density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES OPAREA are provided in Table 3.7-1. Methods and results are detailed in the NODE Reports (DoN, 2007a). Density is not expected to be uniform across the warning area. Striped dolphins will likely be concentrated in waters near and seaward of the shelf break and/or along the Gulf Stream based on habitat preferences.

Harbor Seal

The harbor seal (or common seal) is a small- to medium-sized seal. Adult males attain a maximum length of 1.9 m and weigh 70 to 150 kg; females reach 1.7 m in length and weigh between 60 and 110 kg (Jefferson *et al*., 1993). Northeastern U.S. harbor seals eat sand lance, Atlantic herring, cod, and winter flounder (Payne and Selzer, 1989).

Status and management - Five subspecies of *Phoca vitulina* are recognized; *Phoca vitulina concolor* is the form found in the western North Atlantic (Rice, 1998). Harbor seals are the most common and frequently reported seals in the northeastern U.S. (Katona *et al.*, 1993). Currently, harbor seals along the coast of the eastern U.S. and Canadian coasts are considered a single population (Waring *et al.*, 2008).

The best estimate of abundance of harbor seals in the western North Atlantic stock is 99,340 individuals (Waring *et al.*, 2008). An estimated 5,575 harbor seals over-wintered in southern New England in 1999, increasing from an estimated 2,834 individuals in 1981 (Barlas, 1999). Kraus and Early (1995) suggested that the northeastern U.S. population increase could represent increasing southward shifts in wintering distribution. The harbor seal is under NMFS jurisdiction.

Habitat - This is a coastal species, usually found near shore, and frequently occupying bays, estuaries, and inlets (Baird, 2001). Individual harbor seals have been observed miles upstream in coastal rivers (Baird, 2001).

Although primarily aquatic, harbor seals also utilize terrestrial environments where they haul out periodically. Haulout substrates vary but include intertidal and subtidal rocky outcrops, sandbars, sandy beaches, and even peat banks in salt marshes (Wilson, 1978; Schneider and Payne, 1983; Gilbert and Guldager, 1998). Along the majority of the New England coast, harbor seals haul out on rocky outcroppings and intertidal ledges (Kenney, 1994; Gilbert and Guldager, 1998; Schroeder, 2000). In the mid-Atlantic Bight, harbor seals are commonly observed hauled out on dry parts of submerged structures (Steimle and Zetlin, 2000).

Acoustics and Hearing - Harbor seal males and females produce a variety of low-frequency in-air vocalizations including snorts, grunts, and growls, while pups make individually unique calls for mother recognition (main energy at 0.35 kHz) (Thomson and Richardson, 1995). Adult males also produce several underwater sounds such as roars, bubbly growls, grunts, groans, and creaks during the breeding season. These sounds typically range from 0.025 to 4 kHz (duration range: 0.1 sec to 11 seconds) (Hanggi and Schusterman, 1994). Hanggi and Schusteman (1994) found that there is individual variation in the dominant frequency range of sounds between different males, and Van Parijs *et al.* (2003) reported oceanic, regional, population, and site-specific levels of variation (*i.e.*, could represent vocal dialects) between males.

Harbor seals hear nearly as well in air as underwater (Kastak and Schusterman, 1998). Harbor seals are capable of hearing frequencies from 1 to 180 kHz (most sensitive at frequencies between 1 kHz and 60 kHz using behavioral response testing) in water and from 0.25 to 30 kHz in air (most sensitive from 6 to 16 kHz using behavior and auditory brainstem response testing) (Richardson, 1995; Terhune and Turnbull, 1995; Wolski *et al.*, 2003). Despite the absence of an external ear, harbor seals are capable of directional hearing in-air, giving them the ability to mask out background noise (Holt and Schusterman, 2007). Underwater sound localization was demonstrated by Bodson *et al.* (2006). TTS for the harbor seal was assessed at 2.5 kHz and 3.53 kHz (exposure level was 80 and 95 dB above threshold), by Kastak *et al.* (2005). Data indicated that the range of TTS onset would be between 183-206 dB re: 1µPa2-s (Kastak *et al.*, 2005).

Distribution - Harbor seal distribution is associated with temperate waters (Jefferson *et al*., 1993; Stanley *et al*., 1996). Harbor seals are year-round residents of eastern Canada (Boulva, 1973) and coastal Maine

(Katona *et al*., 1993; Gilbert and Guldager, 1998). The greatest concentrations of harbor seals in northeastern U.S. waters are found along the coast of Maine, specifically in Machias and Penobscot bays and off Mt. Desert and Swans Islands (Katona *et al*., 1993).

Harbor seals occur south of Maine from late September through late May (Rosenfeld *et al*., 1988; Whitman and Payne, 1990; Barlas, 1999; Schroeder, 2000). During winter, the population divides and disperses offshore into the Gulf of Maine south into southern New England, and a portion remains in coastal waters of Maine and Canada. From at least October through December, harbor seal numbers decrease in Canadian waters (Terhune, 1985) but increase three to five fold south of Maine (Rosenfeld *et al*., 1988). A general southward movement along the Canadian coast and northeastern U.S. is thought to occur during this period (Rosenfeld *et al*., 1988). Tagging efforts by Gilbert and Wynne (1985) support this hypothesis. Although harbor seals of all ages and both sexes frequent winter haulout sites south of Maine, many of the over-wintering individuals are immature, suggesting that there might be seasonal segregation resulting from age-related competition for haulout sites near preferred pupping ledges and age-related differences in food requirements (Whitman and Payne, 1990; Slocum and Schoelkopf, 2001).

The timing of harbor seal pupping along the eastern North American coast varies geographically (Temte *et al*. 1991). Pupping takes place from mid May through mid June along the Maine coast (Richardson, 1976; Wilson, 1978; DeHart, 2002).

VACAPES OPAREA harbor seal occurrence—Harbor seals occur seasonally along the southern New England and New York coasts from September through late May (Schneider and Payne 1983; Waring *et al*. 2007). Occurrences of juvenile and possibly adult harbor seals are increasing in frequency in the mid-Atlantic region, primarily December through April (Barco, 2008). Harbor seals are considered rare in the VACAPES OPAREA, which is well south of this specie's typical range. Harbor seals may occur in the nearshore portions of the OPAREA.

Lower Chesapeake Bay harbor seal occurrence - The harbor seal is considered a regular part of the marine fauna of Chesapeake Bay, and healthy individuals are often reported for the area (Barco, 2007). The harbor seal is likely to occur in the Bay from December through April.

Harbor seals haul out at Linkhorn Bay in Virginia Beach and at Hopewell in the James River (Blaylock 1985). Infrequently, small groups of harbor seals may be found near the islands of the Chesapeake Bay Bridge-Tunnel (Blaylock 1985).

VACAPES Study Area harbor seal density - There were not sufficient data available to estimate a density for the Study Area. Nor was there an abundance estimate in the NOAA stock assessment used to derive density (DoN, 2007a).

Gray Seal

Gray seals are large and robust; adult males can reach 2.3 m in length and weigh 310 kg (Jefferson *et al*. 1993). The sexes are sexually dimorphic (Bonner 1981).

Gray seals feed on a variety of fish species and cephalopods; they are largely demersal or benthic feeders (Bonner 1981; D. Thompson *et al*. 1991; P.M. Thompson *et al*. 1991; Hall 2002). The only prey information for gray seals in U.S. waters is from Muskeget Island; prey consumed included windowpane flounder (*Scophthalmus aquosus*), silver hake (*Merluccius bilinearis*), sand lance, skates (*Rajidae*), and gadids (Rough 1995).

Status and management - There are at least three populations of gray seal in the North Atlantic Ocean: eastern North Atlantic, western North Atlantic, and Baltic (Boskovic *et al.* 1996). The western North Atlantic stock is equivalent to the eastern Canada breeding population (Waring *et al.* 2008). There are two breeding concentrations in eastern Canada: one at Sable Island and the other on the pack ice in the Gulf of

St. Lawrence. These two breeding groups are treated as separate populations for management purposes (Mohn and Bowen 1996). There is an estimated 195,000 gray seals in Canada (DFO 2003). The herd on Sable Island is thought be growing and may have more than doubled in number, but the Gulf of St. Lawrence population is declining (Bowen *et al.* 2003). This decline has been attributed to sharp decline in the quantity of suitable ice breeding habitat in the southern Gulf of St. Lawrence possibly due to climate change (Hammill *et al.* 2003). Small breeding colonies have also been documented along the coast of Maine and Massachusetts (Katona *et al.* 1993; Rough 1995).

Present data are insufficient to calculate a population estimate for gray seals in U.S. waters; however surveys of the Maine coast in 2001 counted 1,731 and a 1999 estimate of the Massachusetts population indicated 5,611 animals (Baraff and Loughlin 2000; Waring *et al.* 2008). Gray seal abundance appears to be increasing in the U.S. Atlantic EEZ (Waring *et al.* 2008). The gray seal is under the jurisdiction of NMFS.

Habitat **-** The gray seal is considered to be a coastal species (Lesage and Hammill 2001). Gray seals may forage far from shore but do not appear to leave the continental shelf regions (Lesage and Hammill 2001). Gray seals haul out on ice, exposed reefs, or beaches of undisturbed islands (Lesage and Hammill 2001). Haulout sites are often near rough seas and riptides (Katona *et al*. 1993). Remote, uninhabited islands tend to have the largest gray seal haulout sites (Reeves *et al*. 1992). Weather (strong currents and storms) may change the configuration of haulout sites and result in distribution shifts (Barlas 1999). Gray seals in the Baltic Sea were found to select habitat on the basis of bottom depth or bathymetric features such as slope gradients, which likely correlate with prey availability, yet remain in the vicinity of a specific haulout site for extended periods (Sjöberg and Ball 2000). Foraging areas of gray seals in the North Sea are often localized areas characterized by a gravel/sand sediment, which is the preferred burrowing burrow of the sand lance, an important prey item of the gray seal (McConnell *et al*. 1992).

Acoustics and Hearing- Ketten (1998) determined that most pinnipeds species have peak sensitivities between 1 to 20 kHz. Asselin *et al.* (1993) classified all gray seal vocalizations into seven call types. The majority of calls consisted of guttural "rups" and "rupes", ranging from 0.1 to 3 kHz, or low-frequency growls ranging from 0.1 to 0.4 kHz (Asselin *et al.*, 1993).

Distribution - The gray seal is found throughout temperate and subarctic waters on both sides of the North Atlantic Ocean (Davies 1957). In the western North Atlantic Ocean, the gray seal population is centered in the Canadian Maritimes, including the Gulf of St. Lawrence and the Atlantic Coasts of Nova Scotia, Newfoundland, and Labrador. The largest concentrations are found in the southern half of the Gulf of St. Lawrence (where most seals breed on ice) and around Sable Island (where most seals breed on land) (Davies 1957; Hammill and Gosselin 1995; Hammill *et al*. 1998). Active breeding colonies also exist in Maine and Massachusetts in the U.S. (Waring *et al*. 2007). Gray seals currently range into the northeastern U.S., with strandings as far south as North Carolina (Hammill *et al*. 1998; Waring *et al*. 2007).

VACAPES OPAREA gray seal occurrence **-** Reports of young gray seals are increasing in frequency during winter and spring months in the mid-Atlantic region (Barco, 2008). Gray seals are extralimital in the VACAPES OPAREA.

Lower Chesapeake Bay gray seal occurrence **-** Sporadic occurrences of the gray seal are observed in Chesapeake Bay, including healthy, not just sickly stranded or dead individuals (Barco, 2007). Records from the mid-Atlantic Bight are typically from winter and spring. There is even one record – a March 1998 stranding recorded by NMFS – from upper Chesapeake Bay. Two notable records in the vicinity of Chesapeake Bay include two incidences of pupping at Assateague Island in 1986 and 1989 (Katona, *et al.,* 1993). Gray seals may occur in Chesapeake Bay throughout the year.

VACAPES Study Area gray seal density - There were not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

Harp Seal

These medium-sized phocid seals reach a size of 1.7 m and 130 kg; females are slightly smaller (Lavigne, 2002). Prey-preference studies have revealed that harp seals prefer small fish (such as capelin) to pelagic crustaceans (Lindstrøm *et al*., 1998).

Status and management - The harp seal is the most abundant pinniped in the western North Atlantic Ocean (Hammill and Stenson, 2005). The 2004 Canadian population is estimated at around 5.9 million seals and has changed little since 1996 (DFO, 2005). Data are insufficient to calculate a population estimate for U.S. waters, but the best estimate for all western North Atlantic harp seals is 5.9 million (Waring *et al.* 2008). The harp seal is under the jurisdiction of NMFS.

Habitat - Harp seals are closely associated with drifting pack ice on which they breed and molt; they forage in the surrounding waters (Ronald and Healey 1981; Lydersen and Kovacs 1993). Harp seals prefer rough pack ice that is at least 0.25 m thick; they maintain holes in the ice for easy access to the water (Ronald and Healey 1981; Ronald and Gots 2003). Harp seals make extensive movements over much of the continental shelf within their winter range in the waters off Newfoundland (Bowen and Siniff 1999).

Acoustics and Hearing- The harp seal's vocal repertoire consists of at least 27 underwater and two aerial call types (Serrano, 2001). Harp seals are most vocal during the breeding season (Ronald and Healey, 1981). Serrano (2001) found that calls of low frequency and with few pulse repetitions were predominantly used outside the breeding season, while calls of high frequency and with a high number of pulse repetitions predominated in the breeding season. Terhune and Ronald (1986) measured source levels of underwater vocalizations of 140 dB re 1 µPa-s. Vester *et al.* (2001) recorded ultrasonic clicks with a frequency range of 66 to 120 kHz, with the main energy at 93±22 kHz and average source levels of 143+ dB re 1 µPa-s in conjunction with live fish hunting.

Behavioral audiograms have been obtained for harp seals (Terhune and Ronald, 1972). The harp seal's ear is adapted for better hearing underwater. Underwater, hearing measures between 0.76 to 100 kHz, with areas of increased sensitivity at 2 and 22.9 kHz (Terhune and Ronald, 1972). In air, hearing is irregular and slightly insensitive with the audiogram being generally flat (Terhune and Ronald, 1971).

Distribution - Harp seals are distributed in the pack ice of the North Atlantic and Arctic oceans, from Newfoundland and the Gulf of St. Lawrence to northern Russia (Reeves *et al*., 2002). Most of the western North Atlantic harp seals congregate off the east coast of Newfoundland-Labrador (the Front) to pup and breed. The remainder (the Gulf herd) gather to pup near the Magdalen Islands in the Gulf of St. Lawrence (Ronald and Dougan, 1982).

The number of sightings and strandings of harp seals off the northeastern U.S. has been increasing (McAlpine and Walker, 1990; Rubinstein, 1994; Stevick and Fernald, 1998; McAlpine *et al*., 1999a; McAlpine *et al*. 1999b; Harris *et al*., 2002). Sightings are generally recorded during January through May (Harris *et al*. 2002), when the western North Atlantic stock of harp seals is at its most southern point in distribution (Waring *et al*., 2007). Occurrences as far south as South Carolina are reported (McFee, 2006).

VACAPES OPAREA harp seal occurrence— Harp seal occurrences are becoming more frequent in the mid-Atlantic region, primarily during the months of December through April (Barco, 2008). Harp seals fare extralimital in the VACAPES OPAREA.

Lower Chesapeake Bay harp seal occurrence **-** There are sporadic occurrences of the harp seal in the Chesapeake Bay region. Occurrences in the entire mid-Atlantic region are from January through June. There are records of occurrence around Chesapeake Bay for winter and spring (February through May) (McApline and Walker, 1990; Harris *et al*., 2002). Goodwin (1954) discusses two individuals found within Chesapeake Bay: an adult caught in a fisherman's net on March 12, 1945 at Little Creek (it was tied to a pier, but managed to escape), and the next day, a baby harp seal came ashore at Little Creek and died. On February 22, 2007, a harp seal was found in the dunes at First Landing State Park on Cape Henry. It was released on March 30, 2007 from First Landing State Park with a satellite tag. Another noteworthy individual was stranded on April 20, 2007 in Chincoteague National Wildlife Refuge and was released (also with a satellite tag) on May 19, 2007 from First Landing State Park. Harp seals may occur in Chesapeake Bay during the winter, spring, and early summer.

VACAPES Study Area harp seal density **-** There was not sufficient data available to estimate a density for the Study Area. Nor is there an abundance estimate in the NOAA stock assessment report (DoN, 2007a).

3.7.3 Environmental Consequences

The following sections provide an in-depth discussion of the biological framework for assessing impacts of sound on marine species. Section 3.7.3.1 focuses on the acoustic characteristics of sound. The discussion in this section is presented primarily as it relates to sonar, but much of the information is also applicable to the acoustic components of explosives. Additional consideration was given to discussing the effects of sound from impulsive sources related to underwater detonations. A thorough analysis of these impacts is provided in Section 3.7.3.2.

3.7.3.1 Conceptual Biological Framework for Assessing Marine Mammal Response to Anthropogenic Sound

The regulatory language of the MMPA and ESA requires that all anticipated responses to sound resulting from Navy exercises be considered relative to their potential impact on animal growth, survivability and reproduction. Whether an effect significantly affects a marine mammal must be determined from the best available science regarding marine mammal responses to sound.

A conceptual framework (Figure 3.7-2) has been constructed to assist in ordering and evaluating the potential responses of marine mammals to sound. Although the framework is described in the context of effects of sonar on marine mammals, the same approach could be used for fish, sea turtles, sea birds, etc., that are exposed to other sound sources (e.g., impulsive sounds from explosions); the framework need only be consulted for potential pathways leading to possible effects.

Organization

The framework is a "block diagram" or "flow chart", organized from left to right, and grossly compartmentalized according to the phenomena that occur within each block. These include the physics of sound propagation (physics component), the potential physiological responses associated with sound exposure (physiology component), the behavioral processes that might be affected (behavior component), and the life functions that may be immediately affected by changes in behavior at the time of exposure (life function – proximate). These are extended to longer term life functions (life function – ultimate) and into population and species effects.

Throughout the flow chart, dotted and solid lines are used to connect related events. Solid lines are those items which "**will**" happen, and dotted lines are those which "**might**" happen, but which must be considered (including those hypothesized to occur but for which there is no direct evidence). Blue dotted lines indicate instances of "feedback," where the information flows back to a previous block. Some boxes are colored according to how they relate to the definitions of harassment in the MMPA, with red indicating Level A harassment (injury) and yellow indicating Level B harassment (behavioral disturbance).

The following sections describe the flowthrough of the framework, starting with the production of a sound, and flowing through marine mammal exposures, responses to the exposures, and the possible consequences of the exposure. Along with the description of each block, an overview of the state of knowledge is described with regard to marine mammal responses to sound and the consequences of those exposures. Application of the conceptual framework to impact analyses and regulations defined by the MMPA and ESA are discussed in subsequent sections.

Physics Block

Sounds emitted from a source propagate through the environment to create a spatially variable sound field. To determine if an animal is "exposed" to the sound, the received sound level at the animal's location is compared to the background ambient noise. An animal is **considered exposed if** the predicted received sound level, at the animal's location, is above the ambient level of background noise. If the animal is determined to be exposed, two possible scenarios must be considered with respect to the animal's physiology, responses of the auditory system and responses of non-auditory system tissues. These are not independent pathways and both must be considered since the same sound could affect both auditory and non-auditory tissues.

Physiology Block

Auditory System Response

The primary physiological effects of sound are on the auditory system (Ward, 1997). The mammalian auditory system consists of the outer ear, middle ear, inner ear, and central nervous system. Sound waves are transmitted through the outer and middle ears to fluids within the inner ear. The inner ear contains delicate electromechanical hair cells that convert the fluid motions into neural impulses that are sent to the brain. The hair cells within the inner ear are the most vulnerable to overstimulation by noise exposure (Yost, 1994).

Potential auditory system effects are assessed by considering the characteristics of the received sound (e.g., amplitude, frequency, duration) and the sensitivity/susceptibility of the exposed animals. Some of these assessments can be numerically based, while others will be necessarily qualitative, due to lack of information, or will need to be extrapolated from other species for which information exists. Potential physiological responses to a sound exposure are discussed here in order of increasing severity, progressing from perception of sound to auditory trauma.

No Perception

The received level is not of sufficient amplitude, frequency, and duration to be perceptible to the animal (i.e., the sound is not audible). By extension, this cannot result in a stress response or a change in behavior.

Perception

Sounds with sufficient amplitude and duration to be detected within the background ambient noise are assumed to be perceived (i.e., sensed) by an animal. This category includes sounds from the threshold of audibility through the normal dynamic range of hearing. To determine whether an animal perceives the sound, the received level, frequency, and duration of the sound are compared to what is known of the species' hearing sensitivity. Within this conceptual framework, a sound capable of auditory masking, auditory fatigue, or trauma is assumed to be perceived by the animal.

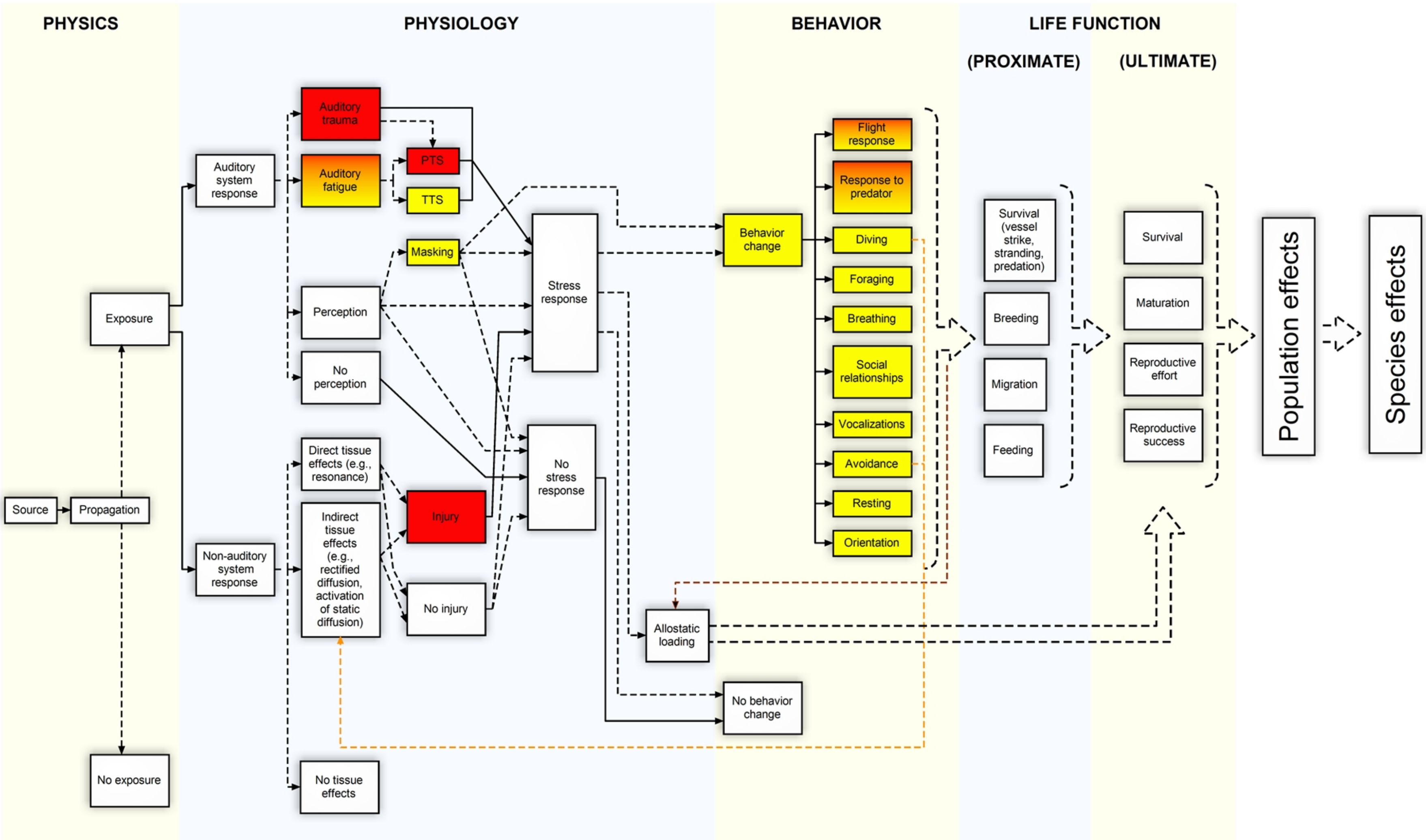


Figure 3.7-2 Conceptual biological framework used to order and evaluate the potential responses of marine mammals to sound.

Information on hearing sensitivity exists for approximately 25 of the nearly 130 species of marine mammals. Within the cetaceans, these studies have focused primarily on odontocete species (e.g., Szymanski *et al.*, 1999; Kastelein *et al.*, 2002; Nachtigall *et al.*, 2005; Yuen *et al.*, 2005; Houser and Finneran, 2006). Because of size and availability, direct measurements of mysticete whale hearing are nearly non-existent (Ridgway and Carder, 2001). Measurements of hearing sensitivity have been conducted on species representing all of the families within the pinniped families (Phocidae, Otariidae, Odobenidae) (Schusterman *et al.*, 1972; Moore and Schusterman, 1987; Terhune, 1988; Thomas *et al.*, 1990b; Turnbull and Terhune, 1990; Kastelein *et al.*, 2002, 2005; Wolski *et al.*, 2003;). Hearing sensitivity measured in these studies can be compared to the amplitude, duration and frequency of a received sound, as well as the ambient environmental noise, to predict whether or not an exposed marine mammal will perceive a sound to which it is exposed.

The features of a perceived sound (e.g., amplitude, frequency, duration, and temporal pattern) are also used to judge whether the sound exposure is capable of producing a stress response. Factors to consider in this decision include the probability of the animal being naïve or experienced with the sound (i.e., what are the known/unknown consequences to the animal from the exposure). Although preliminary because of the small numbers of samples collected, different types of sounds (impulsive vs. continuous broadband vs. continuous tonal) have been shown to produce variable stress responses in marine mammals. Belugas demonstrated no catecholamine (hormones released in situations of stress) response to the playback of oil drilling sounds (Thomas *et al.*, 1990a) but showed an increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano *et al.*, 2004). A dolphin exposed to the same seismic water gun signals did not demonstrate a catecholamine response, but did demonstrate an elevation in aldosterone, a hormone that has been suggested as being a significant indicator of stress in odontocetes (St. Aubin and Geraci, 1989; St. Aubin *et al.*, 2001). Increases in heart rate were observed in dolphins to which conspecific calls were played, although no increase in heart rate was observed when tank noise was played back (Miksis *et al.*, 2001). Collectively, these results suggest a variable response that depends on the characteristics of the received signal and prior experience with the received signal.

Audible natural and artificial sounds can potentially result in auditory masking, a condition that occurs when a sound interferes with an animal's ability to hear other sounds. Masking occurs when the perception of a sound is interfered with by a second sound and the probability of masking increases as the two sounds increase in similarity. It is important to distinguish auditory fatigue, which persists after the sound exposure, from masking, which occurs during the sound exposure. Critical ratios have been determined for pinnipeds (Southall *et al.*, 2000; Southall *et al.*, 2003) and detections of signals under varying masking conditions have been determined for active echolocation and passive listening tasks in odontocetes (Johnson, 1971; Au and Pawloski, 1989; Erbe, 2000). These studies provide baseline information from which the probability of masking can be estimated. The potential impact to a marine mammal depends on the type of signal that is being masked, important cues from conspecifics, signals produced by predators, or interference with echolocation are likely to have a greater impact on a marine mammal when they are masked than will a sound of little biological consequence.

Unlike auditory fatigue, which always results in a localized stress response because the sensory tissues are being stimulated beyond their normal physiological range, masking may or may not result in a stress response since it depends on the degree and duration of the masking effect and the signal that is being masked. Masking may also result in a unique circumstance where an animal's ability to detect other sounds is compromised without the animal's knowledge. This could conceivably result in sensory impairment and subsequent behavior change; in this case, the change in behavior is the *lack of a response* that would normally be made if sensory impairment did not occur. For this reason, masking also may lead directly to behavior change without first causing a stress response.

The most intense underwater sounds that may occur in the VACAPES Study Area are those produced by sonars and other acoustic sources that are in the mid-frequency or higher range. The sonar signals are likely within the audible range of most cetaceans, but are very limited in the temporal, frequency, and spatial domains. In particular, the pulse lengths are short, the duty cycle low, the events are geographically and temporally dispersed, event durations are limited, and the tactical sonars transmit within a narrow band of frequencies (typically less than one-third octave). Finally, high levels of sound are confined to a volume around the source and are constrained by attenuation at mid- and high-frequencies, as well as by limited beam widths and pulse lengths. For these reasons, the likelihood of sonar operations causing masking effects is considered negligible in this EIS/OEIS.

Auditory Fatigue

The most familiar effect of exposure to high intensity sound is hearing loss, meaning an increase in the hearing threshold. This phenomenon is called a noise-induced threshold shift (NITS), or simply a threshold shift (TS) (Miller, 1974). A TS may be either permanent, in which case it is called a permanent threshold shift (PTS), or temporary, in which case it is called a temporary threshold shift (TTS). The distinction between PTS and TTS is based on whether there is a complete recovery of a TS following a sound exposure. If the TS eventually returns to zero (the threshold returns to the preexposure value), the TS is a TTS. If the TS does not return to zero but leaves some finite amount of TS, then that remaining TS is a PTS. Figure 3.7-3 (Two Hypothetical Threshold Shifts) shows one hypothetical TS that completely recovers, a TTS, and one that does not completely recover, leaving some PTS.

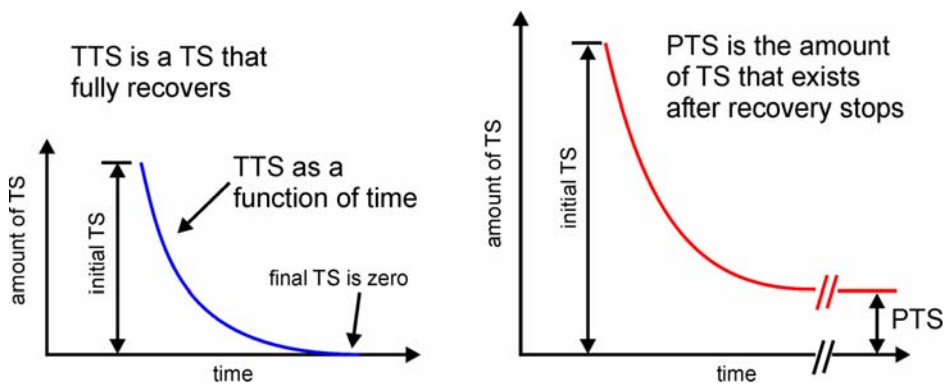


Figure 3.7-3 Two Hypothetical Thresold Shifts

Although both auditory trauma and fatigue may result in hearing loss, the mechanisms responsible for auditory fatigue differ from auditory trauma and would primarily consist of metabolic fatigue and exhaustion of the hair cells and cochlear tissues. Note that the term “auditory fatigue” is often used to mean “TTS”; however, in this EIS/OEIS we use a more general meaning to differentiate fatigue mechanisms (e.g., metabolic exhaustion and distortion of tissues) from trauma mechanisms (e.g., physical destruction of cochlear tissues occurring at the time of exposure). Auditory fatigue may result in PTS or TTS but is always assumed to result in a stress response. The actual amount of threshold shift depends on the amplitude, duration, frequency, and temporal pattern of the sound exposure.

There are no PTS data for cetaceans; however, a number of investigators have measured TTS in cetaceans (Schlundt *et al.*, 2000, 2006; Finneran *et al.*, 2000, 2002, 2005, 2007; Nachtigall *et al.*, 2003, 2004). In these studies hearing thresholds were measured in trained dolphins and belugas before and after exposure to intense sounds. Some of the more important data obtained from these studies are onset-TTS levels – exposure levels sufficient to cause a just-measurable amount of TTS, often defined as 6 dB of TTS (for example, Schlundt *et al.*, 2000). The existing cetacean TTS data show the following for the species studied in this EIS/OEIS and non-impulsive, mid-frequency sounds of interest:

- The growth and recovery of TTS are analogous to those in land mammals. This means that, as in land mammals, cetacean TSs depend on the amplitude, duration, frequency content, and temporal pattern of the sound exposure. Threshold shifts will generally increase with the amplitude and duration of sound exposure. For continuous sounds, exposures of equal energy will lead to approximately equal effects (Ward, 1997). For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur during the quiet period between exposures) (Kryter *et al.*, 1965; Ward, 1997).
- Sound pressure level (SPL) by itself is not a good predictor of onset-TTS, since the amount of TTS depends on both SPL and duration.
- Exposure energy flux density level (EL) is correlated with the amount of TTS and is a good predictor for onset-TTS from single, continuous exposures with variable durations. This agrees with human TTS data presented by Ward *et al.* (1958, 1959).

The most relevant TTS data for analyzing the effects of mid-frequency sonars are from Schlundt *et al.* (2000, 2006) and Finneran *et al.* (2005). These studies point to an energy flux density level of 195 dB re 1 μPa^2-s as the most appropriate predictor for onset-TTS in dolphins and belugas from a single, continuous exposure in the mid-frequency range. This finding is supported by the recommendations of a panel of scientific experts formed to study the effects of sound on marine mammals (Southall *et al.*, 2007).

Research by Kastak *et al.* (1999a; 2005) provided estimates of the average SEL (EFD level) for onset-TTS for a harbor seal, sea lion, and Northern Elephant seal. Although the duration for exposure sessions duration is well beyond those typically used with tactical sonars, the frequency ranges are similar (2.5 kHz to 3.5 kHz). This data provides good estimates for the onset of TTS in pinnipeds since the researchers tested different combinations of SPL and exposure duration, and plotted the growth of TTS with an increasing energy exposure level. Of the three pinniped groups studied by Kastak *et al.*, harbor seals are the most representative of other pinnipeds likely to be present in the Study Area. The onset-TTS number, provided by Kastak *et al.* for harbor seals, is 183 dB re 1 μPa^2-s.

In contrast to TTS data, PTS data do not exist and are unlikely to be obtained for marine mammals. Differences in auditory structures and the way that sound propagates and interacts with tissues prevent terrestrial mammal PTS thresholds from being directly applied to marine mammals; however, the inner ears of marine mammals are analogous to those of terrestrial mammals. Experiments with marine mammals have revealed similarities between marine and terrestrial mammals with respect to features such as TTS, age-related hearing loss, ototoxic drug-induced hearing loss, masking, and frequency selectivity. Therefore, in the absence of marine mammal PTS data, onset-PTS exposure levels may be estimated from marine mammal TTS data and PTS/TTS relationships observed in terrestrial mammals. This involves:

- Estimating the largest amount of TTS that may be induced without PTS. Exposures causing a TS greater than this value are assumed to cause PTS.
- Estimating the additional exposure, above the onset-TTS exposure, necessary to reach the maximum allowable amount of TTS (assumed here to indicate PTS). This requires estimating the growth rate of TTS – how much additional TTS is produced by an increase in exposure level.

A variety of terrestrial mammal data sources indicate that TSs up to 40 to 50 dB may be induced without PTS, and that 40 dB is a reasonable upper limit for TS to prevent PTS (Ward *et al.*, 1958, 1959, 1960; Miller *et al.*, 1963; Kryter *et al.*, 1966). A conservative assumption is that continuous-type exposures producing TSs of 40 dB or more always result in some amount of PTS.

The TTS growth rate as a function of exposure EL is nonlinear; the growth rate at small amounts of TTS is less than the growth rate at larger amounts of TTS. In other words, the curve relating TTS and EL is not a straight line but a curve that becomes steeper as EL and TTS increase. This means that the relatively small amounts of TTS produced in marine mammal studies limit the applicability of these data to estimate the TTS growth rate — since the amounts of TTS are generally small the TTS growth rate estimates would likely be too low. Fortunately, data exist for the growth of TTS in terrestrial mammals at higher amounts of TTS. Data from Ward *et al.* (1958, 1959) reveal a linear relationship between TTS and exposure EL with growth rates of 1.5 to 1.6 dB TTS per dB increase in EL. Since there is a 34 dB TS difference between onset-TTS (6 dB) and onset-PTS (40 dB), the additional exposure above onset-TTS that is required to reach PTS would be 34 dB divided by 1.6 dB, or approximately 20 dB. Therefore, exposures with ELs 20 dB above those producing TTS may be assumed to produce a PTS. For an onset-TTS exposure with EL = 195 dB re 1 μPa^2-s, the estimate for onset-PTS for cetaceans would be 215 dB re 1 μPa^2-s. The estimate for onset-PTS threshold for harbor seals would be 203 dB re 1 μPa^2-s. This extrapolation process and the resulting TTS prediction is identical to that recently proposed by a panel of scientific experts formed to study the effects of sound on marine mammals (Southall *et al.*, 2007). The method predicts larger (worse) effects than have actually been observed in tests on a bottlenose dolphin [Schlundt *et al.* (2006) reported a TTS of 23 dB (no PTS) in a bottlenose dolphin exposed to a 3 kHz tone with an EL = 217 dB re 1 μPa^2-s].

Auditory Trauma

Auditory trauma represents direct mechanical injury to hearing related structures, including tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as the organ of Corti and the associated hair cells. The potential for trauma is related to the frequency, duration, onset time and received sound pressure as well as the sensitivity of the animal to the sound frequencies. Because of these interactions, the potential for auditory trauma will vary among species. Auditory trauma is always injurious, but could be temporary and not result in permanent hearing loss. Auditory trauma is always assumed to result in a stress response.

Relatively little is known about auditory system trauma in marine mammals resulting from known sound exposure. A single study spatially and temporally correlated the occurrence of auditory system trauma in humpback whales with the detonation of a 5,000 kg (11,023 lb) explosive (Ketten *et al.*, 1993). The exact magnitude of the exposure in this study cannot be determined and it is possible that the trauma was caused by the shock wave produced by the explosion (which would not be generated by a sonar). There are no known occurrences of direct auditory trauma in marine mammals exposed to tactical sonars.

Non-Auditory System Response

Potential impacts to tissues other than those related to the auditory system are assessed by considering the characteristics of the sound (e.g., amplitude, frequency, duration) and the known or estimated response characteristics of non-auditory tissues. Some of these assessments can be numerically based (e.g., exposure required for rectified diffusion). Others will be necessarily qualitative, due to lack of information on the mechanical properties of the tissues and their function. Each of the potential responses may or may not result in a stress response. Further information on non-auditory system responses (such as direct and in-direct tissue effects) as it relates to the impulsive characteristics of sound will be discussed in section 3.7.3.2 under Potential Impacts from Exposure to Underwater Detonations.

Direct Tissue Effects

Direct tissue responses to sound stimulation may range from tissue trauma (injury) to mechanical vibration with no resulting injury. Any tissue injury would produce a stress response whereas non-injurious stimulation may or may not.

Resonance is a phenomenon that exists when an object is vibrated at a frequency near its natural frequency of vibration, or the particular frequency at which the object vibrates most readily. The size and geometry of an air cavity determine the frequency at which the cavity will resonate. Displacement of the cavity boundaries during resonance has been suggested as a cause of injury. Large displacements have the potential to tear tissues that surround the air space (e.g., lung tissue).

Understanding resonant frequencies and the susceptibility of marine mammal air cavities to resonance is important in determining whether certain sonars have the potential to affect different cavities in different species. In 2002, NMFS convened a panel of government and private scientists to address this issue (NOAA, 2002). They modeled and evaluated the likelihood that Navy mid-frequency sonars caused resonance effects in beaked whales that eventually led to their stranding (DoC and DON, 2001). The conclusions of that group were that resonance in air-filled structures was not likely to have caused the Bahamas stranding (NOAA, 2002). The frequencies at which resonance was predicted to occur were below the frequencies utilized by the sonar systems employed. Furthermore, air cavity vibrations, even at resonant frequencies, were not considered to be of sufficient amplitude to cause tissue damage, even under the worst-case scenario in which air volumes would be undamped by surrounding tissues and the amplitude of the resonant response would be maximal. These same conclusions would apply to other actions involving mid-frequency tactical sonar.

Indirect Tissue Effects

Based upon the amplitude, frequency, and duration of the sound, it must be assessed whether exposure is sufficient to indirectly affect tissues. For example, one suggested (indirect) cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. Under this hypothesis, one of three things could happen: (1) bubbles grow to the extent that tissue hemorrhage (injury) occurs; (2) bubbles develop to the extent that a complement immune response is triggered or the nervous tissue is subjected to enough localized pressure that pain or dysfunction occurs (a stress response without injury); or (3) the bubbles are cleared by the lung without negative consequence to the animal. The probability of rectified diffusion, or any other indirect tissue effect, will necessarily be based upon what is known about the specific process involved.

Rectified diffusion is facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The dive patterns of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.*, 2001b). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness (DCS).

It is unlikely that the short duration of sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested: stable microbubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario, the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size.

Recent research with *ex vivo* supersaturated tissues suggested that sound exposures of approximately 215 dB re 1 μPa would be required before microbubbles became destabilized and grew (Crum *et al.* 2005). Assuming spherical spreading loss and a nominal sonar source level of 235 dB re 1 μPa, a whale would need to be within 10 m (33 ft) of the sonar dome to be exposed to such sound levels. Furthermore, tissues were supersaturated by exposing them to pressures of 400 to 700 kPa for periods of hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to the high pressures, levels of supersaturation in the tissues could have been as high as 400 to 700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser *et al.*, 2001b). It is improbable that this mechanism is responsible for stranding events or traumas associated with beaked whale strandings. Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

Yet another hypothesis has speculated that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson *et al.*, 2003; Fernandez *et al.*, 2005). This is accounted for in the conceptual framework via a feedback path from the behavioral changes of "diving" and "avoidance" to the "indirect tissue response" block. In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Recent modeling suggests that unrealistically rapid rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected in beaked whales (Zimmer *et al.*, 2007). Recently, Tyack *et al.* (2006) suggested that emboli observed in animals exposed to mid-frequency range sonar (Jepson *et al.*, 2003; Fernandez *et al.*, 2005) could stem instead from a behavioral response that involves repeated dives shallower than the depth of lung collapse. Given that nitrogen gas accumulation is a passive process (i.e. nitrogen is metabolically inert), a bottlenose dolphin was trained to repetitively dive a profile predicted to elevate nitrogen saturation to the point that nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of even asymptomatic nitrogen gas bubbles (Houser *et al.*, 2007).

There is considerable disagreement among scientists as to the likelihood of this phenomenon (Piantadosi and Thalmann, 2004; Evans and Miller, 2003). Although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.*, 2003; Fernandez *et al.*, 2005), nitrogen bubble formation as the cause of the traumas has not been verified. The presence of bubbles postmortem, particularly after decompression, is not necessarily indicative of bubble pathology. Prior experimental work has demonstrated the post-mortem presence of bubbles following decompression in laboratory animals can occur as a result of invasive investigative procedures (Stock *et al.*, 1980).

Additionally, the fat embolic syndrome identified by Fernández *et al.* (2005) is the first of its kind. The pathogenesis of fat emboli formation is as yet undetermined and remains largely unstudied, and it would therefore be inappropriate to causally link it to nitrogen bubble formation. Because evidence of nitrogen bubble formation following a rapid ascent by beaked whales is arguable and requires further investigation, this EIS/OEIS makes no assumptions about it being the causative mechanism in beaked whale strandings associated with sonar operations. No similar findings to those found in beaked whales stranding coincident with sonar activity have been reported in other stranded animals following known exposure to sonar operations. By extension, no marine mammals addressed in this EIS/OEIS are given differential treatment due to the possibility for acoustically mediated bubble growth.

No Tissue Effects

The received sound is insufficient to cause either direct (mechanical) or indirect effects to tissues. No stress response occurs.

The Stress Response

The acoustic source is considered a potential stressor if, by its action on the animal, via auditory or nonauditory means, it may produce a stress response in the animal. The term "stress" has taken on an ambiguous meaning in the scientific literature, but with respect to Figure 3.7-3 and the later discussions of allostasis and allostatic loading, the stress response will refer to an increase in energetic expenditure that results from exposure to the stressor and which is predominantly characterized by either the stimulation of the sympathetic nervous system (SNS) or the hypothalamic-pituitary-adrenal (HPA) axis (Reeder and Kramer, 2005), or through oxidative stress, as occurs in noise-induced hearing loss (Henderson *et al.*, 2006). The SNS response to a stressor is immediate and acute and is characterized by the release of the catecholamine neurohormones norepinephrine and epinephrine (i.e., adrenaline). These hormones produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipids for energy. The HPA response is ultimately defined by increases in the secretion of the glucocorticoid steroid hormones, (e.g. cortisol, aldosterone).. The amount of increase in circulating glucocorticoids above baseline may be an indicator of the overall severity of a stress response (Hennessy *et al.*, 1979). Each component of the stress response is variable in time; e.g., adrenalines are released nearly immediately and are used or cleared by the system quickly, whereas cortisol levels may take long periods of time to return to baseline.

The presence and magnitude of a stress response in an animal depends on a number of factors. These include the animal's life history stage (e.g., neonate, juvenile, and adult), the environmental conditions, reproductive or developmental state, and experience with the stressor. Not only will these factors be subject to individual variation, but they will also vary within an individual over time. Prior experience with a stressor may be of particular importance as repeated experience with a stressor may dull the stress response via acclimation (St. Aubin and Dierauf, 2001). In considering potential stress responses of marine mammals to acoustic stressors, each of these should be considered. For example, is the acoustic stressor in an area where animals engage in breeding activity? Are animals in the region resident and likely to have experience with the stressor (i.e., repeated exposures)? Is the region a foraging ground or are the animals passing through as transients? What is the ratio of young (naïve) to old (experienced) animals in the population? It is unlikely that all such questions can be answered from empirical data; however, they should be addressed in any qualitative assessment of a potential stress response as based on the available literature.

Marine mammals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with conspecifics, and interactions with predators all contribute to the stress a marine mammal experiences. In some cases, naturally occurring stressors can have profound impacts on marine mammals; for example, chronic stress, as observed in stranded animals with long-term debilitating conditions (e.g., disease), has been demonstrated to result in an increased size of the adrenal glands and an increase in the number of epinephrine-producing cells (Clark *et al.*, 2006). Anthropogenic activities have the potential to provide additional stressors above and beyond those that occur naturally. Potential stressors resulting from anthropogenic activities must be considered not only as to their direct impact on the animal but also as to their cumulative impact with environmental stressors already experienced by the animal.

Studies on the stress response of odontocete cetaceans to acute acoustic stimuli were previously discussed Thomas *et al.*, 1990a; Miksis *et al.*, 2001; Romano *et al.*, 2004). Other types of stressors include the presence of vessels, fishery interactions, acts of pursuit and capture, the act of stranding, and pollution. In contrast to the limited amount of work performed on stress responses resulting from sound exposure, a considerably larger body of work exists on stress responses associated with pursuit, capture, handling and stranding. Pursuit, capture and short-term holding of belugas has been observed to result in a decrease in thyroid hormones (St. Aubin and Geraci, 1988) and increases in epinephrine (St. Aubin and Dierauf, 2001). In dolphins, the trend is more complicated with the duration of the handling time potentially contributing to the magnitude of the stress response (St. Aubin *et al.*, 1996; Ortiz and Worthy, 2000; St.

Aubin, 2002). Elephant seals demonstrate an acute cortisol response to handling, but do not demonstrate a chronic response; on the contrary, adult females demonstrate a reduction in the adrenocortical response following repetitive chemical immobilization (Engelhard *et al.*, 2002). With respect to anthropogenic sound as a stressor, the current limited body of knowledge will require extrapolation from species for which information exists to those for which no information exists.

The stress response may or may not result in a behavioral change, depending on the characteristics of the exposed animal. However, provided a stress response occurs, we assume that some contribution is made to the animal's allostatic load. Allostasis is the ability of an animal to maintain stability through change by adjusting its physiology in response to both predictable and unpredictable events (McEwen and Wingfield, 2003). The same hormones associated with the stress response vary naturally throughout an animal's life, providing support for particular life history events (e.g., pregnancy) and predictable environmental conditions (e.g., seasonal changes). The allostatic load is the cumulative cost of allostasis incurred by an animal and is generally characterized with respect to an animal's energetic expenditure. Perturbations to an animal that may occur with the presence of a stressor, either biological (e.g., predator) or anthropogenic (e.g., construction), can contribute to the allostatic load (Wingfield, 2003). Additional costs are cumulative and additions to the allostatic load over time may contribute to reductions in the probability of achieving ultimate life history functions (e.g., survival, maturation, reproductive effort and success) by producing pathophysiological states. The contribution to the allostatic load from a stressor requires estimating the magnitude and duration of the stress response, as well as any secondary contributions that might result from a change in behavior.

If the acoustic source does not produce tissue effects, is not perceived by the animal, or does not produce a stress response by any other means, Figure 3.7-3 assumes that the exposure does not contribute to the allostatic load. Additionally, without a stress response or auditory masking, it is assumed that there can be no behavioral change. Conversely, any immediate effect of exposure that produces an injury (i.e., red boxes on the flow chart in Figure 3.7-3) is assumed to also produce a stress response and contribute to the allostatic load.

Behavior Block

Acute stress responses may or may not cause a behavioral reaction. However, all changes in behavior are expected to result from an acute stress response. This expectation is conservatively based on the assumption that some sort of physiological trigger must exist for an anthropogenic stimulus to alter a biologically significant behavior that is already being performed. The exception to this rule is the case of masking. The presence of a masking sound may not produce a stress response, but may interfere with the animal's ability to detect and discriminate biologically relevant signals. The inability to detect and discriminate biologically relevant signals hinders the potential for normal behavioral responses to auditory cues and is thus considered a behavioral change.

Numerous behavioral changes can occur as a result of stress response, and Figure 3.7-3 lists only those that might be considered the most common types of response for a marine animal. For each potential behavioral change, the magnitude in the change and the severity of the response needs to be estimated. Certain conditions, such as a flight response might have a probability of resulting in injury. For example, a flight response, if significant enough, could produce a stranding event. Under the MMPA, such an event precipitated by anthropogenic noise would be considered a Level A harassment. Each altered behavior may also have the potential to disrupt biologically significant events (e.g., breeding or nursing) and may need to be qualified as Level B harassment. All behavioral disruptions have the potential to contribute to the allostatic load. This secondary potential is signified by the feedback from the collective behaviors to allostatic loading (physiology block).

The response of a marine mammal to an anthropogenic sound source will depend on the frequency content, duration, temporal pattern and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). The direction of the responses can vary, with some changes resulting in either increases or decreases from baseline (e.g., decreased dive times and increased respiration rate). Responses can also overlap; for example, an increased respiration rate is likely to be coupled to a flight response. Differential responses between and within species are expected since hearing ranges vary across species and the behavioral ecology of individual species is unlikely to completely overlap.

A review of marine mammal responses to anthropogenic sound was first conducted by Richardson and others in 1995. A more recent review (Nowacek *et al.*, 2007) addresses studies conducted since 1995 and focuses on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. The following sections provide a very brief overview of the state of knowledge of behavioral responses. The overviews focus on studies conducted since 2000 but are not meant to be comprehensive; rather, they provide an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Estimates of the types of behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species, or extrapolated from closely related species when no information exists.

<u>Flight Response</u> **–** A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. Relatively little information on flight responses of marine mammals to anthropogenic signals exists, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). Flight responses have been speculated as being a component of marine mammal strandings associated with sonar activities (Evans and England, 2001).

<u>Response to Predator</u> – Evidence suggests that at least some marine mammals have the ability to acoustically identify potential predators. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales, but not others. The seals discriminate between the calls of threatening and non-threatening killer whales (Deecke *et al.*, 2002), a capability that should increase survivorship while reducing the energy required for attending to and responding to all killer whale calls. The occurrence of masking or hearing impairment provides a means by which marine mammals may be prevented from responding to the acoustic cues produced by their predators. Whether or not this is a possibility depends on the duration of the masking/hearing impairment and the likelihood of encountering a predator during the time that predator cues are impeded.

<u>Diving</u> – Changes in dive behavior can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive. Variations in dive behavior may reflect interruptions in biologically significant activities (e.g., foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (e.g., increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Nowacek *et al.* (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, an action, they noted, that could lead to an increased likelihood of ship strike. However, the whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. Conversely, Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung, 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating intepretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach and speed of approach, seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung, 2003). Low frequency signals of the Acoustic Thermometry of Ocean Climate (ATOC) sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000) or to overtly affect elephant seal dives (Costa *et al.*, 2003). They did, however, produce subtle effects that varied in direction and degree among the individual seals, illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Due to past incidents of beaked whale strandings associated with sonar operations, feedback paths are provided between avoidance and diving and indirect tissue effects. This feedback accounts for the hypothesis that variations in diving behavior and/or avoidance responses can possibly result in nitrogen tissue supersaturation and nitrogen off-gassing, possibly to the point of deleterious vascular bubble formation (Jepson *et al.*, 2003). Although hypothetical, the potential process is being debated within the scientific community.

Foraging - Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (e.g., bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior in western gray whales off the coast of Russia (Yazvenko *et al.*, 2007) and sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen *et al.*, 2006). Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll *et al.*, 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.*, 2004). Although the received sound pressure level at the animals was similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. A determination of whether foraging disruptions incur fitness consequences will require information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Breathing – Variations in respiration naturally vary with different behaviors and variations in respiration rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to the whale feeding grounds (Gailey *et al.*, 2007). Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms (Kastelein *et al.*, 2001; Kastelein *et al.*, 2006a) and emissions for underwater data transmission (Kastelein *et al.*, 2005). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein *et al.*, 2006a), again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

Social relationships - Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Disruption of social relationships therefore depends on the disruption of other behaviors (e.g., caused avoidance, masking, etc.) and no specific overview is provided here. However, social disruptions must be considered in context of the relationships that are affected. Long-term disruptions of mother/calf pairs or mating displays have the potential to affect the growth and survival or reproductive effort/success of individuals, respectively.

Vocalizations - Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes may result in response to a need to compete with an increase in background noise or may reflect an increased vigilance or startle response. For example, in the presence of low-frequency active sonar, humpback whales have been observed to increase the length of their ”songs” (Miller *et al.*, 2000; Fristrup *et al.*, 2003), possibly due to the overlap in frequencies between the whale song and the low-frequency active sonar. A similar compensatory effect for the presence of low frequency vessel noise has been suggested for right whales; right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.*, 2007). Killer whales off the northwestern coast of the United States have been observed to increase the duration of primary calls once a threshold in observing vessel density (e.g., whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote *et al.*, 2004). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles *et al.*, 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

Avoidance - Avoidance is the displacement of an individual from an area as a result of the presence of a sound. It is qualitatively different from the flight response in its magnitude (i.e., directed movement, rate of travel, etc.). Oftentimes avoidance is temporary, and animals return to the area once the noise has ceased. Longer term displacement is possible, however, which can lead to changes in abundance or distribution patterns of the species in the affected region if they do not become acclimated to the presence of the sound (Blackwell *et al.*, 2004; Bejder *et al.*, 2006; Teilmann *et al.*, 2006). Acute avoidance responses have been observed in captive porpoises and pinnipeds exposed to a number of different sound sources (Kastelein *et al.*, 2001; Finneran *et al.*, 2003; Kastelein *et al.*, 2006a; Kastelein *et al.*, 2006b). Short term avoidance of seismic surveys, low frequency emissions, and acoustic deterrants has also been noted in wild populations of odontocetes (Bowles *et al.*, 1994; Goold, 1996; 1998; Stone *et al.*, 2000; Morton and Symonds, 2002) and to some extent in mysticetes (Gailey *et al.*, 2007), while longer term or repetitive/chronic displacement for some dolpin groups and for manatees has been suggested to be due to the presence of chronic vessel noise (Haviland-Howell *et al.*, 2007; Miksis-Olds *et al.*, 2007).

Orientation - A shift in an animal’s resting state or an attentional change via an orienting response represent behaviors that would be considered mild disruptions if occurring alone, and thus are placed at the bottom of the framework behavior list. As previously mentioned, the responses may co-occur with other behaviors; for instance, an animal may initially orient toward a sound source, and then move away from it. Thus, any orienting response should be considered in context of other reactions that may occur.

Life Function

Proximate life history functions are the functions that the animal is engaged in at the time of acoustic exposure. The disruption of these functions, and the magnitude of the disruption, is something that must be considered in determining how the ultimate life history functions are affected. Consideration of the magnitude of the effect to each of the proximate life history functions is dependent upon the life stage of the animal. For example, an animal on a breeding ground which is sexually immature will suffer relatively little consequence to disruption of breeding behavior when compared to an actively displaying adult of prime reproductive age.

The ultimate life functions are those that enable an animal to contribute to the population (or stock, or species, etc.) and which related to the animal’s *fitness*. The impact to ultimate life functions will depend on the nature and magnitude of the perturbation to proximate life history functions. Depending on the severity of the response to the stressor, acute perturbations may have nominal to profound impacts on ultimate life functions. For example, unit-level use of sonar by a vessel transiting through an area that is utilized for foraging, but not for breeding, may disrupt feeding by exposed animals for a brief period of time. Because of the brevity of the perturbation, the impact to ultimate life functions may be negligible. By contrast, weekly training over a period of years may have a more substantial impact because the stressor is chronic. Assessment of the magnitude of the stress response from the chronic perturbation would require an understanding of how and whether animals acclimate to a specific, repeated stressor and whether chronic elevations in the stress response (e.g., cortisol levels) produce fitness deficits.

The proximate life functions are loosely ordered in decreasing severity of impact. Mortality (survival) has an immediate effect, in that no future reproductive success is feasible and there is no further addition to the population resulting from reproduction. Severe injuries may also lead to reduced survivorship (longevity) and prolonged alterations in behavior. The latter may further affect an animal's overall reproductive success and reproductive effort. Disruptions of breeding have an immediate impact on reproductive effort and may impact reproductive success. The magnitude of the effect will depend on the duration of the disruption and the type of behavior change that was provoked. Disruptions to feeding and migration can affect all of the ultimate life functions; however, the impacts to reproductive effort and success are not likely to be as severe or immediate as those incurred by mortality and breeding disruptions.

3.7.3.2 Background Information for Explosive Ordnance Analysis

Some of the Navy's training exercises include the underwater detonation of explosives. When an explosive detonates, a physical shock front rapidly compresses the explosive material. As this front passes through the explosive, it triggers a chemical reaction, turning the solid of the explosive into gaseous products and liberating a large amount of energy. An accompanying pressure wave, called a "shock wave" is also produced which then passes into the surrounding medium. Noise associated with the blast is also transmitted into the surrounding medium. The shock wave (impulsive characteristic of sound) and blast noise (acoustic characteristic of sound) are of the most concern to marine animals. Beyond a short distance from the blast (generally 3-10 diameters of the explosive charge), thermal and direct detonation effects from the explosion are significantly reduced or eliminated (Viada *et al*., 2008). The main sources of impact outside the immediate vicinity of the explosion are the shock wave and expanding gaseous reaction products. Generally, the original shock wave is the primary cause of harm to aquatic life. The expanding gases, if they break into the water column, can set up a pulsating bubble whose recurring pressure waves also may contribute significantly to damage (Viada *et al*., 2008).

The effects of an underwater explosion on marine mammals and sea turtles, are dependent on several factors, including the size, type, and depth of both the animal and the explosive charge; the depth of the water column; and the standoff distance between the explosive charge and the animal, as well as the sound propagation properties of the environment. Impacts to marine species are a result of physiological responses (generally the destruction of tissues at air-fluid interfaces) to both the type and strength of the acoustic signature and shock wave generated by an underwater explosion. Behavioral impacts are also expected, though the type and severity of these effects are more difficult to define due to limited studies addressing the behavioral effects of explosives on marine mammals and other aquatic species. Potential effects can range from brief acoustic effects (such as behavioral disturbance), tactile perception, physical discomfort, slight injury of the internal organs and the auditory system, to death of the animal (Yelverton *et al*., 1973; O'Keefe and Young, 1984; DoN, 2001). Non-lethal injury includes slight injury to internal organs and the auditory system; however, delayed lethality may be a result of individual or cumulative sublethal injuries (DoN, 2001). Immediate lethal injury would be a result of massive combined trauma to internal organs as a direct result of close proximity to the point of detonation (DoN, 2001). In the following subsections, potential effects due to the exposure to underwater detonations is discussed in more detail.

Potential Impacts from Exposure to Underwater Detonations

Direct Tissue Effects

Direct tissue responses to impulsive sound stimulation may range from tissue trauma (injury) to mechanical vibration or compression with no resulting injury. Any tissue injury would produce a stress response whereas a non-injurious stimulation may or may not.

Generally, blast injury, defined as biophysical and pathophysiological events and clinical syndromes that occur when a living body is exposed to a blast of any origin, comprises two categories: primary blast injury (PBI) and cavitation (Costanzo and Gordon, 1989; Office of the Surgeon General, 1991; DoN, 2001, 2007c). Primary blast injury (PBI) occurs when the shock wave strikes and compresses the body, and energy from the blast is transferred directly from the transmitting medium (water) to the body surface. Cavitation occurs when compression waves generated by an underwater explosion propagate to the surface and are reflected back through the water column as rarefraction waves. Subsequent rarefraction waves create a state of tension in the water column, causing cavitation (defined as the formation of partial vacuums in a liquid by high intensity sound waves) within a bounded area called the cavitation region (Viada *et al*., 2008). In addition to these two avenues for impulsive effects, direct tissue damage can occur if the animal is close enough to the explosive source to be struck by the fragments or casing of the actual explosive device. Given current mitigation measures associated with underwater detonations, this scenario is highly unlikely.

Injury resulting from a shock wave takes place at boundaries between tissues of different density. Different velocities are imparted to tissue of different densities, and this can lead to their physical disruption. Blast effects are greatest at gas-liquid interfaces (Landsberg, 2000). Gas-containing organs, particularly the lungs, gastrointestinal tract, and the auditory system are susceptible in marine animals (Goertner, 1982; Hill, 1978; Yelverton *et al*., 1973). The direct effects of cavitation on marine mammals and sea turtles is unknown, though it is assumed that cavitation created by detonation of a small charge could directly annoy or injure (primarily the auditory system and lungs) or increase the severity of PBI injuries in the cavitation region (DoN, 2001; 2007c). Non-lethal injuries include minor injuries to the auditory system and certain internal organs.

Because the ears are the most sensitive to pressure, they are the organs most sensitive to injury (Ketten, 2000). Sound related damage associated with the blast noise can be theoretically distinct from injury from the shock wave, particularly farther from the explosion. Sound related trauma can be lethal or sub-lethal. Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source and are not, technically, pure acoustic trauma (Ketten, 1995). Sub-lethal impacts include hearing loss, which is caused by exposure to perceptible sounds. Severe damage, from the shock wave, to the ears can include rupture of the tympanic membrane (or tympanum in the case of sea turtles), facture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear (NMFS, 2008b). Moderate injury implies partial hearing loss due to tympanic membrane rupture and blood in the middle ear. Permanent hearing loss also can occur when the hair cells are damaged by one very loud event, as well as prolonged exposure to noise. The level of impact from blasts depends on both an animal's location and, at outer zones, on its sensitivity to the residual noise (Ketten, 1995).

In addition to injuries to the ear, other sensitive organs are also affected by the shock wave from underwater detonations. For example, lung injuries, including laceration and rupture of the alveoli and blood vessels, can lead to hemorrhage, creation of air embolisms, and breathing difficulties. In addition, gas-containing organs including the nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). The gastrointestinal tract is also susceptible to trauma from underwater explosions. Intestinal walls can bruise or rupture, with subsequent hemorrhage and escape of the gut contents into the body cavity. Less severe gastrointestinal tract injuries include contusions, slight hemorrhaging, and petichia (Yelverton *et al*., 1973). In underwater blast studies using cadaver marine mammals, Ketten *et al*. (2003) and Reidenberg and Laitman (2003), injury was consistent with what would be expected in live animals and included apparent hemorrhages at the blubber-muscle interface and in gas-containing organs and the gastrointestinal tract; ruptures of the liver and spleen; and contusions of the kidney. Ketten *et al*. (2003) noted distinct injury patterns to the blubber, melon, and jaw fats of cadaver bottlenose dolphins due to the differences in density, and hence sound speed velocity, of these tissues from adjoining tissues. Compression also appears to cause air to enter tissues adjacent to air spaces in dead marine mammals exposed to explosives (Reidenberg and Laitman, 2003). Slight injury to any of these organs would be considered recoverable and would not ultimately be debilitating to the individual.

Exposures of animals to high peak pressure shock waves can result in injuries including concussive brain damage; cranial, skeletal, or shell fractures; hemorrhage; or massive inner ear trauma (Ketten, 1995). Depending on the size of the animal (with small animals being more susceptible), extremely high shock wave pressure impulses may or may not be lethally injurious to internal organs. However, overall system shock and significant external tissue damage, as well as severe localized damage to the skeletal system, would be expected from such a shock wave. These injuries, if not themselves fatal, would probably put the animal at increased risk of predation, secondary infection, or disease (DoN, 2001; 2007c).

Indirect Tissue Effects

Indirect tissue effects may also be possible from underwater detonations, by means of the impulsive shock wave or its associated acoustic energy. For example, hemorrhage of the gastrointestinal tract can be caused by the direct effect of the shock wave or indirectly by the excitation of radial oscillations of small gas bubbles normally present in the intestines (Richmond *et al.*, 1973 and Yelverton *et al*., 1973).

A plausible mechanism for indirect tissue effects may be from behaviorally mediated bubble growth. Although this hypothesis was originally proposed in relation to the effects of sonar on marine mammals, the general pathway could also be applicable to underwater detonations. By this hypothesis, if the acoustic energy or impulsive force of an underwater detonation was great enough to startle marine mammals, it could trigger their flight response and cause them to react by changing their dive behavior (i.e. rapid ascent, staying at the surface or at depth longer to avoid exposure). Jepson *et al*. (2003) proposed that bubble formation might result from behavioral changes to normal dive profiles (such as accelerated ascent rate), causing excessive nitrogen supersaturation in the tissues (as occurs in decompression sickness). Because evidence of nitrogen bubble formation following a rapid ascent by marine mammals is arguable and requires further investigation, this EIS/OEIS makes no assumptions about it being a causative mechanism.

An alternative, but related hypothesis has also been suggested: stable micro-bubbles could become destabilized, or bubbles could be formed via cavitation following high level sound exposures, which could originate from impulsive sources. Under such a condition, bubble growth could then occur through static diffusion of gas out of the tissues. In this scenario, the marine mammal would need to be in a gas-supersaturated state for a long period of time for bubbles to become of a problematic size. While it is unlikely that the short duration of sonar pings or impulsive sounds from explosive sources would be long enough to drive bubble growth to any substantial size, such a phenomenon is within the realm of possibility. For a further discussion of these mechanisms refer back to the *Indirect Effects* section of the acoustic analysis.

Behavioral Effects

There have been few studies addressing the behavioral effect of explosives on marine mammals. While recognizing that the nature of shock waves produced by high explosives is different from that produced by airguns or MFAS, these sounds serve as the best proxy for assessing the effects of underwater detonations on marine life. Despite the difference in the character of the sound source, it is anticipated that the same general behavioral responses would result from explosive detonations. As a result, for a further discussion of the behavioral effects of underwater detonations on marine species, refer back to the *Behavior Block* section of the acoustic analysis.

Thresholds and Criteria for Impulsive Sound

Criteria and thresholds for estimating the exposures from a single explosive activity on marine mammals were established for the Seawolf Submarine Shock Test Final Environmental Impact Statement (FEIS) ("Seawolf") and subsequently used in the USS Winston S. Churchill (DDG-81) Ship Shock FEIS ("Churchill") (DoN, 1998 and 2001). NMFS adopted these criteria and thresholds in its final rule on unintentional taking of marine animals occurring incidental to the shock testing (NMFS, 2001a). Since the ship-shock events involve only one large explosive at a time, additional assumptions were made to extend the approach to cover multiple explosions for FIREX (with IMPASS) and BOMBEX. In addition, this section reflects a revised acoustic criterion for small underwater explosions (*i.e.*, 23 lbs per square inch [psi] instead of previous acoustic criteria of 12 psi for peak pressure over all exposures), which is based on the final rule issued to the Air Force by NMFS (NMFS, 2005c). As was the case for Seawolf and Churchill, in the absence of specifically developed criteria, criteria and thresholds for impact on protected marine mammals are used for protected sea turtles. Figure 3.7-4 depicts the acoustic impact framework used in this assessment.

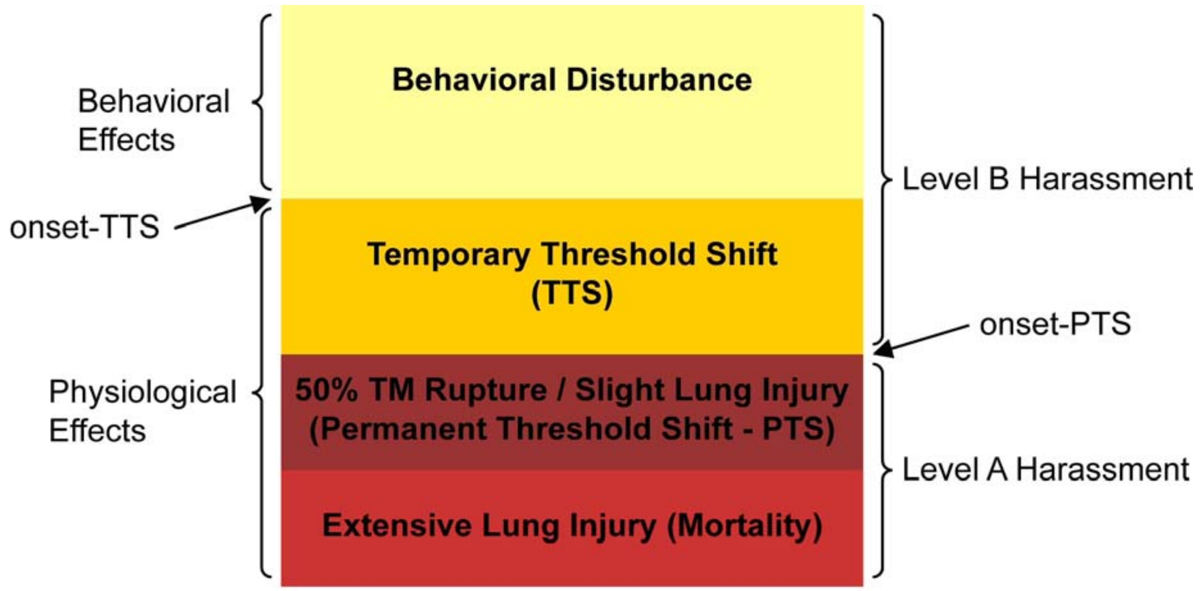
Thresholds and Criteria for Injurious Physiological Effects

Single Explosion

For injury, the Navy uses dual criteria: eardrum rupture (*i.e.*, tympanic-membrane [TM] rupture) and onset of slight lung injury. These criteria are considered indicative of the onset of injury. The threshold for TM rupture corresponds to a 50 percent rate of rupture (*i.e.*, 50% of animals exposed to the level are expected to suffer TM rupture); this is stated in terms of an Energy Flux Density Level (EL) value of 1.17 inch pounds per square inch (in-lbs/in^2) (about 205 dB referenced to one microPascal squared second [dB re one μPa^2-sec]). This recognizes that TM rupture is not necessarily a serious or life-threatening injury, but is a useful index of possible injury that is well correlated with measures of permanent hearing impairment (Ketten [1998] indicates a 30 percent incidence of PTS at the same threshold).

The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 26.9 lbs), and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-millisecond (msec) (DoN, 2001). This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass and, therefore, larger animals require a higher impulse to cause the onset of injury. This analysis assumed the marine species populations were 100 percent small animals. The criterion with the largest potential exposure range (most conservative), either TM rupture (energy threshold) or onset of slight lung injury (peak pressure threshold), will be used in the analysis to determine injurious physiological exposures.

For mortality, the Navy uses the criterion corresponding to the onset of extensive lung injury. This is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure. For small animals, the threshold is given in terms of the Goertner modified positive impulse, indexed to 30.5 psi-msec. Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse



(Figure is not to scale and is for illustrative purposes only)

Figure 3.7-4 Physiological and Behavioral Acoustic Effects Framework for Explosives

value corresponding to the 30.5 psi-msec index is a complicated calculation. To be conservative, the analysis used the mass of a calf dolphin (at 26.9 lbs) for 100 percent of the populations.

Multiple Explosions

For this analysis, the use of multiple explosions occurs during FIREX (with IMPASS) and the BOMBEX events where the MK-82 and MK-83 bombs are used. Since FIREX and portions of BOMBEX require multiple explosions, the Churchill approach had to be extended to cover multiple sound events at the same training site. For FIREX, the exercise is estimated to take up to 6 hours. For BOMBEX, the bombs are dropped roughly 3 minutes apart, so the exercise is approximately 12 minutes For multiple exposures, accumulated energy over the entire training time is the natural extension for energy thresholds since energy accumulates with each subsequent shot (explosion); this is consistent with the treatment of multiple arrivals in Churchill. For positive impulse, it is consistent with Churchill to use the maximum value over all impulses received.

Thresholds and Criteria for Non-Injurious Physiological Effects

The Navy criterion for non-injurious physiological effects is TTS — a slight, recoverable loss of hearing sensitivity (DoN, 2001). For this assessment, there are dual thresholds for TTS, an energy threshold and a peak pressure threshold. The criterion with the largest potential exposure range (most conservative), either the energy threshold or peak pressure threshold, will be used in the analysis to determine non-injurious physiological (TTS) exposures.

Single Explosion –TTS-Energy Threshold

The first threshold is a 182 dB re 1 μPa^2-sec maximum energy flux density level in any 1/3-octave band at frequencies above 100 Hertz (Hz) for toothed whales/sea turtles and in any 1/3-octave band above 10 Hz for baleen whales. For large explosives, as in the case of the Churchill FEIS, frequency range cutoffs at 10 and 100 Hz produce different results in the impact range estimates. For small explosives (<1500 lb NEW), as what was modeled for this analysis, the spectrum of the shot arrival is broad, and there is essentially no difference in exposure ranges resulting from the 10 and 100 Hz frequency range cutoffs for toothed whales/sea turtles or baleen whales.

The TTS energy threshold for explosives is derived from the Space and Naval Warfare Systems Center (SSC) pure-tone tests for TTS (Schlundt *et al*., 2000, Finneran and Schlundt, 2004). The pure-tone threshold (192 decibels [dB] as the lowest value) is modified for explosives by (a) interpreting it as an energy metric, (b) reducing it by 10 dB to account for the time constant of the mammal ear, and (c) measuring the energy in 1/3-octave bands, the natural filter band of the ear. The resulting threshold is 182 dB re 1 μPa^2-sec in any 1/3-octave band. The energy threshold usually dominates over peak pressure threshold and is used in the analysis to determine potential non-injurious physiological (TTS) exposures for single explosion ordnance.

Single Explosion –TTS-Peak Pressure Threshold

The second threshold applies to all species and is stated in terms of peak pressure at 23 psi (about 225 dB referenced to 1 micropascal [dB re 1 μPa]). This criterion was adopted for Precision Strike Weapons (PSW) Testing and Training by Eglin Air Force Base in the Gulf of Mexico (NMFS, 2005c). It is important to note that for small shots near the surface (such as in this analysis), the 23-psi peak pressure threshold generally will produce longer exposure ranges than the 182-dB energy metric. Furthermore, it is not unusual for the TTS exposure range for the 23-psi pressure metric to actually exceed the disturbance exposure range for the 177-dB energy metric.

Multiple Explosions –TTS

For multiple explosions, accumulated energy over the entire training time is the natural extension for energy thresholds since energy accumulates with each subsequent shot/detonation. This is consistent with the energy argument in Churchill. For peak pressure, it is consistent with Churchill to use the maximum value over all impulses received.

Thresholds and Criteria for Behavioral Effects

Single Explosion

For a single explosion, to be consistent with Churchill, TTS is the criterion for non-injurious physiological exposure. In other words, because behavioral disturbance for a single explosion is likely to be limited to a short-lived startle reaction, use of the TTS criterion is considered sufficient protection and, therefore, behavioral effects are not considered for single explosions.

Multiple Explosions

For this analysis, the use of multiple explosions occurs during FIREX (with IMPASS) and the BOMBEX events where MK-82 and MK-83 bombs are used. Because multiple explosions would occur within a discrete time period, a new acoustic criterion-behavioral disturbance is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower noise levels than those that may cause TTS.

The threshold is based on test results published in Schlundt *et al.* (2000), with derivation following the approach of the Churchill FEIS for the energy-based TTS threshold. The original Schlundt *et al*. (2000) data and the report of Finneran and Schlundt (2004) are the basis for thresholds for behavioral disturbance. As reported by Schlundt *et al.* (2000), instances of altered behavior generally began at lower exposures than those causing TTS; however, there were many instances when subjects exhibited no altered behavior at levels above the onset-TTS levels. Regardless of reactions at higher or lower levels, all instances of altered behavior were included in the statistical summary.

The behavioral disturbance (without TTS) threshold for tones is derived from the SSC tests, and is found to be five dB below the threshold for TTS, or 177 dB re: 1 μPa^2-sec maximum energy flux density level in any 1/3-octave band at frequencies above 100 Hz for toothed whales/sea turtles and in any 1/3-octave band above 10 Hz for baleen whales. In shallower water, the behavioral disturbance exposure range can be about twice the exposure range for TTS. However, in deeper water, the TTS pressure criteria (23 psi) exposure range can result in a longer exposure range than the behavioral disturbance criteria exposure range. This is due to the fact that in a deep water environment, it is more likely that there is a direct path for the shockwave to propogate, which results in a larger peak pressure range. In shallow water, there is reflection, absorption, and cancellation of the shockwave propagation due to interactions with the bottom, sediment type, etc., which can limit the peak pressure range.

Summary of Thresholds and Criteria for Impulsive Sounds

Table 3.7-4 summarizes the effects, criteria, and thresholds used in the assessment for impulsive sounds. Non-injurious effects are determined by either the dual physiological criteria for single detonations or by the behavioral criterion for multiple detonations. The criterion for behavioral disturbance used in this analysis is based on use of multiple explosives that only take place during a FIREX (with IMPASS) event or a BOMBEX event involving MK-82 or MK-83 bombs.

TABLE 3.7-4
EFFECTS, CRITERIA, AND THRESHOLDS FOR IMPULSIVE SOUNDS

Effect	Criteria	Metric	Threshold	Effect
Mortality	Onset of Extensive Lung Injury	Goertner modified positive impulse	indexed to 30.5 psi-msec (assumes 100% small animal at 26.9 lbs)	Mortality
Injurious Physiological	50% Tympanic Membrane Rupture- PTS	Energy flux density	1.17 in-lbs/in^2 (about 205 dB re 1 μPa^2-sec)	MMPA - Level A
Injurious Physiological	Onset Slight Lung Injury	Goertner modified positive impulse	indexed to 13 psi-msec (assumes 100% small animal at 26.9 lbs)	MMPA - Level A
Non-injurious Physiological	TTS	Greatest energy flux density level in any 1/3-octave band (above 100 Hz for toothed whales/sea turtles and above 10 Hz for baleen whales) - for total energy over all exposures	182 dB re 1 μPa^2-sec	MMPA - Level B
Non-injurious Physiological	TTS	Peak pressure for any single exposure	23 psi	MMPA - Level B
Non-injurious Behavioral	Behavioral Disturbance	Greatest energy flux density level in any 1/3-octave (above 100 Hz for toothed whales/sea turtles and above 10 Hz for baleen whales) - for total energy over all exposures (multiple explosions only)	177 dB re 1 μPa^2-sec	MMPA - Level B
MMPA: Marine Mammal Protection Act TTS: Temporary Threshold Shift PTS: Permanent Threshold Shift				

Acoustic Environment

Sound propagation (the spreading or attenuation of sound) in the oceans of the world is affected by several environmental factors: water depth, variations in sound speed within the water column, surface roughness, and the geo-acoustic properties of the ocean bottom. These parameters can vary widely with location.

Four types of data are used to define the acoustic environment for each analysis site:

Seasonal Sound Velocity Profiles (SVP) – Plots of propagation speed (velocity) as a function of depth, or SVPs, are a fundamental tool used for predicting how sound will travel. Seasonal SVP averages were obtained for each training area.

Seabed Geo-acoustics – The type of sea floor influences how much sound is absorbed and how much sound is reflected back into the water column.

Wind Speeds – Several environmental inputs, such as wind speed and surface roughness, are necessary to model acoustic propagation in the prospective training areas.

Bathymetry data - Bathymetry data are necessary to model acoustic propagation and were obtained for each of the training areas.

Acoustic Effects Analysis

The exercises that use explosives include: FIREX with IMPASS, MISSILEX, BOMBEX, MINEX, and small arms training. Table 3.7-5 summarizes the number of events (per year) for the No Action Alternative and specific areas where each occurs for each type of explosive ordnance used. Table 3.7-6 summarizes the number of events (per year) for Alternative 1 and specific areas where each occurs for each type of explosive ordnance used. Table 3.7-7 summarizes the number of events (per year) for Alternative 2 and specific areas where each occurs for each type of explosive ordnance used. Events can take place at any time of year and can be assumed to be evenly distributed across all four seasons (unless specified otherwise).

TABLE 3.7-5
NUMBER OF EXPLOSIVE EVENTS WITHIN THE VACAPES RANGE COMPLEX FOR NO ACTION ALTERNATIVE

Sub-Area	Ordnance	Annual Totals
	MISSILEX	
Air-K	Hellfire	30
W-72A (2)	Hellfire	
Air-K	Maverick	20
	FIREX	
5C/D	5" rounds	22
7C/D and 8C/D	5" rounds	
1C1/2	5" rounds	
	MINEX	
W-50 UNDET	20 LBS*	12
	BOMBEX	
Air-K	MK-82**	58
Air-K	MK-83**	23
Air-K	MK-84	8
Air-K	MK-20	12
Area 3B	MK-82**	20
Area 3B	MK-83**	10
Area 3B	MK-84	1

***** *MINEX events are more likely to take place during the summer. This was taken into account in the acoustic exposure analysis.*
*** One event using the MK-82 or MK-83 bombs consists of 4 bombs being dropped in succession. For example, in VACAPES Air-K there are 23 MK-83 events, which mean that a total of 92 bombs will be dropped per year.*

TABLE 3.7-6
NUMBER OF EXPLOSIVE EVENTS WITHIN THE VACAPES RANGE COMPLEX FOR ALTERNATIVE 1

Sub-Area	Ordnance	Annual Totals
	MISSILEX	
Air-K	Hellfire	45
W-72A (2)	Hellfire	15
Air-K	Maverick	20
	FIREX	
5C/D	5" rounds	22
7C/D and 8C/D	5" rounds	
1C1/2	5" rounds	
	MINEX	
W-50 UNDET	5 LBS*	30
W-50 UNDET	20 LBS**	24
	BOMBEX	
Air-K	MK-82***	58
Air-K	MK-83***	23
Air-K	MK-84	8
Air-K	MK-20	12
Area 3B	MK-82***	20
Area 3B	MK-83***	10
Area 3B	MK-84	1

**The use of 3.24 lb charges during AMNS training were conservatively modeled as 5 lb charges.*
****** *MINEX (20 lb) are more likely to take place during the summer. This was taken into account in the acoustic exposure analysis.*
**** One event using the MK-82 or MK-83 bombs consists of 4 bombs being dropped in succession. For example, in VACAPES Air-K there are 23 MK-83 events, which mean that a total of 92 bombs will be dropped per year.*

TABLE 3.7-7
NUMBER OF EXPLOSIVE EVENTS WITHIN THE VACAPES RANGE COMPLEX FOR ALTERNATIVE 2

Sub-Area	Ordnance	Annual Totals
	MISSILEX	
Air-K	Hellfire	45
W-72A (2)	Hellfire	15
Air-K	Maverick	20
	FIREX	
5C/D	5" rounds	22
7C/D and 8C/D	5" rounds	
1C1/2	5" rounds	
	MINEX	
W-50 UNDET	5 LBS*	30
W-50 UNDET	20 LBS**	24
	BOMBEX	
Air-K	MK-83***	5

**The use of 3.24 lb charges during AMNS training were conservatively modeled as 5 lb charges.*
****** *MINEX (20 lb) are more likely to take place during the summer. This was taken into account in the acoustic exposure analysis.*
**** One event using the MK-82 or MK-83 bombs consists of 4 bombs being dropped in succession. For example, in VACAPES Air-K there are 23 MK-83 events, which mean that a total of 92 bombs will be dropped per year.*

The acoustic effects analysis presented in the following sections is briefly described for each major type of exercise. A more in-depth description of the modeling can be found in Appendix J.

FIREX (with IMPASS)

Modeling was completed for a 5-in. round, 8-lbs Net Explosive Weight (NEW) charge exploding at a depth of 1 ft (0.3 m). The analysis approach begins using a high-fidelity acoustic model to estimate energy in each 5-in. explosive round. Effects areas are calculated by summing the energy from multiple explosions over a firing exercise (FIREX) mission, and determining the effects area based on the thresholds and criteria. Non-injurious exposures were determined based on the 177 dB re 1 μPa^2-sec (energy) criteria for behavioral disturbance due to the use of multiple explosions.

Effect areas for a full FIREX (with IMPASS) event must account for the time and space distribution of 39 explosions, as well as the movement of animals (using 3 knot average swim speed) over the several hours of the exercise. The total effect area for the 39-shot event is calculated as the sum of small effect areas for seven FIREX missions (each with four to six rounds fired) and one pre-FIREX action (with six rounds fired). Table 3.7-8 shows the Zone of Influence (ZOI) results of the model estimation.

TABLE 3.7-8
ESTIMATED ZOIS (KM^2) FOR A SINGLE FIREX (WITH IMPASS) EVENT (39 ROUNDS)

Area	Estimated ZOI @ 177 dB re 1 μPa^2-sec (multiple explosions only)	Estimated ZOI @ 23 psi (peak)	Estimated ZOI @ 205 dB re 1 μPa^2-sec or 13 psi-ms
5C/D	*	3.7044	0.16464
7C/D and 8C/D	5.6595	3.7044	0.16464
1C1/2	*	3.7044	0.16464

** In this area, which occurs in shallow water, the ZOI resulting from the 177 dB re 1 uPa^2-s (1/3 octave band) behavioral disturbance criterion is larger than the ZOI resulting from the 182 dB re 1 uPa^2-s (1/3 octave band)/23 psi (peak pressure) dual criteria for TTS, and was therefore used in the analysis to calculate non-injurious exposures.*

The ZOI, when multiplied by the animal densities and the total number of events (Tables 3.7-5 to 3.7-7), provides the exposure estimates for that animal species for the nominal exercise case of 39 5-in. explosive rounds. The potential effects would occur within a series of small effect areas associated with the pre-calibration rounds and missions spread out over a period of several hours. Additionally, target locations are changed from event to event and because of the time lag between events, it is highly unlikely, even if a marine mammal were present, that the marine mammal would be within the small exposure zone for more than one event. The exposure results based on the injurious criteria (13 psi-ms or 205 dB re 1 μPa^2-sec) were very low, and extrapolation showed there would be zero mortality exposures, so modeling was not completed for the 30.5 psi mortality criterion.

FIREX (with IMPASS) is restricted two primary locations (1C1/2; 7C/D & 8C/D) and a secondary location (5C/D) (Figure 2.2-10). In addition to other mitigation measures (see Chapter 5), a dedicated lookout monitors the target area for marine mammals and sea turtles before the exercise, during the deployment of the IMPASS array, and during the return to firing position. Ships will not fire on the target until the area is cleared and will suspend the exercise if any marine mammals (or sea turtles) enter the buffer area. Implementation of mitigation measures like these reduce the likelihood of exposure and potential effects in the ZOI.

BOMBEX

Modeling was completed for four explosive sources involved in BOMBEX, each assumed detonation at 1-m depth. The NEW used in simulations of the MK-82, MK-83 and MK-84 explosives are 192-lbs, 385-lbs, 945-lbs, respectively. The MK-20 explosive is a cluster bomb that houses 247 bomblets where each bomblet holds 0.4-lbs of an explosive mixture referred to as Comp B. The Trinitrotoluene (TNT) equivalent weight of each bomblet is 0.444-lbs. All of the individual bomblets in the MK-20 cluster bomb detonate so close in time (on the order of seconds) and space, that for the purposes of the acoustic modeling, it is considered one explosion. Thus, the total equivalent weight of the MK-20 bomb is 98.5-lbs.

The MK-84 and MK-20 bombs are dropped one at a time and, therefore, are modeled as a single detonation event. More specifically, the single explosion dual TTS criteria were used to determine the ZOI for the non-injurious exposure analysis.

Determining the ZOI for the thresholds in terms of total energy flux density (EFD), impulse, peak pressure and 1/3-octave bands EFD must treat the sequential explosions differently than the single explosions. For the MK-82 and MK-83, two factors are involved for the sequential explosives that deal with the spatial and temporal distribution of the detonations as well as the effective accumulation of the resultant acoustics. In view of the ZOI determinations, the sequential explosions are modeled as a single point event with only the EFD summed incoherently[10]:

$$Total\ EFD\ db = 10\log_{10}\sum_{i=1}^{n} 10^{(EFD_i/10)}$$

The multiple explosives behavioral disturbance energy criterion was used to determine the ZOI for the non-injurious exposure analysis for the MK-82 and MK-83 bombs.

Tables 3.7-9 and 3.7-10 show the ZOI results of the model estimation. The ZOI, when multiplied by the animal densities and total number of events (Tables 3.7-5 to 3.7-7), provides the exposure estimates for that animal species for the given bomb source.

BOMBEX is restricted to one location (Air-K) for Alternative 2 (Figure 2.2-7) and split between two areas (Air-K and Air-3B) for Alternative 1 and the No Action Alternative (Figure 2.2-6). In addition to other mitigation measures (see Chapter 5), aircraft will survey the target area for marine mammals and sea turtles before and during the exercise. Aircraft will not drop ordnance on the target until the area is surveyed and determined to be free of marine mammals (or sea turtles). The exercise will be suspended if any marine mammals (or sea turtles) enter the area. Implementation of mitigation measures like these reduce the likelihood of exposure and potential effects in the ZOI.

MINEX

The Comprehensive Acoustic System Simulation/Gaussian Ray Bundle (Oceanographic and Atmospheric Master Library [OAML], 2002) model, modified to account for impulse response, shock-wave waveform, and nonlinear shock-wave effects, was run for acoustic-environmental conditions derived from the OAML standard databases. The explosive source was modeled with standard similitude formulas, as in the Churchill FEIS. Because all the sites are shallow (less than 50 m), propagation model runs were made for bathymetry in the range from 10 m to 40 m.

Estimated ZOIs varied as much within a single area as from one area to another, which had been the case for the Virtual At Sea Training/IMPASS (DoN, 2003). There was, however, little season dependence. As a result, the ZOIs are stated as mean values with a percentage variation. Generally, in the case of ranges determined from energy metrics, as the depth of water increases, the range shortens. The single explosion dual TTS criteria (energy or peak pressure) were used to determine the ZOI for the non-injurious exposure analysis. Table 3.7-11 shows the ZOI results of the model estimation.

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[10] When the explosions are spaced at greater distance than a few wavelengths for the specific frequencies of interest (the spectral regions where acoustic energy is strongest), then the resulting energy flux density (EFD) levels in all directions can be assumed to be simply the sum of the individual EFDs (incoherent sum).

TABLE 3.7-9
ESTIMATED ZOIS (KM^2) USED IN EXPOSURE CALCULATIONS FOR BOMBEX INVOLVING SINGLE EXPLOSIVES

Area	Ordnance	Estimated ZOI @ 182 dB re 1 μPa²-sec or 23 psi (peak)				Estimated ZOI @ 205 dB re 1 μPa²-sec or 13 psi-ms				Estimated ZOI @ 30.5 psi-ms			
		Win	Spr	Sum	Fall	Win	Spr	Sum	Fall	Win	Spr	Sum	Fall
VACAPES													
Air-K	MK-84	10.78	10.35	10.56	10.78	0.52	0.67	0.79	0.62	0.13	0.06	0.11	0.18
	MK-20	2.09	6.06	9.32	10.35	0.11	0.13	0.13	0.13	0.00	0.00	0.00	0.00
Air-3B	MK-84	11.65	11.65	12.34	11.88	1.40	0.84	0.62	0.57	<0.01	<0.01	<0.01	<0.01

Note: ZOIs for MK-84 and MK-20 bombs are modeled as single detonations.

TABLE 3.7-10
ESTIMATED ZOIS (KM^2) USED IN EXPOSURE CALCULATIONS FOR BOMBEX INVOLVING MULTIPLE EXPLOSIVES

Area	Ordnance	Estimated ZOI @ 177 dB re 1 μPa²-sec (multiple detonations only)				Estimated ZOI @ 205 dB re 1 μPa²-sec or 13 psi-ms				Estimated ZOI @ 30.5 psi-ms			
		Win	Spr	Sum	Fall	Win	Spr	Sum	Fall	Win	Spr	Sum	Fall
VACAPES													
Air-K	MK-82	95.69	270.47	285.80	341.56	1.81	2.09	1.90	1.48	0.07	0.07	0.04	0.04
	MK-83	135.04	555.51	713.99	912.05	4.28	4.01	6.39	4.55	0.05	0.05	0.05	0.05
Air-3B	MK-82	54.55	129.00	327.15	204.84	1.99	1.99	2.28	2.18	<0.01	<0.01	<0.01	<0.01
	MK-83	68.97	200.17	456.67	360.00	4.84	4.98	5.74	5.74	<0.01	<0.01	<0.01	<0.01

Note: ZOIs for MK-82 and MK-83 bombs are modeled as multiple detonations (4 bombs dropped at same location).

TABLE 3.7-11
ESTIMATED ZOIS (KM^2) FOR MINEX

Threshold	ZOIs	
	5-lbs NEW	20-lbs NEW
Estimated ZOI @ 13 psi-ms	0.03 km^2 ± 10%	0.13 km^2 ± 10%
Estimated ZOI @ 182 dB re 1 μPa^2-sec	0.2 km^2 ± 25%	0.8 km^2 ± 25%

Note: The ZOI resulting from the 13 psi-ms criterion was larger than the ZOI resulting from the 205 dB re 1 uPa^2-s (1/3 octave band) criterion, and was therefore used in the analysis to calculate injurious exposures. The ZOI resulting from the 182 dB re 1 uPa^2-s (1/3 octave band) criterion was larger than the ZOI resulting from the 13 psi-ms criterion, and was therefore used in the analysis to calculate non-injurious exposures.

The ZOI, when multiplied by the animal densities and total number of events (Tables 3.7-5 to 3.7-7), provides the exposure estimates for that animal species for each specified charge. The results for the injurious exposures at the 13 psi criterion were very low, and extrapolation showed there would be zero mortality exposures, so modeling was not completed for the 30.5 psi mortality criteria.

Underwater detonations are restricted to one area (W-50) (Figure 2.2-1). In addition to other mitigation measures (see Chapter 5), observers will survey the target area for marine mammals and sea turtles for 30 minutes prior through 30 minutes post detonation. Detonations will be suspended if a marine mammal or sea turtle enters the ZOI and will only restart after the area has been clear for a full 30 minutes. The majority of documented research has noted that most marine mammals complete dives averaging less than 30 minutes. Table 3.7-12 is a list of marine mammal dive times that are documented. Therefore, a 30 minute shutdown of naval exercises represents an adequate time period to assess marine mammal movements within the designated area and ensure the animal's safety before actions resume.

TABLE 3.7-12
MARINE MAMMAL DIVE TIMES

Common Name	*Scientific Name*	Average Dive Duration (min)	Maximum Dive Duration (min)	Citations
Mysticeti (baleen whales)				
Northern Atlantic right whale	*Eubalaena glacialis*	11.5 - 12.2		Goodyear, 1995; Baumgartner and Mate, 2003
Humpback whale	*Megaptera novaeangliae*	8.2	21	Dolphin, 1998 ; Schreer and Kovacs, 1997
Minke whale	*Balaenoptera acutorostrata*	4.43		Stern, 1992
Bryde's whale	*Balaenoptera brydei*	8	20	Wynne and Schwartz, 1999
Sei whale	*Balaenoptera boreali*		20	Lockyer and Waters, 1986 ; Martin, 1990
Fin whale	*Balaenoptera physalus*	5.5	14	Croll *et al*., 2001 ; Lockyer and Waters, 1986 ; Watkins *et al*., 1981
Blue whale	*Balaenoptera musculus*	6.6	18	Croll *et al*., 200; Lagerquist *et al*., 2000

TABLE 3.7-12
MARINE MAMMAL DIVE TIMES (Continued)

Common Name	*Scientific Name*	Average Dive Duration (min)	Maximum Dive Duration (min)	Citations
Odontoceti (toothed whales)				
Sperm whale	*Physeter macrocephalus*	35.9 - 37	73	Amano and Yoshioka, 2003 Watkins *et al*., 1993; Omura, 1950; Watkins *et al*., 1993
Pygmy sperm whale	*Kogia breviceps*		12 -17.7	Evans, 1987; Hohn *et al*., 1995; Scott *et al*., 2001
Dwarf sperm whale	*Kogia sima*		43	Breese and Tershy, 1993
Cuvier's beaked whale	*Ziphius cavirostris*	28.6	68	Barlow, 1999; Baird et al., 2004; Barlow et al., 1997
Sowerby's beaked whale	*Mesoplodon bidens*	12 - 29		Hooker and Baird, 1999
Blainville's beaked whale	*Mesoplodon densirostris*		23	Baird et al., 2004
Rough-toothed dolphin	*Steno bredanensis*		15	Miyazaki and Perrin, 1994
Bottlenose dolphin	*Tursiops truncatus*		8	Evans, 1987; Ridgway and Harrison, 1986
Pantropical spotted dolphin	*Stenella attenuata*		4.7	Perrin *et al*., 1987 Scott *et al*., 1993
Atlantic spotted dolphin	*Stenella frontalis*		5 - 6	Davis *et al*., 1996
Spinner dolphin	*Stenella longirostris*		3.5	Wursig *et al*., 1994
Common dolphin	*Dephinus delphis*		5	Heyning and Perin 1994; Evans, 1971
Atlantic white-sided dolphin	*Lagenorhynchus acutus*		4	Mate *et al*., 1994
Risso's dolphin	*Grampus griseus*		30	Clarke, 1986
False killer whale	*Pseudorca crassidens*	8 - 12		Ligon and Baird, 2001
Killer whale	*Orcinus orca*		10.4 - 15	Baird *et al*., 2005; Schreer and Kovacs, 1997
Long-finned pilot whale	*Globicephala melas*	8.1		Baird *et al*., 2002
Short-finned pilot whale	*Globicephala macrorhynchus*		27	Baird *et al*., 2003
Harbor porpoise	*Phocoena phocoena*		5.35	Westgate *et al*., 1995; Otani *et al*., 1998; 2000

TABLE 3.7-12
MARINE MAMMAL DIVE TIMES (Continued)

Common Name	*Scientific Name*	Average Dive Duration (min)	Maximum Dive Duration (min)	Citations
Pinnipedia (seals, sea lions, walruses)				
Harbor seal	*Phoca vitulina*		7	Schreer and Kovacs, 1997
Gray seal	*Halichoerus grypus*		32	Schreer and Kovacs, 1997
Harp seal	*Pagophilus groenlandicus*		16	Schreer and Kovacs, 1997
Sirenia (manatees and dugongs)				
West Indian manatee	*Trichechus manatus*		6	Schreer and Kovacs, 1997

MISSILEX (Hellfire and Maverick)

Modeling was completed for two explosive missiles involved in MISSILEX, each assumed detonation at 1-m depth. The NEW used in simulations of the Hellfire and Maverick missiles are 8 lbs and 80 lbs, respectively. The single explosion dual TTS criteria (energy or peak pressure) were used to determine the ZOI for the non-injurious exposure analysis. Table 3.7-13 shows the ZOI results of the model estimation.

The total ZOI, when multiplied by the animal densities (Table 3.7-1) and total number of events (Tables 3.7-5 through 3.7-7), provides the exposure estimates for that animal species for each specified missile. MISSILEX is restricted to two locations, Air-K, W-72A2 (Figures 2.2-8 and 2.2-9). In addition to other mitigation measures (see Chapter 5), aircraft will survey the target area for marine mammals or sea turtles before and during the exercise. Aircraft will not fire on the target until the area is cleared and will suspend the exercise if any enter the buffer area. Implementation of mitigation measures like these reduce the likelihood of exposure and potential effects in the ZOI.

3.7.3.3 No Action Alternative

Vessel Movements

Overview

The No Action Alternative includes vessel movements. These involve transit to and from port to the various components of the VACAPES Study Area (*e.g.*, OPAREA, Chesapeake Bay training areas, and warning areas), as well as vessel movements within and through the Range Complex to other destinations. Many of the ongoing and proposed operations within the VACAPES Study Area involve maneuvers by various types of surface ships, boats, and submarines (collectively referred to as vessels). Vessel movements have the potential to affect marine mammals by directly striking or disturbing individual animals. The probability of vessel and marine mammal interactions occurring in the VACAPES Study Area is dependent on several factors including numbers, types, and speeds of vessels; the regularity, duration, and spatial extent of operations; the presence/absence and density of marine mammals; and protective measures implemented by the Navy. Currently, the number of Navy vessels operating in the VACAPES Study Area varies based on training schedules and can range from 0 to about 10 vessels at any given time. Ship sizes range from 362 feet for a nuclear submarine (SSN) to 1,092 feet for a nuclear powered aircraft carrier (CVN).

TABLE 3.7-13
ESTIMATED ZOIS (KM^2) USED IN EXPOSURE CALCULATIONS FOR MISSILEX

Area	Ordnance	Estimated ZOI @ 182 dB re 1 μPa^2-s or 23 psi (peak)				Estimated ZOI @ 205 dB re 1 μPa^2-s or 13 psi-ms				Estimated ZOI @ 30.5 psi-ms			
		Win	Spr	Sum	Fall	Win	Spr	Sum	Fall	Win	Spr	Sum	Fall
Air-K	Hellfire	0.44	0.49	0.48	0.49	0.02	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01
W-72A (2)	Hellfire	0.58	0.60	0.57	0.59	0.03	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Air-K	Maverick	1.99	2.80	10.56	1.64	0.09	0.07	0.07	0.09	0.04	0.02	0.04	0.04

Operations involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to 2 weeks. These operations are widely dispersed throughout the OPAREA, which is a vast area encompassing 27,661 nm^2 (an area approximately the size of Indiana). Consequently, the density of ships within the Study Area at any given time is extremely low (*i.e.*, less than 0.0004 ships/nm^2). The Navy logs about 1400 total steaming days within the Study Area during a typical year.

Also, it should be noted that a variety of smaller craft, such as service vessels for routine operations and opposition forces used during training events will be operating within the Study Area. Small craft types, sizes and speeds vary. The Navy's rigid hull inflatable boat (RHIB) is one representative example of a small craft that may be used during training exercises. By way of example, the Naval Special Warfare RHIB is 35 feet in length and has a speed of 40+ knots. Other small craft, such as those used in maritime security training events, are of similar length and speed to the RHIB and often resemble, and often are, recreational fishing boats (*i.e*., a 30 - 35 foot center consol boat with twin outboard engines).

During training, speeds generally range from 10 to 14 knots; however, ships/craft can and will, on occasion, operate within the entire spectrum of their specific operational capabilities. It is necessary for vessels/craft to operate at higher speeds during specific events, such as, but not limited to, pursuing and overtaking hostile vessels, evasive maneuvers, and maintenance/ performance checks, such as ship trials. During these types of events ships may often operate at high speeds (high end of the vessel's speed capability). In all cases, the vessels/craft will be operated in a safe manner consistent with the local conditions.

While the lookout requirements described above do not apply to small boats, small boat crews are trained to detect and avoid all objects on or near the water surface as a standard safety measure. In addition, some training exercises that involve small boats also involve a ship that has lookouts. In such cases, observations of marine species by shipboard lookouts would be transmitted to the small boats and the avoidance measures applicable to the ship would apply to the small boats.

Disturbance Associated with Vessel Movements

Marine mammals are frequently exposed to vessels due to research, ecotourism, commercial and private vessel traffic, and government activities. The presence of vessels has the potential to alter the behavior patterns of marine mammals. It is difficult to differentiate between responses to vessel sound and visual cues associated with the presence of a vessel; thus, it is assumed that both play a role in prompting reactions from animals. Anthropogenic sound has increased in the marine environment over the past 50 years (Richardson *et al.* 1995; NRC, 2003) and can be attributed to vessel traffic, marine dredging and construction, oil and gas drilling, geophysical surveys, sonar, and underwater explosions (Richardson *et al.* 1995).

Marine mammals react to vessels in a variety of ways. Some respond negatively by retreating or engaging in antagonistic responses while other animals ignore the stimulus altogether (Watkins, 1986; Terhune and Verboom, 1999). The Endangered Species Act (ESA)-listed marine mammal species (blue, fin, humpback, North Atlantic right, sei, sperm whales, and manatees) that occur in the Study Area are not generally documented to approach vessels in their vicinity. The predominant reaction is either neutral or avoidance behavior, rather than attraction behavior. Additional information regarding each listed species is provided below.

North Atlantic Right Whales

Although very few data exist examining the relationship between vessel presence and significant impact to the North Atlantic right whale, it is thought that any impacts from vessel disturbance would be minor and/or temporary in nature (NMFS, 2005a). North Atlantic right whales continually utilize habitats in high ship traffic areas (Nowacek *et al.*, 2004). Studies show that North Atlantic right whales have little, if any, reaction to sounds of vessel approaching or the presence of the vessels themselves (Terhune and

Verboom, 1999; Nowacek *et al.*, 2004). In addition, North Atlantic right whales are protected through measures such as the 500-yard no-approach limit, which affords them additional protection and further alleviates any effect vessel traffic might have on behavior or distribution (NMFS, 1997).

Fin and Humpback Whales

Fin whales have been observed altering their swimming patterns by increasing speed and heading away from the vessel, as well as changing their breathing patterns in response to a vessel approach (Jahoda *et al.,* 2003). Observations show that when vessels remained 100 m or farther from fin and humpback whales, they were largely ignored (Watkins *et al.,* 1981). Only when vessels approached more closely did the fin whales in the study alter their behavior by increasing time at the surface and engaging in evasive maneuvers. In this study, humpback whales did not exhibit any avoidance behavior (Watkins *et al.*, 1981). However, in other instances, humpback whales did react to vessel presence. In a study of regional vessel traffic, Baker *et al.* (1983) found that when vessels were in the area, the respiration patterns of the humpback whales changed. The whales also exhibited two forms of behavioral avoidance: 1) horizontal avoidance (changing direction and/or speed) when vessels were between 2,000 and 4,000 m away, or 2) vertical avoidance (increased dive times and change in diving pattern) when vessels were between 0 and 2,000 m away (Baker *et al.*, 1983).

Based on existing studies, it is likely that fin and humpback whales would have little reaction to vessels that maintain a reasonable distance from the animals. The distance that will provoke a response varies based on many factors including, but not limited to, vessel size, geographic location, and individual animal tolerance levels (Watkins *et al.,* 1981; Baker *et al.*, 1983; Jahoda *et al.,* 2003). Should the vessels approach close enough to invoke a reaction, animals may engage in avoidance behaviors and/or alter their breathing patterns. Reactions exhibited by the whales would be temporary in nature. They would be expected to return to their pre-disturbance activities once the vessel has left the area.

Blue and Sei Whales

There is little information on blue whale or sei whale response to vessel presence (NMFS, 1998b; NMFS, 1998a). Sei whales have been observed ignoring the presence of vessels and passing close to the vessel (Weinrich *et al.,* 1986). The response of blue and sei whales to vessel traffic is assumed to be similar to that of the other baleen whales, ranging from avoidance maneuvers to disinterest in the presence of vessels. Any behavioral response would be short-term in nature.

Sperm Whales

Sperm whales generally had little to no reaction to ships, except on close approaches (within several hundred meters); however, some did show avoidance behavior such as quick diving (Würsig *et al.,* 1998). In addition, in the presence of whale watching and research boats, changes in respiration (alter blow intervals) and echolocation patterns (reduced time until first click after diving) were observed in male sperm whales (Richter *et al.,* 2006). Disturbance from boats does not generally result in a change in behavior patterns and is short-term in nature (Magalhães *et al.,* 2002).

West Indian Manatees

The presence of vessels has the potential to alter the behavior patterns of West Indian manatees. West Indian manatees respond to vessel movement via acoustic and possibly visual cues (Miksis-Olds *et al.*, 2007; Nowacek *et al.*, 2004b). West Indian manatees tend to move away from the approaching vessel, by increasing their rate of swimming speed and moving toward deeper water (Nowacek *et al.*, 2004b). The degree of response varies with individual West Indian manatees and may be more pronounced in areas of deeper water, where they are more easily able to locate the direction of the approaching vessel (Nowacek *et al.*, 2004b). This disturbance is a temporary response to the approaching vessel. West Indian manatees have also been shown to seek out areas with a lower density of vessels (Buckingham *et al.* 1999). West

Indian manatees react (*i.e.*, exhibit a clear behavioral response) to vessels within distances of 25 to 50 m, but it is unclear at what distance the West Indian manatees first detect the presence of vessels (Nowacek *et al.*, 2004b). Vessel traffic and recreational activities that disturb West Indian manatees may cause them to leave preferred habitats and may alter biologically important behaviors such as feeding, suckling, or resting (Haubold *et al.*, 2006). The overall distribution of West Indian manatees may be affected by areas of high recreational boat activity (Buckingham *et al.*, 1999).

Delphinids

Species of delphinids can vary widely in their reaction to vessels. Many exhibit mostly neutral behavior, but there are frequent instances of observed avoidance behaviors (Hewitt 1985; Würsig *et al*., 1998). In addition, approaches by vessels can elicit changes in behavior, including a decrease in resting behavior or change in travel direction (Bejder *et al*., 2006). Alternately, many of the delphinid species exhibit behavior indicating attraction to vessels. This can include just approaching a vessel (observed in harbor porpoises) (David, 2002), but many species such as common, rough-toothed and bottlenose dolphins are frequently observed bow riding or jumping in the wake of a vessel (Norris and Prescott, 1961; Shane *et al*., 1986; Würsig *et al*., 1998; Ritter 2002). These behavioral alterations are short-term and would not result in any lasting effects.

Dwarf and Pygmy Sperm Whales and Beaked Whales

Kogia spp. and beaked whales show strong adverse reactions to vessels. They engage in quick diving behavior and avoidance maneuvers (Würsig *et al*., 1998).

Chronic stress response to vessel movements-- Marine mammals exposed to a passing Navy vessel may not respond at all, or they could exhibit a short-term behavioral response, but not to the extent where natural behavioral patterns would be abandoned or significantly altered. Human disturbance to wild animals may elicit similar reactions to those caused by natural predators (Gill *et al.,* 2001; Beale and Monaghan, 2004). Behavioral responses may also be accompanied by a physiological response (Romero, 2004), although this is very difficult to study in the wild. Short-term exposures to stressors result in changes in immediate behavior (Frid, 2003). Repeated exposure to stressors, including human disturbance such as vessel disturbance and anthropogenic sound, can result in negative consequences to the health and viability of an individual or population. In individual bottlenose dolphins, chronic stress due to physical injury or disease, resulted in morphological changes to the adrenal glands (Clark *et al.,* 2006). Although this study related to natural induced stressors, similar physiological changes may result from other types of stressors such as anthropogenic disturbance. Chronic stress can result in decreased reproductive success (Lordi *et al.*, 2000; Beale and Monaghan, 2004), decreased energy budget (Frid, 2003), displacement from habitat (Southerland and Crockford, 1993), and lower survival rates of offspring (Lordi *et al.*, 2000). At this time, it is unknown what the long-term implications of chronic stress may be on marine mammal species.

Vessel movements under the No Action Alternative are not expected to result in chronic stress because, as discussed above, Navy vessel density in the Study Area would remain low and the Navy implements mitigation measures to avoid marine mammals (and sea turtles).

Summary-- Vessel traffic related to the proposed activity would pass near marine mammals only on an incidental basis. Most of the studies mentioned previously examine the reaction of animals to vessels that approach and intend to follow or observe an animal (*i.e.*, whale watching vessels, research vessels, *etc*.). Reactions to vessels not pursuing the animals, such as those transiting through an area or engaged in training exercises, may be similar but would likely result in less stress to the animal because they would not intentionally approach animals. In fact, Navy mitigation measures include several provisions to avoid approaching marine mammals (or sea turtles) (see Chapter 5 for a detailed description of mitigation measures). Listed cetacean species generally pay little attention to transiting vessel traffic as it approaches, although they may engage in last minute avoidance maneuvers (Laist *et al.,* 2001). As previously noted, all quick avoidance maneuvers are short-term alterations and not expected to permanently impact an animal. Most studies have ascertained the short-term response to vessel sound and vessel traffic (Watkins *et al.,* 1981; Baker, *et al.,* 1983; Magalhães *et al.,* 2002); however, the long-term implications of ship sound on marine mammals is largely unknown (NMFS, 2007b).

General disturbance associated with vessel movements may affect ESA-listed cetaceans, but is not expected to result in Level A or Level B harassment as defined by the MMPA. Manatees only rarely occur in the area because it is within the northern extent of the animal's summer range. Navy vessels transit nearshore waters; however, most operations occur in the Atlantic Ocean greater than 3 nm offshore or in relatively deep waters of the lower Chesapeake Bay, where manatees are not expected to occur. No vessel operations occur in areas that provide foraging habitat for the manatee. In addition, the Navy has adopted mitigation measures to reduce the potential for interactions with marine mammals. Therefore, general disturbance associated with vessel disturbance would have no effect on the manatee. In accordance with NEPA, vessel disturbance in territorial waters would have no significant impact on marine mammals. Furthermore, vessel disturbance in non-territorial waters would not cause significant harm to marine mammals in accordance with EO 12114.

Vessel Strikes

Collisions with commercial and Navy ships can result in serious injury and may occasionally cause fatalities to cetaceans and manatees. Although the most vulnerable marine mammals may be assumed to be slow-moving cetaceans or those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whale), fin whales are actually struck most frequently (Laist *et al.* 2001). Manatees are also particularly susceptible to vessel interactions and collisions, with recreational watercraft constitute the leading cause of mortality (USFWS 2007). Smaller marine mammals such as bottlenose and Atlantic spotted dolphins move more quickly throughout the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

After reviewing historical records and computerized stranding databases for evidence of ship strikes involving baleen and sperm whales, Laist *et al.* (2001) found that accounts of large whale ship strikes involving motorized boats in the area date back to at least the late 1800s. Ship collisions remained infrequent until the 1950s, after which point they increased. Laist *et al.* (2001) report that both the number and speed of motorized vessels have increased over time for trans-Atlantic passenger services, which transit through the area. They concluded that most strikes occur over or near the continental shelf, that ship strikes likely have a negligible effect on the status of most whale populations, but that for small populations or segments of populations the impact of ship strikes may be significant.

Although ship strike mortalities may represent a small proportion of whale populations, Laist *et al.* (2001) also concluded that, when considered in combination with other human-related mortalities in the area (e.g., entanglement in fishing gear), these ship strikes may present a concern for whale populations.

Of 11 species known to be hit by ships, fin whales are struck most frequently; right whales, humpback whales, sperm whales, and gray whales are all hit commonly (Laist et al 2001). In some areas, one-third of all fin whale and right whale strandings appear to involve ship strikes. Sperm whales spend long periods (typically up to 10 minutes; Jacquet *et al.* 1996) "rafting" at the surface between deep dives. This could make them exceptionally vulnerable to ship strikes. Berzin (1972) noted that there were "many" reports of sperm whales of different age classes being struck by vessels, including passenger ships and tug boats. There were also instances in which sperm whales approached vessels too closely and were cut by the propellers (NMFS 2006d).

Accordingly, the Navy has adopted mitigation measures to reduce the potential for collisions with surfaced marine mammals (for more details refer to Chapter 5). These measures include the following:

- Using lookouts trained to detect all objects on the surface of the water, including marine mammals and sea turtles.
- Implementing reasonable and prudent actions to avoid the close interaction of Navy assets and marine mammals (or sea turtles).
- Maneuvering to keep away from any observed marine mammal.

Navy shipboard lookouts (also referred to as "watchstanders") are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the Officer of the Deck (e.g., trash, a periscope, marine mammals, sea turtles) and all disturbances (e.g., surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water. Navy lookouts undergo extensive training in order to qualify as a lookout. This training includes on-the-job instruction under the supervision of an experienced lookout, followed by completion of the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).

The Navy includes marine species awareness as part of its training for its bridge lookout personnel on ships and submarines. Lookouts are trained how to look for marine species, and report sightings to the Officer of the Deck so that action may be taken to avoid the marine species or adjust the exercise to minimize effects to the species. Marine Species Awareness Training was updated in 2006, and the additional training materials are now included as required training for Navy ship and submarine lookouts. Additionally, all Commanding Officers and Executive Officers of units involved in training exercises are required to undergo marine species awareness training. This training addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments, and general observation information to aid in avoiding interactions with marine species.

North Atlantic right whales are of particular concern. On average one or two right whales are killed annually in collisions. Between 2001 and 2007, at least eight right whales, including four adult females, a juvenile male, a juvenile female and a female calf died as a result of being struck by ships. (MMC 2008) (RWC 2007)

In order to reduce the risk of ship strikes, the Navy has instituted North Atlantic right whale protective measures that cover vessels operating all along the Atlantic coast. Standing protective measures and annual guidance have been in place for ships in the vicinity of the right whale critical habitat off the Southeast coast since 1997. In addition to specific operating guidelines, the Navy’s efforts in the southeast include annual funding support to the Early Warning System (EWS), and organization of a communication network and reporting system to ensure the widest possible dissemination of right whale sighting information to Department of Defense and civilian shipping.

In 2002 right whale protective measures were promulgated for all Fleet activities occurring in the Northeast region and most recently in December 2004, the U.S. Navy issued further guidance for all Fleet ships to increase awareness of right whale migratory patterns and implement additional protective measures along the mid-Atlantic coast. This includes areas where ships transit between southern New England and northern Florida. The Navy coordinated with NOAA Fisheries for identification of seasonal right whale occurrence patterns in six major sections of the mid-Atlantic coast, with particular attention to port and coastal areas of key interest for vessel traffic management. The Navy’s resulting guidance calls for extreme caution and operation at a slow, safe speed within 20 nm arcs of specified coastal and port reference points. The guidance reiterates previous instructions that Navy ships post two lookouts, one of whom must have completed marine mammal recognition training, and emphasizes the need for utmost vigilance in performance of these watchstander duties.

The Navy has enacted additional protective measures to protect North Atlantic right whales in the mid-Atlantic region. The mid-Atlantic is a principal migratory corridor for North Atlantic right whales that travel between the calving/nursery areas in the Southeastern United States and feeding grounds in the northeast US and Canada. Southward right whale migration generally occurs from mid- to late November, although some right whales may arrive off the Florida coast in early November and stay into late March (Kraus *et al.*, 1993). The northbound migration generally takes place between January and late March. Data indicate that during the spring and fall migration, right whales typically occur in shallow water immediately adjacent to the coast, with over half the sightings (63.8%) occurring within 18.5 km (10 nm), and 94.1 percent reported within 55 km (30 nm) of the coast.

Given the low abundance of North Atlantic right whales relative to other species, the frequency of occurrence of ship strikes to right whales suggests that the threat of ship strikes is proportionally greater to this species (Jensen and Silber, 2003). NMFS has implemented a right whale vessel collision reduction strategy to establish operational measures for the shipping industry to reduce the potential for large vessel ship strikes of North Atlantic right whales while transiting to and from mid-Atlantic ports during right whale migratory periods (NMFS, 2008a). Recent studies of right whales have shown that these whales tend to lack a response to the sounds of oncoming vessels (Nowacek *et al.*, 2004). Although Navy vessel traffic generally represents only 2 to 3 percent of the overall large vessel traffic, based on this biological characteristic and the presence of critical Navy ports along the whales' mid-Atlantic migratory corridor, the Navy was the first federal agency to adopt additional protective measures for transits in the vicinity of mid-Alantic ports during right whale migration.

Specifically, the Navy has unilaterally adopted the following protective measures:

- During months of expected North Atlantic right whale occurrence, Navy vessels will practice increased vigilance with respect to avoidance of vessel-whale interactions along the mid-Atlantic coast, including transits to and from any mid-Atlantic ports.
- All surface units transiting within 30 nm of the coast in the mid-Atlantic will ensure at least two watchstanders are posted, including at least one lookout that has completed required marine mammal awareness training.
- Navy vessels will avoid knowingly approaching any whale head on and will maneuver to keep at least 460 m (1,500 ft) away from any observed whale, consistent with vessel safety.

For purposes of these measures, the mid-Atlantic is defined broadly to include ports south and east of Block Island Sound southward to South Carolina. These measures are similar to vessel transit procedures in place since 1997 for Navy vessels in the vicinity of designated right whale critical habitat in the southeastern United States. Based on the implementation of Navy mitigation measures, especially during times of anticipated right whale occurrence, and the relatively low density of Navy ships in the study area the likelihood that a vessel collision would occur is very low.

<u>Aircraft Overflights</u>

Overview

Various types of fixed-wing aircraft and helicopters are used in training exercises throughout the VACAPES Study Area (see Chapter 2 and Appendix D). These aircraft overflights would produce airborne noise and some of this energy would be transmitted into the water. Marine mammals could be exposed to noise associated with subsonic and supersonic fixed-wing aircraft overflights and helicopter operations while at the surface or while submerged (see Section 3.5 – Noise Environment for a description of the existing noise environment and Appendix H for an overview of airborne and underwater acoustics). In addition to sound, marine mammals could react to the shadow of a low-flying aircraft and/or, in the case of helicopters, surface disturbance from the downdraft.

Transmission of sound from a moving airborne source to a receptor underwater is influenced by numerous factors and has been addressed by Urick (1972), Young (1973), Richardson *et al.* (1995), Eller and Cavanagh (2000), Laney and Cavanagh (2000), and others. Sound is transmitted from an airborne source to a receptor underwater by four principal means: (1) a direct path, refracted upon passing through the air-water interface; (2) direct-refracted paths reflected from the bottom in shallow water; (3) lateral (evanescent) transmission through the interface from the airborne sound field directly above; and (4) scattering from interface roughness due to wave motion.

Aircraft sound is refracted upon transmission into water because sound waves move faster through water than through air (a ratio of about 0.23:1). Based on this difference, the direct sound path is totally reflected if the sound reaches the surface at an angle more than 13 degrees from vertical. As a result, most of the acoustic energy transmitted into the water from an aircraft arrives through a relatively narrow cone with a 26 degree apex angle extending vertically downward from the aircraft (Figure 3.7-5). The intersection of this cone with the surface traces a "footprint" directly beneath the flight path, with the width of the footprint being a function of aircraft altitude.

The sound pressure field is actually doubled at the air-to-water interface because the large difference in the acoustic properties of water and air. For example, a sonic boom with a peak pressure of 10 pounds per square foot (psf) at the sea surface becomes an impulsive wave in water with a maximum peak pressure of 20 psf. The pressure and sound levels then decrease with increasing depth.

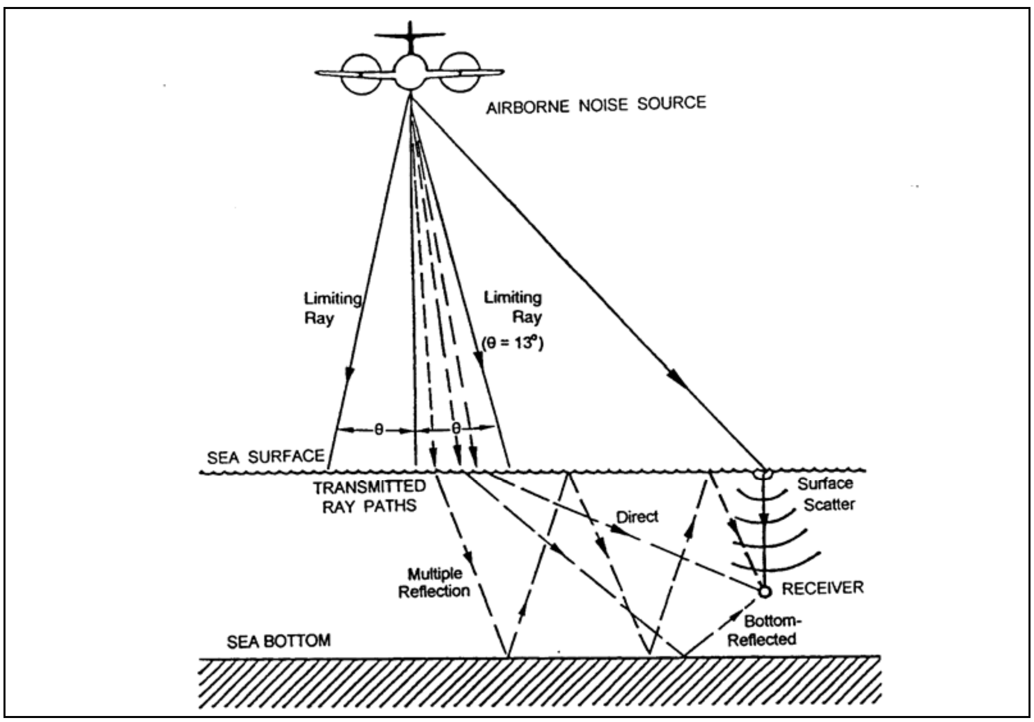


Figure 3.7-5 Characteristics of Sound Transmission through Air-Water Interface

Eller and Cavanagh (2000) modeled estimates of sound pressure level as a function of time at selected underwater locations (receiver animal depths of two, 10, and 50 m) for F-18 aircraft subsonic overflights (250 knots) at various altitudes (300, 1000, and 3,000 m). As modeled for all deep water scenarios, the sound pressure levels ranged from approximately 120 to 150 dB (referenced to one microPascal [re one μPa]). They concluded that it is difficult to construct cases (for any aircraft at any altitude in any propagation environment) for which the underwater sound is sufficiently intense and long lasting to cause harm to any form of marine life.

The maximum overpressures calculated for F/A-18 aircraft supersonic overflights range from 5.2 psf at 10,000 ft to 28.8 psf at 1,000 feet (Ogden, 1997). Considering an extreme case of a sonic boom that generates maximum overpressure of 50 psf in air, it would become an impulsive wave in water with a maximum peak pressure of 100 psf or about 0.7 pounds per square inch (psi). Therefore, even a worst case situation for sonic booms would produce a peak pressure in water well below the level that is commonly considered to cause harassment to marine mammals or sea turtles (Laney and Cavanagh, 2000) and not analyzed further.

It should be noted that most of the aircraft overflight exposures analyzed in the studies mentioned above are different than Navy aircraft overflights. Survey and whale watching aircraft are expected to fly at lower altitudes than typical Navy fixed-wing overflights. Exposure durations would be longer for aircraft intending to observe or follow an animal. These factors might increase the likelihood of a response to survey or whale watching aircraft. Exposure to Navy overflights would be very brief, but the noise levels might be higher based on aircraft type and airspeed.

Fixed-Wing Aircraft Overflights

Approximately 5,966 fixed-wing sorties would occur in the VACAPES OPAREA annually under the No Action Alternative and more than 88 percent of the sorties would be above 5,000 feet. While fixed-wing aircraft operations can occur in Special Use Airspace throughout the VACAPES Study Area, a majority of the sorties are associated with Air Combat Maneuver (ACM) training, which takes place in W-72A (Air-2A/B and Air-3A/B) (Figure 2.1-2). Altitudes range from 5,000 to 30,000 feet and typical airspeeds range from very low (less than 100 knots) to high subsonic (less than 600 knots). Sound exposure levels at the sea surface from most ACM overflights are expected to be less than 85 dBA (based on an FA-18 aircraft flying at an altitude of 5,000 feet and at a subsonic airspeed [400 knots]). Some ACM training involves supersonic flight, which produces sonic booms, but such airspeeds are infrequent and occur above 30,000 feet.

Exposure to fixed-wing aircraft noise would be brief (seconds) as an aircraft quickly passes overhead. Exposures would be infrequent based on the transitory and dispersed nature of the overflights; repeated exposure to individual animals over a short period of time (hours or days) is extremely unlikely. Furthermore, the sound exposure levels would be relatively low to marine mammals that spend the majority of their time underwater.

Most observations of cetacean responses to aircraft overflights are from aerial scientific surveys that involve aircraft flying at relatively low altitudes and low airspeeds. Mullin *et al.* (1991) reported that sperm whale reactions to aerial survey aircraft (standard survey altitude of 750 feet) were not consistent. Some sperm whales remained on or near the surface the entire time the aircraft was in the vicinity, while others dove immediately or a few minutes after the sighting.

Smultea *et al.* (2001) reported that a group of sperm whales responded to a circling aircraft (altitude of 800 to 1,100 feet) by moving closer together and forming a fan-shaped semi-circle with their flukes to the center and their heads facing the perimeter. Several sperm whales in the group were observed to turn on their sides, to apparently look up toward the aircraft. Smultea *et al.* (2008) reported that observed reactions of sperm whales to brief fixed-wing aircraft overflights were short-term and probably of no long-term biological significance. Richter *et al.* (2003) reported that the number of sperm whale blows per surfacing increased when recreational whale watching aircraft were present, but the changes in ventilation were small and probably of little biological consequence. The presence of whale watching aircraft also apparently caused sperm whales to turn more sharply, but did not affect blow interval, surface time, time to first click, or the frequency of aerial behavior (Richter *et al.*, 2003). A review of behavioral observations of baleen whales indicates that whales will either demonstrate no behavioral reaction to an aircraft or, occasionally, display avoidance behavior such as diving (Koski *et al.,* 1998). Smaller delphinids also generally display a neutral or startle response (Würsig *et al*., 1998). Species, such as *Kogia* spp. and beaked whales, that show strong avoidance behaviors with ship traffic, also exhibit disturbance reactions to aircraft (Würsig *et al*., 1998). Although there is little information regarding reactions to aircraft overflights for other cetacean species, it is expected that reactions would be similar to those described above; either no reaction or quick avoidance behavior.

Marine mammals exposed to a low-altitude fixed-wing aircraft overflights could exhibit a short-term behavioral response, but not to the extent where natural behavioral patterns would be abandoned or significantly altered. Fixed-wing aircraft overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed to low altitude overflights. Fixed-wing aircraft overflights may affect ESA-listed marine mammals, but are not expected to result in injurious or non-injurious effects as defined by the MMPA. In accordance with NEPA, fixed-wing aircraft overflights over territorial waters would have no significant impact on marine mammals. Furthermore, fixed-wing aircraft overflights over non-territorial waters would not cause significant harm to marine mammals in accordance with EO 12114.

Helicopter Overflights

Approximately 1,743 helicopter sorties would occur in the VACAPES Study Area annually under the No Action Alternative. Helicopter overflights can occur throughout the VACAPES Study Area, but most would occur in W-50 and the lower Chesapeake Bay under the No Action Alternative. Unlike fixed-wing aircraft, helicopter training operations often occur at low altitudes (75 to 100 feet), which increase the likelihood that marine mammals would respond to helicopter overflights.

Very little data are available regarding reactions of cetaceans to helicopters. One study observed that sperm whales showed no reaction to a helicopter until the whales encountered the downdrafts from the propellers (Clarke, 1956). Other species such as bowhead whale and beluga whales show a range of reactions to helicopter overflights, including diving, breaching, change in direction or behavior, and alteration of breathing patterns, with belugas exhibiting behavioral reactions more frequently than bowheads (38% and 14% of the time, respectively) (Patenaude *et al.*, 2002). These reactions were less frequent as the altitude of the helicopter increased to 150 m or higher. Manatees have been shown to exhibit behavioral reactions to helicopters flying below 100 m by abandoning resting behavior and fleeing to deeper water (Rathbun 1988).

Within the lower Chesapeake Bay, helicopter overflights are a component of the MCM exercise, and various marine mammal species, including seals and manatees, may occur in this region. However, within the lower Chesapeake Bay, all maneuvers involving helicopters are anticipated to take place in waters 16 ft or deeper, where manatees are not expected to occur based on preference for shallower waters. Manatee exposure to helicopter overflights is not expected under the No Action Alternative. Therefore, helicopter overflights would have no effect on manatees.

The three seal species (harp, gray, and harbor) may also occur within the Chesapeake Bay region. However, the harbor seal is the only species that occurs with any regularity. Thus, the likelihood of harp or gray seals being in the area and at or near the water surface is low due to their sparse occurrence. Helicopter overflights would have no effect on harp or gray seals. Helicopters are used in studies of several species of seals hauled out and is considered an effective means of observation (Gjertz and Børset 1992; Bester *et al*. 2002; Bowen *et al*. 2006), although they have been known to elicit behavioral reactions such as fleeing (Hoover 1988). In other studies, harbor seals showed no reaction to helicopter overflights (Gjertz and Børset 1992). It is not likely that a harbor seal would be at or near the surface of the water in areas where helicopters overflights occur in the lower Chesapeake Bay; however, only short-term behavioral reactions are expected if they were be exposed.

Marine mammals exposed to a low-altitude helicopter overflights under the No Action Alternative could exhibit a short-term behavioral response, but not to the extent where natural behavioral patterns would be abandoned or significantly altered. Helicopter overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed. Helicopter overflights may affect ESA-listed marine mammals, but are not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, helicopter overflights over territorial waters would have no significant impact on marine mammals. Furthermore, helicopter overflights over non-territorial waters would not cause significant harm to marine mammals in accordance with EO 12114.

Towed Mine Warfare (MIW) Devices

As described in Section 2 and Appendix D, Mine Warfare Exercises conducted in the Study Area include the use of various underwater mine detection and countermeasures systems that are towed through the water by helicopters flying approximately 75 feet above the water at low airspeeds. Under the No Action Alternative, this training would occur in the lower Chesapeake Bay and portions of the OPAREA that are closest to the Bay (areas that are within 45 nm of NS Norfolk, see Figures 2.2-2, 2.2-3, and 2.2-4). Based on occurrence data and habitat preferences described in Section 3.7.3, blue, sei, and sperm whales are not expected to occur in areas where towed MIW devices would be used. In addition, manatees are not expected to occur in these areas because they prefer shallow nearshore waters. Use of towed MIW devices under the No Action Alternative would have no effect on the blue whale, sei whale, sperm whale, and manatee.

While the potential exists for marine mammals to be struck by a towed MIW device, there are no documented instances of this occurring in the Study Area. Helicopter crew members monitor the water's surface during training to identify and avoid any objects that might damage the equipment. Based on the low flight altitudes and relatively slow air speeds, it is likely that crew members would be able see marine mammals at or near the surface and avoid them. Marine mammals at or near the surface would likely see or hear the oncoming helicopter or feel the downdraft, which could initiate avoidance behavior. The water column disturbance and sound created by the towed MIW device would likely elicit short-term behavioral responses similar to those discussed for vessel movements and aircraft overflights.

The use of towed MIW devices under the No Action Alternative may affect fin, humpback, North Atlantic right whales, but the potential effects of collisions would be discountable because they are extremely unlikely to occur. The use of towed MIW devices is not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, towed device use in territorial waters would have no significant impact on marine mammals. Furthermore, towed device use in non-territorial waters would not cause significant harm to marine mammals in accordance with EO 12114.

Weapons Firing/Non-explosive Practice Munitions Use

Non-explosive Practice Munitions Strikes

Current Navy training operations in the VACAPES Study Area include firing a variety of weapons and employ a variety of non-explosive practice munitions and explosive rounds, including bombs, missiles, naval gun shells, cannon shells, small caliber ammunition, and grenades. The majority of ordnance fired in the Study Area consists of non-explosive practice munitions (Table 2.2-6). The analysis presented in this section focuses on non-explosive practice munitions, while potential effects of explosive rounds are analyzed below in the explosions section. Training exercises that involve weapons firing and ordnance use take place in several training areas (see Table 2.2-6 for a summary of ordnance use by training area). Ordnance use is not authorized in W-110 and W-387 (approximately 4,168 nm^2) or the lower Chesapeake Bay. The manatee is only expected to occur in nearshore, shallow waters of the Chesapeake Bay were ordnance is not used. Therefore, the No Action Alternative would have no effect on the manatee.

Direct ordnance strikes and disturbance associated with sound from firing are potential stressors to other listed marine mammals. Ingestion of expended ordnance is also a potential concern for some marine mammals and is analyzed below under military expended materials. The primary concern is potential exposure of marine mammals at or near the water's surface, which could result in injury or mortality.

The potential for marine mammals to be struck by fired ordnance was evaluated using statistical probability modeling as described in Appendix I. Model input values include ordnance use data (frequency and type) and marine mammal density data for each season and training area where ordnance use occurs. The model first calculates the probability of a marine mammal being struck and then calculates the number of exposures (marine mammal/ordnance strikes) for the given season and training area. The model outputs for marine mammal/ordnance strikes are biased by the following assumptions and data/model limitations:

- The model is two-dimensional and assumes that all marine mammals would be at or near the surface 100 percent of the time, when in fact, marine mammals spend up to 90 percent of their time under the water (Costa, 1993).
- The model does not take into account standard mitigation measures used by the Navy to avoid and minimize marine mammal/ordnance strikes.
- The model assumes the animal is stationary and does not account for any movement of the marine mammal or any potential avoidance of the training.

The ordnance strike model is not expected to produce false negatives because the assumptions will more likely produce an overestimate of impacts. A model output of less than one exposure provides a high level of certainty that marine mammals would not be struck and that ordnance strikes would have no effect on marine mammals.

Appendix I provides a breakdown of the model input/output values for each group of marine mammals (for which density estimates are available) by training area where ordnance is fired or released. All model output values are substantially less than one (Appendix I), indicating that marine mammal/ordnance strikes are extremely unlikely to occur. The probability of a direct ordnance strike is further reduced by Navy mitigation measures (see Chapter 5). Non-explosive practice munitions would have no effect on marine mammals. In accordance with NEPA, non-explosive practice munitions use in territorial waters would have no significant impact on marine mammals. Furthermore, non-explosive practice munitions use in non-territorial waters would not cause significant harm to marine mammals.

Weapons Firing Disturbance

Transmitted Gunnery Sound

A gun fired from a ship on the surface of the water propagates a blast wave away from the gun muzzle. This spherical blast wave reflects off and diffracts around objects in its path. As the blast wave hits the water, it reflects back into the air, transmitting a sound pulse back into the water in proportions related to the angle at which it hits the water.

Propagating energy is transmitted into the water in a finite region below the gun. A critical angle (about 13°, as measured from the vertical) can be calculated to determine the region of transmission in relation to a ship and gun (DoN, 2006).

The largest proposed shell size for these operations is a five-inch shell. This will produce the highest pressure and all analysis will be done using this as a conservative measurement of produced and transmitted pressure, assuming that all other smaller ammunition sizes would fall under these levels.

Aboard the USS Cole in June 2000, a series of pressure measurements were taken during the firing of a five-inch gun. Average pressure measured approximately 200 decibels (dB) with reference pressure of one micro Pascal (dB re: 1 μPa) at the point of the air and water interface. Based on the USS Cole data, down-range peak pressure levels were calculated to be less than 186 dB re: 1 μPa at 100 m (DoN, 2000) and as the distance increases, the pressure would decrease.

In reference to the energy flux density (EFD) harassment criteria, the EFD levels (greatest in any 1/3 octave band above 10 Hz) of a 5-inch gun muzzle blast were calculated to be 190 dB with reference pressure of one micropascal squared in one second (dB re: 1 μPa2-sec) directly below the gun muzzle decreasing to 170 dB re: 1 μPa2-sec at 100 m (328 feet) into the water (DoN, 2006). The rapid dissipation of the sound pressure wave coupled with the mitigation measures implemented by the Navy (see Chapter 5 for details) to detect marine mammals in the area prior to conducting operations, would result in a blast from a gun muzzle having no effect on marine mammal species listed under the ESA. In accordance with NEPA there would be no significant impact to marine mammals from transmitted gunnery sound during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to marine mammals resulting from transmitted gunnery sound during training exercises in non-territorial waters.

Sound Transmitted Through Ship Hull

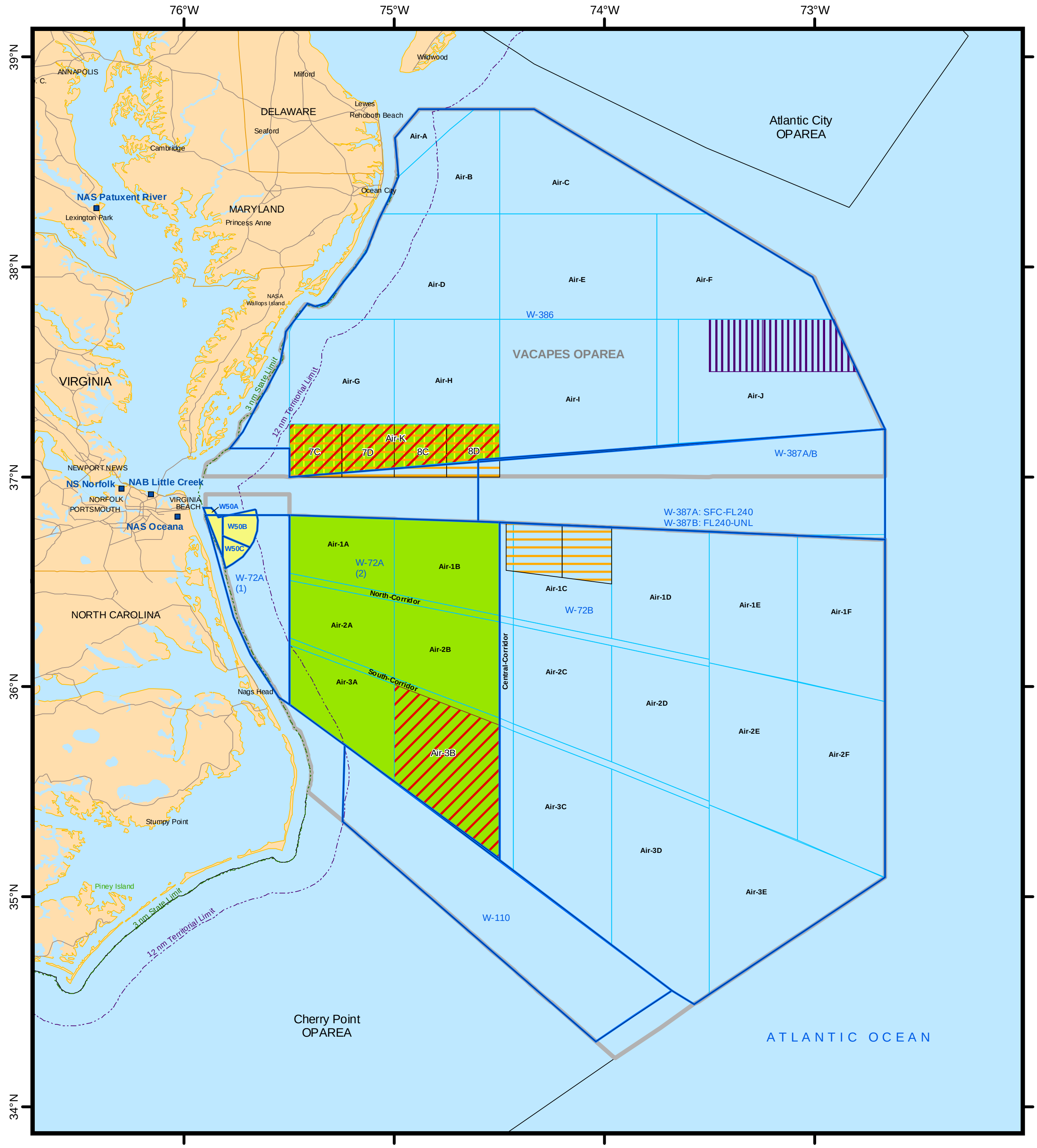
A gun blast will also transmit sound waves through the structure of the ship which can propagate into the water. The 2000 study aboard the USS Cole also examined the rate of sound pressure propagation through the hull of a ship (DoN, 2000). The structurally borne component of the sound consisted of low-level oscillations on the pressure time histories that preceded the main pulse, due to the air blast impinging on the water (DoN, 2006).

The structural component for a standard round was calculated to be 6.19 percent of the air blast (DoN, 2006). Given that this component of a gun blast was a small portion of the sound propagated into the water from a gun blast, and far less than the sound from the gun muzzle itself, the transmission of sound from a gun blast through the ship's hull would have no effect on species listed under the ESA. In accordance with NEPA there would be no significant impact to marine mammals from sound transmitted through a ship hull during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to marine mammals resulting from sound transmitted through a ship hull during training exercises in non-territorial waters.

Underwater Detonations and Explosive Ordnance Use

Overview

Explosions that occur in the OPAREA are associated with training exercises that use explosive ordnance, including bombs (BOMBEX), missiles (MISSILEX), 5-in. explosive naval gun shells with IMPASS (FIREX), as well as underwater detonations associated with Mine Neutralization training (MINEX). Explosive ordnance use is limited to specific training areas (see Table 2.2-7 for a summary of explosions by training area and Figure 3.7-6 for a summary of the areas involved). Explosive ordnance would not be used in the lower Chesapeake Bay or within 3 nm of the Atlantic Ocean shoreline under any of the alternatives. Therefore, underwater detonations and explosive ordance use would have no effect on the manatee.



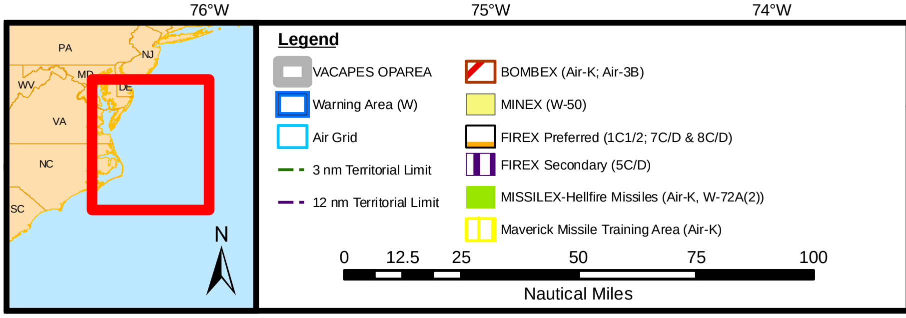


Figure 3.7-6

Underwater Explosive Ordnance Areas in the VACAPES Study Area for No Action and Alternative 1 VACAPES Range Complex

Coordinate System: GCS WGS 1984

An explosive analysis was conducted to estimate the number of marine mammals that could be exposed to impacts from explosions. Appendix J contains a technical report describing the scientific basis, methods, assumptions, and all results of the explosive analysis. Tables 3.7-14 and 3.7-15 provide summaries of the explosive analysis results for the No Action Alternative.

Effects from exposure to explosives vary depending on the level of exposure. Behavioral responses can include shorter surfacings, shorter dives, fewer blows per surfacing, longer intervals between blows (breaths), ceasing or increasing vocalizations, shortening or lengthening vocalizations, and changing frequency or intensity of vocalizations (NRC, 2005). However, it is not known how these responses relate to significant effects (*e.g.*, long-term effects or population consequences) (NRC, 2005). In addition, animals exposed to thresholds that equate to a temporary threshold shift (TTS), may experience a slight, recoverable loss of hearing sensitivity.

Exposures that result in long-term injuries such as permanent threshold shift (PTS) may limit an animal's ability to find food, communicate with other animals, and/or interpret the environment around them. Impairment of these abilities can decrease an individual's chance of survival or impact their ability to successfully reproduce. Mortality of an animal will remove the animal entirely from the population as well as eliminate any future reproductive potential.

TABLE 3.7-14
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Fin whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Humpback whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
North Atlantic right whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Sperm whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Atlantic Spotted dolphin			
BOMBEX training	10	1	0
MISSILEX Training	4	0	0
MINEX Training	0	0	0
Total Exposures	14	1	0

TABLE 3.7-14
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE (Continued)

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Beaked whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Bottlenose dolphin			
BOMBEX training	23	2	0
MISSILEX Training	6	0	0
MINEX training	0	0	0
Total Exposures	29	2	0
Clymene dolphin			
BOMBEX training	2	0	0
MISSILEX Training	1	0	0
MINEX training	0	0	0
Total Exposures	3	0	0
Common dolphin			
BOMBEX training	169	7	1
MISSILEX Training	92	2	1
MINEX training	0	0	0
Total Exposures	261	9	2
Kogia spp.			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Minke whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Pantropical spotted dolphin			
BOMBEX training	4	0	0
MISSILEX Training	3	0	0
MINEX training	0	0	0
Total Exposures	7	0	0
Pilot whales			
BOMBEX training	4	0	0
MISSILEX Training	2	0	0
MINEX training	0	0	0
Total Exposures	6	0	0
Risso's dolphin			
BOMBEX training	3	0	0
MISSILEX Training	3	0	0
MINEX training	0	0	0
Total Exposures	6	0	0

TABLE 3.7-14
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE (Continued)

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Rough-toothed dolphin			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Striped dolphin			
BOMBEX training	41	2	0
MISSILEX Training	33	1	0
MINEX training	0	0	0
Total Exposures	74	2	0

TABLE 3.7-15
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Fin whale			
BOMBEX training	44	0	0
FIREX training	0	0	0
Total Exposures	44	0	0
Humpback whale			
BOMBEX training	25	0	0
FIREX training	0	0	0
Total Exposures	25	0	0
North Atlantic right whale			
BOMBEX training	4	0	0
FIREX training	0	0	0
Total Exposures	4	0	0
Sperm whale			
BOMBEX training	98	1	0
FIREX training	2	0	0
Total Exposures	100	1	0
Atlantic Spotted dolphin			
BOMBEX training	5,303	80	0
FIREX training	30	1	0
Total Exposures	5,333	81	0
Beaked whale			
BOMBEX training	11	0	0
FIREX training	0	0	0

TABLE 3.7-15
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE (Continued)

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Total Exposures	11	0	0
Bottlenose dolphin			
BOMBEX training	11,131	166	0
FIREX training	5	0	0
Total Exposures	11,136	166	0
Clymene dolphin			
BOMBEX training	362	3	0
FIREX training	1	0	0
Total Exposures	363	3	0
Common dolphin			
BOMBEX training	36,235	373	4
FIREX training	37	1	0
Total Exposures	36,272	374	4
Kogia spp.			
BOMBEX training	34	0	0
FIREX training	0	0	0
Total Exposures	34	0	0
Minke whale			
BOMBEX training	1	0	0
FIREX training	0	0	0
Total Exposures	1	0	0
Pantropical spotted dolphin			
BOMBEX training	757	7	0
FIREX training	2	0	0
Total Exposures	759	7	0
Pilot whales			
BOMBEX training	1,776	24	0
FIREX training	7	0	0
Total Exposures	1,783	24	0
Risso's dolphin			
BOMBEX training	593	5	0
FIREX training	3	0	0
Total Exposures	596	5	0
Rough-toothed dolphin			
BOMBEX training	16	0	0
FIREX training	0	0	0
Total Exposures	16	0	0
Striped dolphin			
BOMBEX training	6,746	53	1
FIREX training	41	2	0
Total Exposures	6,787	55	1

Summary of Exposure Results for Individual Marine Mammals

Fin, humpback, North Atlantic right, sperm whales, Atlantic spotted dolphins, beaked whales, bottlenose dolphins, Clymene dolphins, common dolphins, *Kogia* spp., minke whales, pantropical spotted dolphins, pilot whales, Risso's dolphins, rough-toothed dolphins, and striped dolphins may be exposed at levels that could result in behavioral disturbance (Table 3.7-15, 177 dB column). Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphins, common dolphins, pantropical spotted dolphins, pilot whales, Risso's dolphins, and striped dolphins may be exposed at levels that could result in temporary threshold shift, or non-injurious physiological effects (Table 3.7-14, 182 dB column). Sperm whales, Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphins, common dolphins, pantropical spotted dolphins, pilot whales, Risso's dolphins, and striped dolphins may be exposed at levels that could result in permanent threshold shift, or injurious physiological effects (Tables 3.7-14 and 3.7-15, 205 dB column). Common dolphins and striped dolphins may be exposed to levels that would result in mortality (Tables 3.7-14 and 3.7-15, 30.5 psi column).

Exposure estimates could not be calculated for several species (blue whale, sei whale, Bryde's whale, killer whale, pygmy killer whale, false killer whale, melon-headed whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin, and harbor porpoise) because density data could not be calculated due to the limited available data for these species. However, the likelihood of exposure should be even lower than that estimated for other species with given densities since they are less likely to occur in the Study Area. The mitigation measures presented in Chapter 5 would further lower the likelihood of exposure. Therefore, no exposures are expected for blue whale, sei whale, Bryde's whale, killer whale, pygmy killer whale, false killer whale, melon-headed whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin, and harbor porpoise.

The mitigation measures described in Chapter 5 are designed to reduce exposure of marine mammals to potential impacts to achieve the least practicable adverse affect on marine mammal species or populations. Lookouts will monitor the area before ordnance is used. Fin, humpback whales, and sperm whales will have high detections rates at the surface because of their large body size and pronounced blows. Because of large group sizes, it is likely that lookouts would detect Atlantic spotted dolphins, bottlenose dolphins, Clymene, common, pantropical spotted dolphins, Risso's dolphins, and rough-toothed dolphins. Implementation of mitigation measures will likely reduce the potential effects to marine mammals.

Effects on Marine Mammal Populations

Effects from the use of explosive ordnance are not anticipated to have lasting impacts on any marine mammal population due to the following factors:

- Most exposures are within the non-injurious TTS or behavioral effects zones. Effects associated with these exposures are expected to be temporary.
- The exposure analysis predicts that only two species would be exposed to levels that could potentially result in mortality (six potential mortality exposures for common dolphin and one for striped dolphin). These species are among the most abundant marine mammals in the Study Area and the small number of potential mortality exposures would be negligible from a population standpoint.
- Although the numbers presented in Tables 3.7-14 and 3.7-15 represent estimated harassment and injury, as described above, they are probably over estimates as the model calculates harassment without taking into consideration standard mitigation measures.

Endangered Species Act Conclusions

Underwater detonations and explosive ordnance in No Action Alternative may affect fin, North Atlantic right whales, sei, blue, humpback, and sperm whales. Underwater detonations and explosive ordnance use in the No Action Alternative may affect fin, North Atlantic right, sei, blue, humpback, and sperm whales. However, the effects on blue and sei whales are most likely discountable based on the low likelihood of encountering these species in the Study Area. Underwater detonations and explosive ordnance use would have no effect on the manatee because these exercises take place greater than 3 nm offshore where manatees are not expected to occur.

Marine Mammal Protection Act Conclusions

Fin whales, humpback whales, North Atlantic right whales, sperm whales, Atlantic spotted dolphins, beaked whales, bottlenose dolphins, Clymene dolphins, common dolphins, *Kogia* spp., minke whales, pantropical spotted dolphins, pilot whales, Risso's dolphins, rough-toothed dolphins and striped dolphins may be exposed at levels that would constitute Level B harassment under the MMPA. Sperm whales, Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphin, common dolphin, pantropical spotted dolphins, pilot whales, Risso's dolphins, and striped dolphins may be exposed at levels that would constitute Level A harassment under the MMPA. Common and striped dolphins may be exposed to levels that would result in mortality.

National Environmental Policy Act and Executive Order 12114 Conclusions

The analysis presented above indicates that underwater detonations and explosive ordnance use under the No Action Alternative would affect individual marine mammals, but any effects observed at the population, stock, or species level would be negligible. Therefore, in accordance with NEPA, there would be no significant impact to marine mammal populations from explosive ordnance use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to marine mammal populations resulting from explosive ordnance use during training exercises in non-territorial waters.

Military Expended Materials

Ordnance Related Materials

Ordnance related materials include various sizes of non-explosive practice munitions and shrapnel from explosive rounds (Tables 2.2-5 and 2.2-6). These solid metal materials would quickly move through the water column and settle to the sea floor. The analyses presented in Sections 3.2.3 and 3.3.3 indicate that these materials would become encrusted by natural processes and incorporated into the seafloor, with no significant accumulations in any particular area and no negative effects to water quality. However, benthic foraging marine mammals could be exposed to expended ordnance through ingestion. Ingestion of expended ordnance is not expected to occur in the water column because ordnance quickly sinks. Some materials such as an intact non-explosive training bomb would be too large to be ingested by a marine mammal, but many materials such as cannon shells, small caliber ammunition, and shrapnel are small enough to be ingested. Records indicate that generally metal debris ingested by marine mammals are small (*e.g.*, fishhooks, bottle caps, metal spring; (Walker and Coe, 1990; Laist, 1997). The effects of ingesting solid metal objects on marine mammals are unknown. A documented instance indicates that certain types of metal debris, in this case a lead sinker, may cause toxicosis in marine mammals (Zabka *et al*., 2006). Ordnance materials, made of different alloys than a sinker, would not necessarily cause a similar physiological reaction. Extensive literature searches reveal no studies related to potential toxic effects of ingestion of types of ordnance used in these exercises by marine mammals.Another instance of lead toxicosis was documented in a captive bottlenose dolphin that had ingested 55 air gun pellets (which contain 40% lead) resulting in mortality (Schlosberg et al. 1997). Expended ordnance which contains lead may have the potential to induce toxicosis in marine mammals in some circumstances. Ingestion of marine debris in general can also cause digestive tract blockages or damage the digestive system (Gorzelany, 1998; Stamper *et al.*, 2006). Relatively small objects with smooth edges such a cannon shell or small caliber ammunition might pass through the digestive tract without causing harm, while a piece of metal shrapnel with sharp edges would be more likely to cause damage.

The potential for ordnance ingestion depends on species-specific feeding habitats. Manatees would not ingest ordnance because they feed on seagrass beds along the coast where ordnance is not used. Blue, fin, North Atlantic right, and sei whales feed at the surface or in the water column and would not ingest ordnance from the bottom. While humpback whales feed predominantly by lunging through the water after krill and fish, there have been instances of humpback whales disturbing the bottom in an attempt to flush prey, the northern sand lance (*Ammodytes dubius*) (Hain *et al.*, 1995). This behavior has been observed on Stellwagen Bank off eastern Massachusetts. Although observations of humpback whales feeding in mid-Atlantic waters (Swingle *et al.*, 1993; Smith *et al.*, 1996) have led to the supposition that a supplemental winter feeding ground may exist in the U.S. mid-Atlantic (Barco *et al.*, 2002), humpback whale feeding primarily takes place farther north than the OPAREA (CETAP, 1982; Whitehead, 1982; Kenney and Winn, 1986; Weinrich *et al.*, 1997). Humpback whales are not expected to ingest ordnance because feeding in the OPAREA would be limited and they primarily feed in the water column. Ordnance ingestion under the No Action Alternative would have no effect on the manatee, blue whale, fin whale, humpback whale, North Atlantic right whale, or sei whale.

Although sperm whales feed predominantly on cephalopods, they also frequently feed on or near the bottom (Whitehead *et al.*, 1992). In doing so, animals will ingest non-food items such as rocks and sand (NMFS, 2006d). Sperm whales are known to incidentally ingest foreign objects while foraging (Walker and Coe, 1990), suggesting that the potential exists to ingest debris that has settled on the ocean floor as a result of the proposed activities. However, about 79 percent of all ordnance (based on number of rounds) would be expended west of the continental shelf break under the No Action Alternative. Sperm whales display a strong offshore preference (Rice, 1989) and are mostly associated with waters over the continental shelf edge, continental slope, and offshore waters (CETAP 1982; Hain *et al.,* 1985; Smith *et al.*, 1996; Waring *et al.*, 2001; Davis *et al.,* 2002). Consequently, the likelihood that a sperm whale would encounter and subsequently ingest a piece of expended ordnance is extremely low. Ordnance ingestion under the No Action Alternative may affect sperm whales, but the effects would be considered discountable because ingestion is extremely unlikely to occur.

Most non-listed marine mammal species feed at the surface or in the water column and would have a little chance of encountering expended ordnance on the bottom. Baleen and toothed whales and harbor seals, which feed at the surface or in the water column, would not be expected to ingest ordnance from the bottom. Beaked whales have exhibited bottom feeding behavior using suction feeding techniques (MacLeod *et al*., 2003) and are known to incidentally ingest foreign objects while foraging (Walker and Coe, 1990). Although the potential exists for ingestion of expended ordnance, the amount of ordnance that an animal would encounter is low. In addition, an animal would not likely ingest every piece of ordnance that it encounters. Thus, it is unlikely that an animal would both encounter and ingest ordnance. Ordnance related materials are not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, ordnance related materials would have no significant impact on marine mammals in territorial waters. Furthermore, ordnance related materials would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Target Related Materials

A variety of at-sea targets are used in the OPAREA, ranging from high-tech remotely operated airborne and surface targets (*e.g.*, airborne drones and Seaborne Powered Targets) to low-tech floating at-sea targets (*e.g.*, inflatable targets, 55-gallon metal drums) and towed banners. Many of the targets are designed to be recovered for reuse and are not destroyed during training because ordnance is set to detonate before impacting the target. The only expendable airborne targets used in the OPAREA are Tactical Air-Launched Decoys, which are non-powered, constructed of extruded aluminum, weigh about 400 pounds, and are about 7 feet long. Expendable targets such as floating at-sea inflatable targets are recovered after use and properly disposed of onshore. Some targets such as 55-gallon metal drums cannot be recovered and sink to the sea floor after use. Unrecoverable floating materials generated by target use are expected to be minimal. Descriptions of the targets used in the OPAREA and information on fate and transport are provided in Section 3.2.

As discussed above for ordnance related materials, species that feed on or near the bottom (*i.e.*, sperm whales and beaked whales) may encounter an expended target while feeding; however, the size of the target would prohibit any listed species from ingesting it. Therefore, the use of targets under the No Action Alternative would have no effect on listed marine mammals. Targets are not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, targets would have no significant impact on marine mammals in territorial waters. Furthermore, targets would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Chaff Fibers, End-caps, and Pistons

Radiofrequency chaff (chaff) is an electronic countermeasure designed to reflect radar waves and obscure aircraft, ships, and other equipment from radar tracking sources. Chaff is composed of an aluminum alloy coating on glass fibers of silicon dioxide. The coating is about 99.4 percent aluminum by weight and contains negligible amounts of silicon, iron, copper, manganese, magnesium, zinc, vanadium, and titanium (USAF, 1997). These aluminum-coated glass fibers (about 60% silica and 40% aluminum by weight) range in lengths of 0.8 to 7.5-cm with a diameter of about 40 micrometers. Chaff is released or dispensed from military vehicles in cartridges or projectiles that contain millions of chaff fibers. When deployed, a diffuse cloud of fibers is formed that is undetectable to the human eye. Chaff is a very light material that can remain suspended in air anywhere from 10 minutes to 10 hours and can travel considerable distances from its release point, depending on prevailing atmospheric conditions (USAF, 1997; Arfsten *et al.*, 2002). Doppler radar has tracked chaff plumes containing approximately 900 grams of chaff drifting 200 miles from the point of release with the plume covering a volume of greater than 400 cubic miles (Arfsten *et al.*, 2002).

Various types of chaff systems are used in the OPAREA. Fixed-wing aircraft use RR-144A/AL chaff cartridges, which contain about 150 grams of chaff or about five million fibers. For each cartridge used, a plastic end-cap and Plexiglas piston is released into the environment in addition to the chaff fibers. The end-cap and piston are both round and are 1.3 inches in diameter and 0.13 inches thick (Spargo, 2007). As summarized in Table 3.7-16, a total of 18,000 RR-144A/AL cartridges would be used per year in W-72 and W-386 under the No Action Alternative. The amount of chaff used on any given day varies based on scheduled training events and could range from 0 to 360 cartridges per day.

Ships use MK-214 or MK-216 Super Rapid Off-board Chaff. The MK-214 contains about 11 kg of chaff or more than 360 million fibers, while the MK-216 contains about 7.6 kg of chaff or more than 250 million fibers. As summarized in Table 3.7-14, a total of 198 MK-214 and MK-216 cartridges would be used per year in W-72 and W-386.

Based on the dispersion characteristics of chaff, large areas of open water within the OPAREA would be exposed to chaff, but the chaff concentrations would be low. For example, Hullar *et al.* (1999) calculated that a 4.97 miles by 7.46 miles (37.1 mi^2 or 28 nm^2) area would be affected by deployment of a single cartridge containing 150 grams of chaff. The resulting chaff concentration would be about 5.4 g/nm^2.

This corresponds to less than 179,000 fibers/nm^2 or less than 0.005 fibers/ft^2, assuming that each canister contains five million fibers.

TABLE 3.7-16
CHAFF USE (PER YEAR) AND RELATIVE ENVIRONMENTAL CONCENTRATIONS PER ALTERNATIVE THAT COULD OCCUR UNDER THE PROPOSED ACTION

Annual Chaff Use and Relative Concentration[1]	No Action	Alternative 1	Alternative 2
W-72 - RR-144A/AL Cartridges			
Number of Cartridges	15,063	16,596	16,596
Chaff Released (kg/year)	2,259	2,489	2,489
Relative Chaff Concentration (kg/nm^2/year)	0.152	0.168	0.168
Relative Chaff Concentration (fibers/nm^2/year)[1]	5,075,477	5,592,021	5,592,021
Number of End-caps and Pistons	30,126	33,192	33,192
Relative End-cap/Piston Concentration (pieces/nm^2/year)[1]	2.0	2.2	2.2
W-386 - RR-144A/AL Cartridges			
Number of Cartridges	2,937	3,554	3,554
Chaff Released (kg/year)	441	533	533
Relative Chaff Concentration (kg/nm^2/year)	0.046	0.055	0.055
Relative Chaff Concentration (fibers/nm^2/year)[1]	1,519,400	1,838,593	1,838,593
Number of End-caps and Pistons	5,874	7,108	7,108
Relative End-cap/Piston Concentration (pieces/nm^2/year)[1]	0.6	0.7	0.7
Total RR-144A/AL Cartridges			
Number of Cartridges	18,000	20,150	20,150
Chaff Released (kg/year)	2,700	3,023	3,023
Number of End-caps and Pistons	36,000	40,300	40,300
W-72 – MK-214 and MK-216 Cartridges			
Number of Cartridges	29	33	33
Chaff Released (kg/year)	295	336	336
Relative Chaff Concentration (kg/nm^2/year)[1]	0.022	0.025	0.025
Relative Chaff Concentration (fibers/nm^2/year)[1]	727,092	827,433	827,433
W-386 – MK-214 and MK-216 Cartridges			
Number of Cartridges	169	189	189
Chaff Released (kg/year)	1,720	1,923	1,923
Relative Chaff Concentration (kg/nm^2/year)[1]	0.178	0.199	0.199
Relative Chaff Concentration (fibers/nm^2/year)[1]	5,930,678	6,630,798	6,630,798
Total MK-214 and MK-216 Cartridges			
Number of Cartridges	198	222	222
Chaff Released (kg/year)	2,015	2,259	2,259

[1] Concentration based on even dispersion in W-72 (14,839 nm^2) and W-386 (9,665 nm^2).

The chaff concentrations that marine life could be exposed to following release of multiple cartridges (*e.g.*, following a single day of training) is difficult to accurately estimate because it depends on several unknown factors. First of all, specific release points are not recorded and tend to be random, and chaff dispersion in air depends on prevailing atmospheric conditions. After falling from the air, chaff fibers would be expected to float on the sea surface for some period of time depending on wave and wind action. The fibers would be dispersed further by sea currents as they float and slowly sink toward the bottom. Chaff concentrations in benthic habitats following release of a single cartridge would be lower than the values noted above based on dispersion by currents and the enormous dilution capacity of the receiving waters. Some fibers may become entrained in *Sargassum* mats and remain at or near the surface for longer periods of time. Consequently, chaff concentrations in *Sargassum* mats might be higher than those in the water column or on the bottom.

Table 3.7-16 summarizes changes in chaff use and relative environmental concentrations that could occur under the proposed action. Note that the relative environmental concentrations presented in Table 3.7-16 are based on the assumption that the chaff would be evenly distributed in the area where it is used, and are primarily presented for comparison purposes. Actual concentrations would depend on the factors discussed above and would be dynamic. Nonetheless, actual chaff concentrations are expected to be low. For example, a chaff concentration of 1.8 fibers/ft^2 would be expected given a totally unrealistic (worst-case) assumption of simultaneous release of 360 RR-144A/AL chaff cartridges at a single release point.

Several literature reviews and controlled experiments have indicated that chaff poses little environment risk except at concentrations substantially higher than those that could reasonably occur from military training use (Arfsten *et al.*, 2002, Hullar *et al.*, 1999, and USAF, 1997). Nonetheless, some marine mammal species within the OPAREA could be exposed to chaff through direct body contact, inhalation, and ingestion. As discussed in more detail below, chemical alteration of water and sediment resulting from decomposition of chaff fibers is not expected to result in exposure. Manatees would not be exposed to measurable concentrations of chaff because chaff use is limited to the OPAREA and manatees are only expected to occur in shallow, nearshore waters of the lower Chesapeake Bay. Therefore, chaff is not considered a potential stressor to manatees and chaff use under the No Action Alternative would have no effect on manatees.

Based on the dispersion characteristics of chaff it is likely that marine mammals would occasionally come in direct contact with chaff fibers while at the water's surface and while submerged, but such contact would be inconsequential. Chaff is similar in form to fine human hair (USAF, 1997). Due to its flexible nature and softness, external contact with chaff would not be expected to adversely affect most wildlife (USAF, 1997) and the fibers would quickly wash off shortly after contact. Given the properties of chaff, skin irritation is not expected to be a problem (USAF, 1997).

The potential exits for marine mammals to inhale chaff fibers if they are at the surface while chaff is airborne. Arfsten *et al.* (2002), Hullar *et al.* (1999), and USAF (1997) reviewed the potential effects of chaff inhalation on humans, livestock, and animals and concluded that the fibers are too large to be inhaled into the lung. If inhaled, the fibers are predicted to be deposited in the nose, mouth, or trachea and are either swallowed or expelled. However, these reviews did not specifically consider marine mammals. It is possible that marine mammals, particularly large whales, could inhale chaff fibers into the lung based on their size and respiratory system characteristics. In terrestrial environments chaff fibers could break into smaller particles by various physical processes. If resuspended, the small particles could be available for inhalation (USAF, 1997). However, this is not a concern in the marine environment because chaff fibers would not break up on the water's surface or be resuspended. Any effects of chaff inhalation on marine mammals are considered insignificant given, the low concentration of airborne fibers (1.8 fibers/ft^2 for a worst-case scenario of 360 chaff cartridges simultaneously released at a single drop point), and the fact that marine mammals spend significant time submerged.

Based on the small size of chaff fibers, it appears unlikely that marine mammals would confuse the fibers with prey items or purposefully feed on chaff fibers. However, marine mammals could occasionally ingest low concentrations of chaff incidentally from the surface, water column, or sea floor. While no studies have been conducted to evaluate the effects of chaff ingestion on marine mammals, the effects are expected to be negligible based the low concentrations that could reasonably be ingested, the small size of chaff fibers, and available data on the toxicity of chaff and aluminum. In laboratory studies conducted by the University of Delaware (Systems Consultants, 1977), blue crabs and killifish were fed a food-chaff mixture daily for several weeks and no significant mortality was observed at the highest exposure treatment (1,000 times the exposure level expected to be found in Chesapeake Bay). Similar results were found when chaff was added directly to exposure chambers containing filter-feeding menhaden. Histological examination indicated no damage by chaff exposures. A study on calves (cattle) that were fed chaff found no evidence of digestive disturbance or other clinical symptoms (USAF, 1997).

Silicon dioxide, also known as silica, is an abundant compound in nature that is prevalent in soil, rocks, and sand (USAF, 1997). Silicon is the second most abundant element in the earth's crust, making up approximately 28.2 percent by weight (Jefferson Lab, 2007). As such, the diet of benthic foraging marine animals that routinely ingest sediment while feeding likely contains relatively high concentrations of silicon dioxide. Silicon dioxide is chemically unreactive in the environment (USEPA, 1991) and the acute and chronic oral toxicity of silicon dioxide is low. No significant toxicity or mortality has been reported in animals given doses of up to 3,000 mg/kg of body weight per day (EVM, 2003). No observed adverse effect levels of 2,500 and 7,500 mg/kg of body weight per day were obtained for mice and rats, respectively in long-term studies (up to 24 months) (Takizawa *et al*., 1988).

Aluminum is the third most abundant element in the earth's crust, making up approximately 8.2 percent by weight (Jefferson Lab, 2007). Similar to silicon dioxide, the diet of benthic foraging marine animals that routinely ingest sediment while feeding likely contains relatively high concentrations of aluminum. Aluminum toxicosis in domestic animals is largely expressed as secondary phosphorus deficiency, presumably because it binds phosphorus in an unabsorbable complex in the intestine (NRC, 1980). Signs of phosphorus deficiency have been observed in sheep, chicks, rats, and mice receiving high levels of dietary aluminum (as summarized in NRC, 1980).

Scheuhammer (1987) reviewed the metabolism and toxicology of aluminum in birds and terrestrial mammals. Intestinal absorption of orally ingested aluminum salts was very poor, and the small amount absorbed was almost completely removed from the body by excretion in urine. Rates and mice presented with a moderately high dietary aluminum content (160 to 335 mg/kg) excreted most of it in the feces (NRC, 1980). However, aluminum can be deposited in the liver, skeleton, brain, and other tissues, and the amount of aluminum retained is positively related to the amount consumed (NRC, 1980). High concentrations of aluminum have been found in the stomach content, liver, and brain of stranded gray whales (Varanasi *et al.*, 1993) and in the stomach content of subsistence harvested (presumably healthy) gray whales (Tilbury, 2002), which appears to be consistent with the ingestion of sediments by this benthic foraging species. The aluminum concentrations in brain tissue of gray whales are within the range for some terrestrial mammals that may receive high concentrations of aluminum in their diets, suggesting a broad range in tolerance to aluminum in mammals (Varanasi *et al.*, 1993).

Dietary aluminum normally has small effects on healthy birds and terrestrial mammals, and often high concentrations (>1,000 mg/kg) are needed to induce effects such as impaired bone development, reduced growth, and anemia (Nybo, 1996). Studies suggest that the maximum tolerable level of aluminum for cattle and sheep is about 1,000 mg/kg (of body weight) (NRC, 1980). A marine animal weighing 1 kg would need to ingest more than 83,000 chaff fibers per day to receive a daily aluminum dose equal to 1,000 mg/kg (based on chaff consisting of 40 percent aluminum by weight and a 150-g chaff canister containing 5 million fibers). An adult male sperm whale weighing 40,800 kg would need to ingest more than 3 billion chaff fibers per day to receive a daily aluminum dose equal to 1,000 mg/kg. It is highly unlikely that a marine mammal would ingest a toxic dose of chaff based on the anticipated environmental concentration of chaff (1.8 fibers/ft^2 for a worst-case scenario of 360 chaff cartridges simultaneously released at a single drop point).

Marine mammals would not be indirectly affected by changes in water quality resulting from the degradation of chaff in water. Any changes in water quality from chaff use would be negligible based on the low concentration of chaff, the slow rate at which it degrades in saltwater (USAF, 1997), and the enormous dilution capacity of the receiving waters of the OPAREA. In addition, available data indicate that chaff is relatively non-toxic in marine environments. Laboratory toxicity tests conducted using two marine indicator organisms (mysid shrimp and sheepshead minnow) indicated that chaff is not acutely toxic at concentrations greater than 1,000 mg/L (Haley and Kurnas, 1992). The bioavailability and toxicity of aluminum is relatively low in marine environments compared to freshwater environments because of the high pH levels and high calcium and sodium concentrations in saltwater (Lydersen and Lofgren, 2002). The U.S. Environmental Protection Agency has not designated aluminum as a priority pollutant and has not established ambient water quality criteria for aluminum in saltwater (USEPA, 2007). A review of numerous toxicological studies indicated that the principal components of chaff are unlikely to have significant effects on humans and the environment based on the general toxicity of the components, the dispersion patterns, and the unlikelihood of the components to interact with other substances in nature to produce synergistic toxic effects (USAF, 1997). In addition, available evidence suggests that chaff use does not result in significant accumulation of aluminum in sediments after prolonged training. Sediment samples collected from an area of the Chesapeake Bay where chaff had been used for approximately 25 years indicated that aluminum concentrations in sediments were not significantly different than background concentrations (Wilson *et al.*, 2002).

Chaff cartridge plastic end-caps and pistons would also be released into the marine environment, where they would persist for long periods and could be ingested by marine mammals. Chaff end-caps and pistons sink in saltwater (Spargo, 2007), which reduces the likelihood of ingestion by marine mammals at the surface or in the water column. As discussed above for ordnance related materials, the sperm whale is the only listed marine mammal species that is expected to routinely forage on or near the bottom. Sperm whales have been known to ingest anthropogenic debris similar to the end-caps and pistons during the course of feeding (Walker and Coe, 1990; Laist, 1997); however, this does not always result in negative consequences to health or vitality (Walker and Coe, 1990). Walker and Coe (1990) theorized that for larger animals, such as beaked whales, it would take a high volume of foreign debris to result in death or debilitation resulting from impaction. This can be extrapolated to sperm whales as well.

Based on the small size of chaff end-caps and pistons (1.3 inch diameter, 0.13 inch thick), it appears unlikely that sperm whales would confuse them with prey items or purposefully feed on them. The likelihood of a sperm whale ingesting an end-cap or piston appears to be extremely low based on the number of pieces released per year (36,000), the low environmental concentration (0.6 to 2.0 pieces/nm^2/year, see Table 3.7-16), and the fact that sperm whale foraging is expected to be limited to areas east of the continental shelf break. If ingested, it is likely that the small (1.3 inch diameter, 0.13 inch thick), round end-cap or piston would be excreted without causing harm. Sperm whales primarily feed on squid and their digestive systems are capable of excreting indigestible squid beaks. However, ingestion of foreign materials has been noted to result in negative consequences to marine mammals, including mortality, due to disruption of the digestive tract and/or intestinal blockage (Stamper et.al. 2006; Gorzelany 1998). Documented instances of this are rare, particularly for smaller items (Laist 1997; Walker and Coe 1990). Although instances of impacts from ingestion of debris have been recorded, the low concentration and minimal likelihood that a sperm whale would ingest an end-cap or piston make the potential effects discountable.

Chaff use under the proposed action may affect blue, fin, humpback, North Atlantic right, sei, and sperm whales. Chaff is not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, chaff would have no significant impact on marine mammals in territorial waters.

Furthermore, chaff would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Self-Protection Flares

Self-protection flares consist of a magnesium/Teflon formulation that, when ignited and released from an aircraft, burn for a short period of time (less than 10 seconds) at very high temperatures. Flares release heat and light to disrupt tracking of Navy aircraft by enemy infrared tracking devices or weapons. Flares are designed to burn completely. Under normal operations, the only material that would enter the water would be a small, round plastic end-cap (approximately 1.4 inch diameter). About 465 self-protection flares would be used in the OPAREA (W-72 and W-386) per year under the No Action Alternative.

An extensive literature review and controlled experiments conducted by the U.S. Air Force revealed that self-protection flare use poses little risk to the environment or animals (USAF, 1997). Nonetheless, marine mammals within the OPAREA could be exposed to light generated by the flares and flare plastic end-caps. The light generated by flares would have no effect on marine mammals based on short burn time, relatively high altitudes where they are used, and the wide-spread and infrequent use. Flare end-caps have similar properties as chaff end-caps and pistons, therefore, the analysis of potential impacts from chaff end-caps and pistons is applicable to flare end-caps as well. Although instances of impacts from ingestion of debris have been recorded, the low concentration and minimal likelihood that a sperm whale would ingest an end-cap or piston make the potential effects discountable. Ingestion of flare end-caps under the No Action Alternative may affect the sperm whale, but the effects would be considered discountable because ingestion is extremely unlikely to occur. Self-protection flares are not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, flares would have no significant impact on marine mammals in territorial waters. Furthermore, flares would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Marine Markers

The MK-25 and MK-58 marine markers produce chemical flames and regions of surface smoke and are used in various training exercises to mark a surface position to simulate divers, ships, and points of contact on the surface of the ocean. When the accompanying cartridge is broken, an area of smoke is released. The smoke dissipates in the air having little effect on the marine environment. The marker burns similar to a flare, producing a flame until all burn components have been used. While the light generated from the marker is bright enough to be seen up to three miles away in ideal conditions, the resulting light would either be reflected off the water's surface or would enter the water and attenuate in brightness over depth. The point source of the light would be focused and be less intense than if an animal were to look to the surface and encounter the direct path of the sun. The MK-25 is composed of aluminum and contains either one or two seawater-activated batteries (depending on the model) and a red phosphorus pyrotechnic composition. The MK-25 marine marker is 18.5 inches long and 2.9 inches in diameter. It produces yellow flame and white smoke for 10 to 20 minutes (The Ordnance Shop, 2007). The MK-58 is composed of tin and contains two red phosphorus pyrotechnic candles and a seawater-activated battery. The MK-58 marine marker is 21.78 inches long and 5.03 inches in diameter, weighs 12.8 pounds, and produces a yellow flame and white smoke for a minimum of 40 minutes and a maximum of 60 minutes (The Ordnance Shop, 2007). The markers themselves are not designed to be recovered and would eventually sink to the bottom and become encrusted and/or incorporated into the sediments. Approximately 300 marine markers would be used in the Study Area per year under the No Action Alternative.

It is unlikely that marine mammals would be exposed to any chemicals that produce either flames or smoke since these components are consumed in their entirety during the burning process. Animals are unlikely to approach and/or get close enough to the flame to be exposed to any chemical components.

Expended marine markers are a potential ingestion hazard for marine mammals while they are floating or after they sink to the bottom. However, the probability of ingestion is extremely low based on the low number of marine markers expended per year (300) and the low concentration (0.01/nm^2/year). Marine marker ingestion under the No Action Alternative may affect ESA-listed marine mammals, but the effects would be considered discountable because ingestion is extremely unlikely to occur. The use of marine markers is not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, there would be no significant impact to marine mammals from marine marker use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to marine mammals resulting from use of marine markers during training exercises in non-territorial waters.

3.7.3.4 Alternative 1

Vessel Movements

The number of operations involving vessel movements would increase by about 1.4 percent per year in the VACAPES Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased potential for short-term behavioral reactions to vessels. Potential for collision would increase slightly compared to the No Action Alternative; however, Navy mitigation measures (see Chapter 5) would reduce the probability. Vessel movements under Alternative 1 may affect ESA-listed marine mammals and would have no affect on manatees. Vessel movements are not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, vessel movements would have no significant impact on marine mammals in territorial waters. Furthermore, vessel movements would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Aircraft Overflights

Alternative 1 would include a 10 percent increase in fixed-wing aircraft sorties per year and an 88 percent increase in helicopter sorties per year in the VACAPES Study Area (Table 2.2-5). A majority of the new helicopter sorties would occur over the lower Chesapeake Bay. As a result, the potential for marine mammals to be exposed to overflights would increase compared to baseline conditions, particularly in the lower Chesapeake Bay. The magnitude of individual exposures would not increase because Alternative 1 does not include use of new aircraft that are louder than current equipment. Peak noise levels generated by the new MH-60R and MH-60S Multi-Mission Combat Support Helicopters would be similar to or less than the noise levels generated by the helicopters that they would replace.

The additional overflights may result in increased instances of behavioral disturbance due to sound, shadow-effects, and/or, in the case of helicopters, water column disturbance. Similar to the No Action Alternative, the responses would be limited to short-term behavioral or physiological reactions. Aircraft overflights under Alternative 1 may affect ESA-listed marine mammals. Aircraft overflights are not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, aircraft overflights would have no significant impact on marine mammals in territorial waters. Furthermore, aircraft overflights would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Towed MIW Devices

Towed MIW device sorties would increase by 75 percent per year under Alternative 1. Similar to the No Action Alternative, use of towed MIW devices under Alternative 1 would have no effect on the blue whale, sei whale, sperm whale, and manatee because use would take place where these species are not expected to occur. Fin, humpback, and North Atlantic right whales may occur in areas where towed MIW devices would be used. While the potential exists for marine mammals to be struck by a towed MIW device, there are no documented instances of this occurring in the Study Area. Helicopter crew members monitor the water's surface during training to identify and avoid any objects that might damage the equipment. Based on the low flight altitudes and relatively slow air speeds, it is likely that crew members would be able see marine mammals at or near the surface and avoid them. Marine mammals at or near the surface would likely see or hear the oncoming helicopter or feel the downdraft, which could initiate avoidance behavior. The water column disturbance and sound created by the towed MIW device would likely elicit short-term behavioral responses similar to those discussed for vessel movements and aircraft overflights. The use of towed MIW devices under Alternative 1 may affect fin, humpback, North Atlantic right whales, but the potential effects of collisions would be discountable because they are extremely unlikely to occur and the effects of disturbance would be insignificant. Towed MIW devices are not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, towed MIW devices would have no significant impact on marine mammals in territorial waters. Furthermore, towed MIW devices would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

<u>Weapons Firing/Non-explosive Practice Munitions Use</u>

Non-explosive Practice Munitions Strikes

The amount of ordnance fired would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5 and 2.2-6) approximately 28 percent. These changes would result in increased potential exposure for marine mammal ordnance strikes compared to baseline conditions. However, ordnance strike modeling predicts that no marine mammals would be exposed to direct ordnance strikes under Alternative 1 (see Appendix I). Additionally, Navy mitigation measures further reduce the probability of ordnance-related exposure. There would be no effects from the use of non-explosive practice munitions on marine mammals under Alternative 1. Non-explosive practice munitions use is not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, non-explosive would have no significant impact on marine mammals in territorial waters. Furthermore, non-explosive practice munitions would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Weapons Firing Disturbance

The number of weapons firings in the VACAPES Study Area would increase under Alternative 1. Based on the discussion under the No Action Alternative above, the sound from firing of weapons would not result in an exposure of marine mammals; therefore, any weapon firings under Alternative 1 would have no effect to ESA-listed marine mammals. Weapons firing sound disturbance is not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, weapons firing sound disturbance would have no significant impact on marine mammals in territorial waters. Furthermore, weapons firing sound disturbance would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

<u>Underwater Detonations and Explosive Ordnance</u>

Overview

The number and location of explosions occurring in the Study Area would not change under Alternative 1, with the exception of Hellfire missiles, 5 lb and 20 lb net explosive weight underwater detonation charges (Table 2.2-7 and Figure 3.7-6). Under Alternative 1 30 additional Hellfire missile explosions would occur in the OPAREA, 30 additional 5 lb underwater detonation charges would occur in W-50, and 12 additional 20 lb underwater detonation charges would occur in W-50.

An explosive analysis was conducted to estimate the number of marine mammals that could be exposed to impacts from explosions. Appendix J contains a technical report describing the scientific basis, methods and assumptions of the explosive analysis. Tables 3.7-17 and 3.7-18 provide summaries of the explosive analysis for Alternative 1. As discussed for the No Action Alternative, effects from exposure to explosives vary depending on the level of exposure.

TABLE 3.7-17
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 1

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Fin whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Humpback whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
North Atlantic right whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Sperm whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Atlantic Spotted dolphin			
BOMBEX training	10	1	0
MISSILEX Training	6	0	0
MINEX training	0	0	0
Total Exposures	16	1	0
Beaked whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Bottlenose dolphin			
BOMBEX training	23	2	0
MISSILEX Training	9	0	0
MINEX training	0	0	0
Total Exposures	32	2	0
Clymene dolphin			
BOMBEX training	2	0	0
MISSILEX Training	1	0	0

TABLE 3.7-17
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 1 (Continued)

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
MINEX training	0	0	0
Total Exposures	3	0	0
Common dolphin			
BOMBEX training	169	7	1
MISSILEX Training	104	3	1
MINEX training	0	0	0
Total Exposures	273	10	2
Kogia spp.			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Minke whale			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Pantropical spotted dolphin			
BOMBEX training	4	0	0
MISSILEX Training	3	0	0
MINEX training	1	0	0
Total Exposures	8	0	0
Pilot whales			
BOMBEX training	4	0	0
MISSILEX Training	3	0	0
MINEX training	0	0	0
Total Exposures	7	0	0
Risso’s dolphin			
BOMBEX training	3	0	0
MISSILEX Training	3	0	0
MINEX training	0	0	0
Total Exposures	6	0	0
Rough-toothed dolphin			
BOMBEX training	0	0	0
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Striped dolphin			
BOMBEX training	41	2	0
MISSILEX Training	36	1	0
MINEX training	0	0	0
Total Exposures	77	3	0

TABLE 3.7-18
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 1

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Fin whale			
BOMBEX training	44	0	0
FIREX training	0	0	0
Total Exposures	44	0	0
Humpback whale			
BOMBEX training	25	0	0
FIREX training	0	0	0
Total Exposures	25	0	0
North Atlantic right whale			
BOMBEX training	4	0	0
FIREX training	0	0	0
Total Exposures	4	0	0
Sperm whale			
BOMBEX training	98	1	0
FIREX training	2	0	0
Total Exposures	100	1	0
Atlantic Spotted dolphin			
BOMBEX training	5,303	80	0
FIREX training	30	1	0
Total Exposures	5,333	81	0
Beaked whale			
BOMBEX training	11	0	0
FIREX training	0	0	0
Total Exposures	11	0	0
Bottlenose dolphin			
BOMBEX training	11,131	166	0
FIREX training	5	0	0
Total Exposures	11,136	166	0
Clymene dolphin			
BOMBEX training	362	3	0
FIREX training	1	0	0
Total Exposures	363	3	0
Common dolphin			
BOMBEX training	36,235	373	4
FIREX training	37	1	0
Total Exposures	36,272	374	4
Kogia spp.			
BOMBEX training	34	0	0
FIREX training	0	0	0
Total Exposures	34	0	0

TABLE 3.7-18
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 1 (Continued)

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Minke whale			
BOMBEX training	1	0	0
FIREX training	0	0	0
Total Exposures	1	0	0
Pantropical spotted dolphin			
BOMBEX training	757	7	0
FIREX training	2	0	0
Total Exposures	759	7	0
Pilot whales			
BOMBEX training	1,776	24	0
FIREX training	7	0	0
Total Exposures	1,783	24	0
Risso's dolphin			
BOMBEX training	593	5	0
FIREX training	3	0	0
Total Exposures	596	5	0
Rough-toothed dolphin			
BOMBEX training	16	0	0
FIREX training	0	0	0
Total Exposures	16	0	0
Striped dolphin			
BOMBEX training	6,746	53	1
FIREX training	41	2	0
Total Exposures	6,787	55	1

Summary of Exposure Results for Individual Marine Mammals

Fin, humpback, North Atlantic right, sperm whales, Atlantic spotted dolphins, beaked whales, bottlenose dolphins, Clymene dolphins, common dolphins, *Kogia* spp., minke whales, pantropical spotted dolphins, pilot whales, Risso's dolphins, rough-toothed dolphins, and striped dolphins may be exposed at levels that could result in behavioral disturbance (Table 3.7-18, 177 dB column). Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphins, common dolphins, pantropical spotted dolphins, pilot whales, Risso's dolphins, and striped dolphins may be exposed at levels that could result in temporary threshold shift, or non-injurious physiological effects (Table 3.7-17, 182 dB column). Sperm whales, Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphins, common dolphins, pantropical spotted dolphins, pilot whales, Risso's dolphins, and striped dolphins may be exposed at levels that could result in permanent threshold shift, or injurious physiological effects (Tables 3.7-17 and 3.7-18, 205 dB column). Common dolphins and striped dolphins may be exposed to levels that would result in mortality (Tables 3.7-17 and 3.7-18, 30.5 psi column).

Exposure estimates could not be calculated for several species (blue whale, sei whale, Bryde's whale, killer whale, pygmy killer whale, false killer whale, melon-headed whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin, and harbor porpoise) because density data could not be calculated due to the limited available data for these species. For the same reasons discussed under the No Action Alternative, no exposures are expected for blue whale, sei whale, Bryde's whale, killer whale, pygmy killer whale, false killer whale, melon-headed whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin, and harbor porpoise. As dicussed for the No Action Alternative implementation of mitigation measures under Alternative 1 would likely reduce the potential effects to all marine mammals.

Effects on Marine Mammal Populations

Effects from the use of explosive ordnance are not anticipated to have lasting impacts on any marine mammal population due to the following factors:

- Most exposures are within the non-injurious TTS or behavioral effects zones. Effects associated with these exposures are expected to be temporary.
- The exposure analysis predicts that only two species would be exposed to levels that could potentially result in mortality (six potential mortality exposures for common dolphin and one for striped dolphin). These species are among the most abundant marine mammals in the Study Area and the small number of potential mortality exposures would be negligible from a population standpoint.
- Although the numbers presented in Tables 3.7-17 and 3.7-18 represent estimated harassment and injury, as described above, they are probably over estimates as the model calculates harassment without taking into consideration standard mitigation measures.

Endangered Species Act Conclusions

Underwater detonations and explosive ordnance use in Alternative 1 may affect fin, North Atlantic right whales, sei, blue, humpback, and sperm whales. However, the effects on blue and sei whales are most likely discountable based on the low likelihood of encountering these species in the Study Area. Underwater detonations and explosive ordnance use would have no effect on the manatee because these exercises take place greater than 3 nm offshore where manatees are not expected to occur.

Marine Mammal Protection Act Conclusions

Fin whales, humpback whales, North Atlantic right whales, sperm whales, Atlantic spotted dolphins, beaked whales, bottlenose dolphins, Clymene dolphin, common dolphin, *Kogia* spp., minke whales, pantropical spotted dolphins, pilot whales, Risso's dolphins, rough-toothed dolphins and striped dolphins may also be exposed at levels that would constitute Level B harassment under the MMPA. Sperm whales, Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphins, common dolphins, pantropical spotted dolphins, pilot whales, Risso's dolphins, and striped dolphins may be exposed at levels that would constitute Level A harassment under the MMPA. Common and striped dolphins may be exposed to levels that would result in mortality.

National Environmental Policy Act and Executive Order 12114 Conclusions

The analysis presented above indicates that underwater detonations and explosive ordnance use under Alternative 1 would affect individual marine mammals, but any effects observed at the population, stock, or species level would be negligible. Therefore, in accordance with NEPA, there would be no significant impact to marine mammal populations from explosive ordnance use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to marine mammal populations resulting from explosive ordnance use during training exercises in non-territorial waters.

Military Expended Materials

Ordnance Related Materials

The amount of ordnance fired would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5 and 2.2-6) by approximately 28 percent. Similar to the No Action Alternative, only sperm whales would potentially be exposed to expended ordnance via ingestion from the bottom. However, about 82 percent of all ordnance (based on number of rounds) would be expended west of the continental shelf break under Alternative 1. Based on sperm whale habitat preferences and known feeding behaviors discussed above, it is extremely unlikely that they would encounter and ingest expended ordnance. Ingestion of ordnance under Alternative 1 may affect the sperm whale, but the effects would be discountable. Ordnance ingestion under Alternative 1 would have no effect on the manatee, blue whale, fin whale, humpback whale, North Atlantic right whale, or sei whale based on the feeding habits of these species. Ordnance related materials would not be expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, ordnance related materials would have no significant impact on marine mammals in territorial waters. Furthermore, ordnance related materials would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Target Related Materials

The number of targets used in the Study Area would increase by about 10 percent per year under Alternative 1 (Table 2.2-5). As discussed above for the No Action Alternative, species that feed on or near the bottom (*i.e.*, sperm whales and beaked whales) may encounter an expended target while feeding; however, the size of the target would prohibit any listed species from ingesting it. Therefore, the use of targets under Alternative 1 would have no effect on listed marine mammals. Targets would not be expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, targets would have no significant impact on marine mammals in territorial waters. Furthermore, targets would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Chaff Fibers, End-caps, and Pistons

The amount of chaff used in the OPAREA would increase by about 12 percent per year under Alternative 1 (Tables 2.2-5 and 3.7-16). This increase in chaff use would result in negligible increases in relative environmental concentrations of chaff fibers, end-caps, and pistons (Table 3.7-16). Similar to the No Action Alternative, chaff use under Alternative 1 would have no effect on manatees because they would not be exposed to measurable concentrations. Effects of direct body contact, inhalation, and any changes to water or sediment quality would continue to be insignificant. The potential for marine mammals to ingest chaff fibers would increase under Alternative 1, but ingestion of a toxic dose (greater than 1,000 mg/kg) would continue to be highly unlikely based on the anticipated low environmental concentration (1.8 fibers/ft^2). Sperm whales could ingest chaff end-caps and pistons under Alternative 1, but the likelihood of ingest remains extremely low based on the low environmental concentration (0.7 to 2.2 pieces/nm^2). If ingested, it is likely that the small end-cap or piston would be excreted without causing harm. Chaff use under Alternative 1 would have no effect on the manatee, but may affect ESA-listed large whales. Chaff use would not be expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, chaff would have no significant impact on marine mammals in territorial waters. Furthermore, chaff would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Self-Protection Flares

The number of self-protection flares used in the Study Area would increase under Alternative 1 from 465 to 825 per year (77%). Similar to the No Action Alternative, ingestion of flare end-caps under

Alternative 1 may affect sperm whales, but the effects would be considered discountable because ingestion is extremely unlikely to occur. Self-protection flares not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, flares would have no significant impact on marine mammals in territorial waters. Furthermore, flares would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Marine Markers

The number of marine markers used in the Study Area would increase under Alternative 1 from 300 to 495 per year, an increase of 65 percent. The probability of a marine mammal ingesting an expended marine marker would be extremely low based on the low concentration in the Study Area (0.02/nm^2/year). Marine marker ingestion under Alternative 1 may affect ESA-listed marine mammals (with the exception of the manatee), but the effects would be considered discountable because ingestion is extremely unlikely to occur. The use of marine markers is not expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, there would be no significant impact to marine mammals from marine marker use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to marine mammals resulting from use of marine markers during training exercises in non-territorial waters.

3.7.3.5 Alternative 2 (Preferred Alternative)

<u>All Stressors</u>

As detailed in Chapter 2 and Table 2.2-5, Alternative 2 would include all the activities proposed under Alternative 1 with 445 less bombs 324 less fixed-wing sorties, 70 additional helicopter sorties, 842 additional towed MIW device sorties, and establishment of Mine Warfare Training Areas. Vessel movements and military expended materials are not expected to change under Alternative 2. The additional overflights may result in increased instances of behavioral disturbance in marine mammals due to sound, shadow-effects, and/or, in the case of helicopters, water column disturbance. The responses would be limited to short-term behavioral or physiological reactions. The changes in helicopter and towed sorties under Alternative 2 are negligible with respect to the potential effects to marine mammals. Therefore, the Alternative 1 analyses for vessel movements, aircraft overflights, towed MIW devices, and military expended materials are applicable to Alternative 2. The analysis for Alternative 2 focuses on the establishment of the Mine Warfare Training Areas (non-explosive mine shape deployment/recovery) and the reduction in the number of bombs used.

<u>Mine Warfare Training Area Establishment (Non-explosive Mine Shape Deployment/Recovery)</u>

As discussed in Chapter 2, new Mine Warfare Training Areas would be established in W-50A/C and the lower Chesapeake Bay under Alternative 2. This section addresses potential effects on marine mammals associated with establishing and maintaining these training areas (*i.e.*, non-explosive mine shape deployment/recovery). The effects of conducting training exercises in these areas are analyzed under aircraft overflights, towed MIW devices, and explosions.

The effects of Mine Warfare Training Area establishment would be limited to short-term and localized disturbances of the water column and benthic habitat associated with deployment and recovery of non-explosive mine shapes. As discussed in Chapter 2, the mine shape assembly would include a concrete anchor, mooring line, and the non-explosive mine shape. Approximately 20 permanent concrete anchors would be placed in the proposed Mine Warfare Training Area in W-50A/C and approximately 60 would be placed in the proposed training areas in the lower Chesapeake Bay (see Figures 2.2-2 and 2.2-3 for specific locations). In some cases the entire assembly (mine shape, mooring line, and anchor) would be deployed concurrently from a boat or aircraft and recovered immediately following the exercise. In other cases concrete anchors would be permanently placed on the sea floor and divers would attach the mooring lines and mine shapes for specific exercises. The non-explosive mine shape deployment and recovery process would have no effect on marine mammals. The mooring lines would not present an entanglement risk for marine mammals because they are held taut by the anchor and mine shape. Entanglement of marine mammals usually occurs in fishing gear, ropes, and other flexible material that can wrap around the body or body parts of an animal (Laist, 1997). Mooring lines would only be left in place for as long as the mine shape is in the water. Establishment of Mine Warfare Training Areas under Alternative 2 would have no effect on ESA-listed marine mammals. The establishment of Mine Warfare Training Areas would not be expected to result in Level A or Level B harassment as defined by the MMPA. In accordance with NEPA, the establishment of Mine Warfare Training Areas would have no significant impact on marine mammals in territorial waters. Furthermore, the establishment of Mine Warfare Training Areas would not cause significant harm to marine mammals in non-territorial waters in accordance with EO 12114.

Underwater Detonations and Explosive Ordnance

Overview

Explosions associated with BOMBEX that would occur under Alternative 2 would decrease 96 percent from Alternative 1 and the No Action Alternative. An explosive analysis was conducted to estimate the number of marine mammals that could be exposed to impacts from explosions. Appendix J of the EIS contains a technical report describing the scientific basis, methods and assumptions of the explosive analysis. Tables 3.7-19 and 3.7-20 provide summaries of the explosive analysis for Alternative 2. Figure 3.7-7 shows a summary of the areas where high explosives would be used under Alternative 2. As discussed for the No Action Alternative, effects from exposure to explosives vary depending on the level of exposure.

TABLE 3.7-19
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 2

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Fin whale			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Humpback whale			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
North Atlantic right whale			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Sperm whale			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Atlantic Spotted dolphin			

TABLE 3.7-19
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 2 (Continued)

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
MISSILEX Training	4	0	0
MINEX training	0	0	0
Total Exposures	4	0	0
Beaked whale			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Bottlenose dolphin			
MISSILEX Training	7	0	0
MINEX training	0	0	0
Total Exposures	7	0	0
Clymene dolphin			
MISSILEX Training	1	0	0
MINEX training	0	0	0
Total Exposures	1	0	0
Common dolphin			
MISSILEX Training	97	2	1
MINEX training	0	0	0
Total Exposures	97	2	1
Kogia spp.			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Minke whale			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Pantropical spotted dolphin			
MISSILEX Training	3	0	0
MINEX training	1	0	0
Total Exposures	4	0	0
Pilot whales			
MISSILEX Training	2	0	0
MINEX training	0	0	0
Total Exposures	2	0	0
Risso's dolphin			
MISSILEX Training	2	0	0
MINEX training	0	0	0
Total Exposures	2	0	0

TABLE 3.7-19
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 2 (Continued)

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Rough-toothed dolphin			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Striped dolphin			
MISSILEX Training	26	1	0
MINEX training	0	0	0
Total Exposures	26	1	0

TABLE 3.7-20
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 2

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Fin whale			
BOMBEX training	2	0	0
FIREX training	0	0	0
Total Exposures	2	0	0
Humpback whale			
BOMBEX training	2	0	0
FIREX training	0	0	0
Total Exposures	2	0	0
North Atlantic right whale			
BOMBEX training	0	0	0
FIREX training	0	0	0
Total Exposures	0	0	0
Sperm whale			
BOMBEX training	0	0	0
FIREX training	2	0	0
Total Exposures	2	0	0

TABLE 3.7-20
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 2- (Continued)

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Atlantic Spotted dolphin			
BOMBEX training	9	0	0
FIREX training	30	1	0
Total Exposures	39	1	0
Beaked whale			
BOMBEX training	0	0	0
FIREX training	0	0	0
Total Exposures	0	0	0
Bottlenose dolphin			
BOMBEX training	17	0	0
FIREX training	5	0	0
Total Exposures	22	0	0
Clymene dolphin			
BOMBEX training	31	0	0
FIREX training	1	0	0
Total Exposures	32	0	0
Common dolphin			
BOMBEX training	2,059	17	0
FIREX training	37	1	0
Total Exposures	2,096	18	0
Kogia spp.			
BOMBEX training	3	0	0
FIREX training	0	0	0
Total Exposures	3	0	0
Minke whale			
BOMBEX training	0	0	0
FIREX training	0	0	0
Total Exposures	0	0	0
Pantropical spotted dolphin			
BOMBEX training	64	1	0
FIREX training	2	0	0
Total Exposures	66	1	0
Pilot whales			
BOMBEX training	1	0	0
FIREX training	7	0	0
Total Exposures	8	0	0
Risso's dolphin			
BOMBEX training	11	0	0
FIREX training	3	0	0
Total Exposures	14	0	0

TABLE 3.7-20
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR MARINE MAMMALS IN THE VACAPES STUDY AREA—ALTERNATIVE 2- (Continued)

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Rough-toothed dolphin			
BOMBEX training	1	0	0
FIREX training	0	0	0
Total Exposures	1	0	0
Striped dolphin			
BOMBEX training	1	0	0
FIREX training	41	2	0
Total Exposures	42	2	0

Summary of Exposure Results for Individual Marine Mammals

Fin, humpback, sperm whales, Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphins, common dolphins, *Kogia* spp., pantropical spotted dolphins, pilot whales, Risso's dolphins, rough-toothed dolphins, and striped dolphins may be exposed at levels that could result in behavioral disturbance (Table 3.7-20, 177 dB column). Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphins, common dolphins, pantropical spotted dolphins, pilot whales, Risso's dolphins, and striped dolphins may be exposed at levels that could result in temporary threshold shift, or non-injurious physiological effects (Table 3.7-19, 182 dB column). Atlantic spotted dolphins, common dolphins, pantropical spotted dolphins, and striped dolphins may be exposed at levels that could result in permanent threshold shift, or injurious physiological effects (Tables 3.7-19 and 3.7-20, 205 dB column). Under Alternative 2 no marine mammals would be exposed to levels that would result in mortality (Tables 3.7-19 and 3.7-20, 30.5 psi column).

Exposure estimates could not be calculated for several species (blue whale, sei whale, Bryde's whale, killer whale, pygmy killer whale, false killer whale, melon-headed whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin, and harbor porpoise) because density data could not be calculated due to the limited available data for these species. For the same reasons discussed under the No Action Alternative, no exposures are expected for blue whale, sei whale, Bryde's whale, killer whale, pygmy killer whale, false killer whale, melon-headed whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin, and harbor porpoise. As discussed for the No Action Alternative implementation of mitigation measures under Alternative 2 would likely reduce the potential effects to all marine mammals.

Effects on Marine Mammal Populations

Effects from the use of explosive ordnance are not anticipated to have lasting impacts on any marine mammal population due to the following factors:

- Most exposures are within the non-injurious TTS or behavioral effects zones. Effects associated with these exposures are expected to be temporary and only a small percentage of the local population would be exposed.

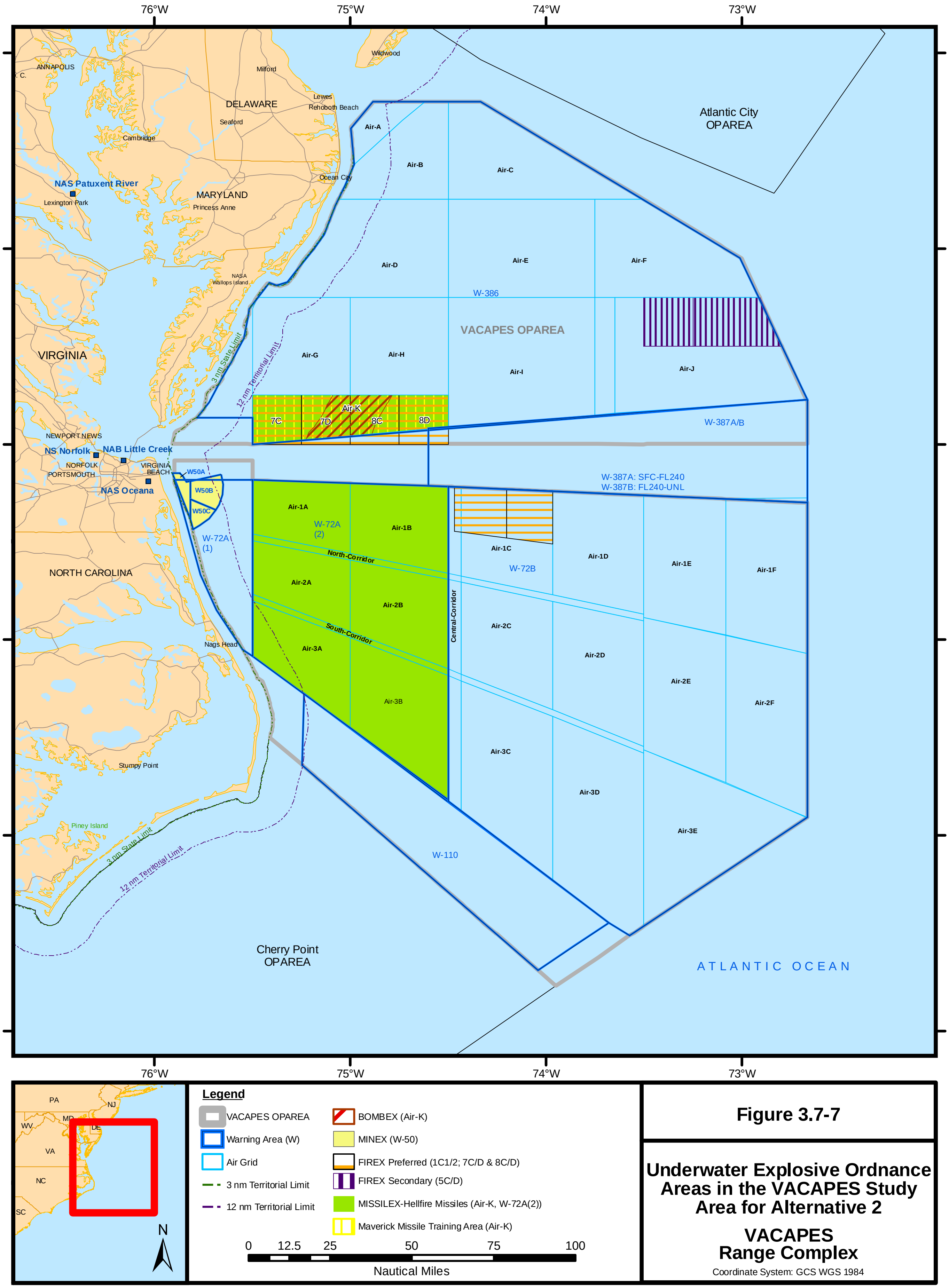


Figure 3.7-7

Underwater Explosive Ordnance Areas in the VACAPES Study Area for Alternative 2

VACAPES Range Complex

Coordinate System: GCS WGS 1984

- The exposure analysis predicts that only five species (Atlantic spotted dolphin, common dolphin, pantropical spotted dolphin, and striped dolphin) may be exposed at levels that could result in permanent threshold shift, or injurious physiological effects. These species are among the most abundant marine mammals in the study area and the small number of potential injury exposures would be negligible from a population standpoint.
- The exposure analsis predicts that no marine mammals would be exposed to levels that would result in mortality.
- Although the numbers presented in Tables 3.7-19 and 3.7-20 represent estimated harassment and injury, as described above, they are probably over estimates as the model calculates harassment without taking into consideration standard mitigation measures.

Endangered Species Act Conclusions

Underwater detonations and explosive ordnance in Alternative 2 may affect fin, North Atlantic right whales, sei, blue, humpback, and sperm whales. However, the effects on blue and sei whales are most likely discountable based on the low likelihood of encountering these species in the Study Area. The effects on the North Atlantic right whale would also be discountable because the exposure analysis predicts no exposures for this species. The Navy has initiated the ESA Section 7 formal consultation process with NMFS for listed whales and Alternative 2.

Underwater detonations and explosive ordnance use would have no effect on the manatee because these exercises take place greater than 3 nm offshore where manatees are not expected to occur. The Navy has completed the ESA Section 7 informal consultation process with USFWS for the manatee. In a letter dated October 7, 2008, the USFWS concurred with the Navy's determination that explosive ordnance use would have no effect on the manatee (Appendix C).

Marine Mammal Protection Act Conclusions

Fin whales, humpback whales, sperm whales, Atlantic spotted dolphins, bottlenose dolphins, Clymene dolphin, common dolphin, *Kogia* spp., pantropical spotted dolphins, pilot whales, Risso’s dolphins, rough-toothed dolphins and striped dolphins may also be exposed at levels that would constitute Level B harassment under the MMPA. Atlantic spotted dolphins, common dolphins, pantropical spotted dolphins, and striped dolphins may be exposed at levels that would constitute Level A harassment under the MMPA. No marine mammals would be exposed to levels that would result in mortality. The Navy has submitted to NMFS an application for a Letter of Authorization under MMPA for Alternative 2 (the Preferred Alternative).

National Environmental Policy Act and Executive Order 12114 Conclusions

The analysis presented above indicates that underwater detonations and explosive ordnance use under Alternative 2 would affect individual marine mammals, but any effects observed at the population, stock, or species level would be negligible. Therefore, in accordance with NEPA, there would be no significant impact to marine mammal populations from explosive ordnance use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to marine mammal populations resulting from explosive ordnance use during training exercises in non-territorial waters.

3.7.4 Unavoidable Significant Environmental Effects

The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that unavoidable significant effects to marine mammals do not result from implementation of the proposed action.

3.7.5 Summary of Environmental Effects

3.7.5.1 Endangered Species Act

Table 3.7-21 provides a summary of the Navy's determination of effect for Alternative 2 (the Preferred Alternative) for federally listed marine mammals that occur in the VACAPES Study Area. The analysis presented indicates that actions may affect ESA-listed marine mammals. Accordingly, the Navy requested formal ESA Section 7 consultation with NMFS to ensure the proposed action would not likely jeopardize ESA-listed marine mammals. The Study Area does not contain designated critical habitat for any listed species. Consequently, the proposed action would have no effect on critical habitat. The Navy has completed the ESA Section 7 informal consultation process with USFWS for the manatee. In a letter dated October 7, 2008, the USFWS concurred with the Navy's determination that Alternative 2 (Preferred Alternative) would have no effect on the manatee (Appendix C).

3.7.5.2 Marine Mammal Protection Act

The analysis presented above indicates that several species of marine mammals could be exposed to impacts associated with underwater detonations and explosive ordnance use under Alternative 2 (Preferred Alternative) that could result in Level A or Level B harassment as defined by MMPA provisions that are applicable to the Navy. Exposure estimates are provided in Tables 3.7-19 and 3.7-20. Although some individuals may be exposed at levels that could result in Level A or B harassment, it is unlikely that there would be adverse effects on the recruitment or survival of any species at the population level. Other stressors associated with Alternative 2 are not expected to result in Level A or Level B harassment. The Navy is working with NMFS through the MMPA permitting process to ensure compliance with the MMPA.

TABLE 3.7-21
SUMMARY OF THE NAVY'S DETERMINATION OF EFFECT FOR FEDERALLY LISTED MARINE MAMMALS THAT MAY OCCUR IN THE VACAPES STUDY AREA – ALTERNATIVE 2

Stressor	Blue Whale	Fin Whale	Humpback Whale	North Atlantic Right Whale	Sei Whale	Sperm Whale	West Indian Manatee
Vessel Movements							
Vessel Disturbance	May Affect	May Affect	May Affect	May Affect	May Affect	May Affect	No Effect
Vessel Collisions	May Affect	May Affect	May Affect	May Affect	May Affect	May Affect	No Effect
Aircraft Overflights							
Aircraft Disturbance	May Affect	May Affect	May Affect	May Affect	May Affect	May Affect	No Effect
Towed MIW devices							
Towed MIW device Strikes	No Effect	May Affect	May Affect	May Affect	No Effect	No Effect	No Effect
Mine Warfare Training Area Establishment							
Non-explosive Mine Shape Deployment/Recovery	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect

TABLE 3.7-21
SUMMARY OF THE NAVY'S DETERMINATION OF EFFECT FOR FEDERALLY LISTED MARINE MAMMALS THAT MAY OCCUR IN THE VACAPES STUDY AREA – ALTERNATIVE 2 (Continued)

Stressor	Blue Whale	Fin Whale	Humpback Whale	North Atlantic Right Whale	Sei Whale	Sperm Whale	West Indian Manatee
Weapons Firing/Ordnance Use							
Weapons Firing Disturbance	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Ordnance Strikes	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Explosions							
Live Ordnance	May Affect	May Affect	May Affect	May Affect	May Affect	May Affect	No Effect
Underwater Detonation	May Affect	May Affect	May Affect	May Affect	May Affect	May Affect	No Effect
Military Expended Materials							
Ordnance Related Materials	No Effect	No Effect	No Effect	No Effect	No Effect	May Affect	No Effect
Target Related Materials	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Chaff	May Affect	May Affect	May Affect	May Affect	May Affect	May Affect	No Effect
Self protection Flares	No Effect	No Effect	No Effect	No Effect	No Effect	May Affect	No Effect
Marine Markers	May Affect	May Affect	May Affect	May Affect	May Affect	May Affect	No Effect

3.7.5.3 National Environmental Policy Act and Executive Order 12114

As summarized in Table 3.9-22, the No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on marine mammals in territorial waters in accordance with NEPA. Furthermore, in accordance with EO 12114 the No Action Alternative, Alternative 1, and Alternative 2 would not cause significant harm to marine mammals in non-territorial waters.

TABLE 3.7-22
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON MARINE MAMMALS IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
No Action		
Vessel Movements	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel collisions.	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel collisions.
Aircraft Overflights	Potential for short-term behavioral responses to overflights. No long-term population-level effects.	Potential for short-term behavioral responses to overflights. No long-term population-level effects.
Towed MIW Devices	Low potential for towed MIW device strikes. No long-term population-level effects.	No effect.
Non-explosive Mine Shape Deployment/ Recovery	No effect.	No effect.
Weapons Firing/Non-explosive Practice Munitions Use	No effect based on extremely low probability of direct strikes.	No effect based on extremely low probability of direct strikes.
Underwater Detonations and Explosive Ordnance	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI.	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI.
Military Expended Materials	Low potential for ingestion of ordnance related materials and chaff and/or flare plastic end-caps and pistons.	Low potential for ingestion of ordnance related materials and chaff and/or flare plastic end-caps and pistons.
Impact Conclusion	No significant impact to marine mammals.	No significant harm to marine mammals.
Alternative 1		
Vessel Movements	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel collisions. Slight increase compared to No Action.	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel collisions. Slight increase compared to No Action.
Aircraft Overflights	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.
Towed MIW Devices	Low potential for towed MIW device strikes. Slight increase compared to No Action. No long-term population-level effects.	No effect.
Non-explosive Mine Shape Deployment/ Recovery	No effect.	No effect.

TABLE 3.7-22
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON MARINE MAMMALS IN THE VACAPES STUDY AREA (Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Weapons Firing/Non-explosive Practice Munitions Use	No effect based on extremely low probability of direct strikes.	No effect based on extremely low probability of direct strikes.
Underwater Detonations and Explosive Ordnance	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI. A decrease compared to No Action.	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI. Slight increase compared to No Action.
Military Expended Materials	Low potential for ingestion of ordnance related materials and chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.	Low potential for ingestion of ordnance related materials and chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.
Impact Conclusion	No significant impact to marine mammals.	No significant harm to marine mammals.
Alternative 2		
Vessel Movements	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel collisions. Slight increase compared to No Action.	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel collisions. Slight increase compared to No Action.
Aircraft Overflights	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.
Towed MIW Devices	Low potential for towed MIW device strikes. Slight increase compared to No Action. No long-term population-level effects.	No effect.
Non-explosive Mine Shape Deployment/ Recovery	No effect.	No effect.
Weapons Firing/Non-explosive Practice Munitions Use	No effect based on extremely low probability of direct strikes.	No effect based on extremely low probability of direct strikes.
Underwater Detonations and Explosive Ordnance	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI. Slight increase compared to No Action.	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI. Substantial decrease compared to No Action.
Military Expended Materials	Low potential for ingestion of ordnance related materials and chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.	Low potential for ingestion of ordnance related materials and chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.
Impact Conclusion	No significant impact to marine mammals.	No significant harm to marine mammals.

3.8 SEA TURTLES

3.8.1 Introduction and Methods

3.8.1.1 Regulatory Framework

Endangered Species Act

The Endangered Species Act (ESA) established protection over and conservation of threatened and endangered species. An "endangered" species is a species that is in danger of extinction throughout all or a significant portion of its range, while a "threatened" species is one that is likely to become endangered within the foreseeable future throughout all or in a significant portion of its range. The USFWS and NMFS jointly administer the ESA and are also responsible for the listing of species (*i.e.*, the labeling of a species as either threatened or endangered). The USFWS has primary management responsibility for management of terrestrial and freshwater species, including nesting sea turtles. The NMFS has primary responsibility for sea turtles in the marine environment. The ESA requires federal agencies to conserve listed species and consult with the USFWS and/or NMFS to ensure that proposed actions that may affect listed species or critical habitat are consistent with the requirements of the ESA. The ESA specifically requires agencies not to "take" or "jeopardize the continued existence of" any endangered or threatened species, or to destroy or adversely modify habitat critical to any endangered or threatened species. Under Section 9 of the ESA, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect. Harm is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by USFWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR §17.3). Under Section 7 of the ESA, "jeopardize the continued existence of" means to engage in any action that would be expected to reduce appreciably the likelihood of the survival and recovery of a listed species by reducing its reproduction, numbers, or distribution (50 CFR §402.02).

All five species of sea turtles that potentially occur in the VACAPES Study Area are listed as threatened or endangered under the ESA. For purposes of ESA compliance, the Navy analyzed effects of the action to make a determination of effect for listed species (*e.g.*, no effect or may affect). The definitions used in making the determination of effect under Section 7 of the ESA are based on the USFWS and NMFS *Endangered Species Consultation Handbook* (USFWS and NMFS, 1998). "No effect" is the appropriate conclusion when a listed species will not be affected, either because the species will not be present or because the project does not have any elements with the potential to affect the species. "No effect" does not include a small effect or an effect that is unlikely to occur: if effects are insignificant (in size), discountable (extremely unlikely), or wholly beneficial a "may affect" determination is appropriate. Insignificant effects relate to the magnitude or extent of the impact (*i.e.*, they must be small and would not rise to the level of a take of a species). Discountable effects are those extremely unlikely to occur and based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

The Navy has initiated the ESA Section 7 formal consultation process with NMFS to determine if the action would adversely affect ESA-listed sea turtles or jeopardize the continued existence of a listed species. Copies of correspondence with NMFS are provided in Appendix C of this EIS/OEIS.

National Environmental Policy Act and Executive Order 12114

In addition to addressing ESA requirements, potential effects were analyzed in accordance with the National Environmental Policy Act (NEPA) to determine if the action would result in significant impacts to sea turtles in territorial waters and in accordance with Executive Order (EO) 12114 to determine if the action would result in significant harm to sea turtles in non-territorial waters.

For purposes of NEPA and EO 12114, the Navy considered context and intensity to determine the significance of effects. Context refers to the affected environment in which the action would occur and intensity refers to the severity of impacts. The Navy considered several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. The duration of effects (*e.g*., short-term, long-term, temporary, permanent); degree of controversy; degree of highly uncertain effects or unique or unknown risks; precedent-setting effects; cumulative effects; adverse effect on ESA-listed species or designated critical habitat; and whether the action threatens a violation of law or requirements imposed for the protection of the environment were also considered. The potential for adverse effects to be observed at the population or species level was a primary factor considered by the Navy in determining the significance of effects to sea turtles. While the factors outlined above for ESA were considered in making NEPA and EO 12114 significance conclusions, it should be recognized that the terminology used to characterize effects varies under these Acts. For example, take of an individual sea turtle under ESA does not necessarily equate to a significant impact under NEPA. Rather, the Navy considered context, intensity, and population-level effects in making its significance conclusions for sea turtles.

3.8.1.2 Assessment Methods and Data Used

General Approach to Analysis

The general approach to analysis for sea turtles is the same as the approach described for marine mammals in Section 3.7.1.2.

Study Area

The study area for sea turtles is described in Section 1.5 and is shown in Figure 1.5-1. The Study Area is analogous to the "action area," for purposes of analysis under Section 7 of the ESA.

Data Sources

A comprehensive and systematic review of relevant literature data was conducted to complete this analysis for sea turtles. These data sources are described in Section 3.7.1.2.

Marine Resource Assessments

The information contained in this Chapter relies heavily on the data gathered in the Marine Resource Assessments (MRA). The Navy MRA Program was implemented by the Commander, Fleet Forces Command, to initiate collection of data and information concerning the protected and commercial marine resources found in the Navy's OPAREAs. Specifically, the goal of the MRA program is to describe and document the marine resources present in each of the Navy's OPAREAs. The MRA for the VACAPES OPAREA was finalized in 2008 (DoN, 2008).

The MRA data were used to provide a regional context for each species. The MRA represents a compilation and synthesis of available scientific literature (*e.g*., journals, periodicals, theses, dissertations, project reports, and other technical reports published by government agencies, private businesses, or consulting firms), and NMFS reports including recovery plans, and survey reports.

Navy OPAREA Density Estimates Report

The density estimates that were used in previous Navy environmental documents have been recently updated to provide a compilation of the most recent data and information on the occurrence, distribution, and density of sea turtles. The updated density estimates presented in this EIS/OEIS are derived from *the Navy OPAREA Density Estimates (NODEs) for the Southeast OPAREAs: VACAPES, CHPT,* *JAX/CHASN, and Southeastern Florida & AUTEC Andros* report (DoN, 2007a). The Navy OPAREA density estimate (NODE) report represents the most current density estimates for sea turtles (DoN, 2007a) in the VACAPES OPAREA and were obtained through spatial modeling of survey data provided by NMFS (Southeast and Northeast Fisheries Science Centers).

Density estimates for sea turtles were modeled using available line-transect survey data. Using the model-based approach, density estimates were calculated for each species within areas containing survey effort. A relationship between these density estimates and the associated environmental parameters such as depth, slope, distance from the shelf break, sea surface temperature (SST), and chlorophyll *a* (chl *a*) concentration was formulated using generalized additive models (GAMs). This relationship was then used to generate a two-dimensional density surface for the region by predicting densities in areas where no survey data exist.

The analyses for sea turtles were based on sighting data collected through aerial surveys conducted by NMFS-Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (NMFS-SEFSC) between 1998 and 2005. For specifics of data used in these analyses refer to DoN (2008). All spatial models and density estimates were reviewed by and coordinated with NMFS Science Center technical staff and scientists with the University of St. Andrews, Scotland, Centre for Environmental and Ecological Modeling (CREEM).

Density estimates were generated for the leatherback turtle, loggerhead turtle, Kemp's ridley turtle, and the group hardshell turtles. The species incorporated into the hardshell turtles group include green, hawksbill, and unidentified hardshell turtles and were pooled together because the numbers of sightings for each species or group were not sufficient to allow spatial modeling. This category did not include leatherback turtles since identification is not difficult. The NODE report did not include density estimates for waters less than 10 m deep. Table 3.8-1 summarizes the density estimates for training areas where explosive ordnance use may occur in the VACAPES Range Complex.

TABLE 3.8-1
SEASONAL DENSITY ESTIMATES FOR SEA TURTLES IN THE VACAPES STUDY AREA WHERE EXPLOSIVE ORDNANCE MAY OCCUR

Species and Training Area	Density (animals/km^2)			
	Winter (Dec-Feb)	Spring (Mar-May)	Summer (June-Aug)	Fall (Sept-Nov)
Loggerhead Turtle				
W-50	0.10999	0.10999	0.10200	0.10999
W-72A (2)	0.13517	0.13517	0.12567	0.13517
Air-E, F, I, J	0.07146	0.07146	0.12466	0.07146
Air-K	0.15127	0.15127	0.13158	0.15127
Air-3B	0.07742	0.07742	0.10826	0.07742
1C1/2	0.15045	0.15045	0.13480	0.15045
5C/D	0.15045	0.15045	0.13480	0.15045
7C/D and 8C/D	0.15045	0.15045	0.13480	0.15045
Leatherback Turtle				
W-50	0.00065	0.00065	0.00009	0.00065
W-72A (2)	0.01352	0.01352	0.02655	0.01352
Air-E, F, I, J	0.01243	0.01243	0.02988	0.01243
Air-K	0.00308	0.00308	0.00212	0.00308
Air-3B	0.00685	0.00685	0.00434	0.00685
1C1/2	0.00320	0.00320	0.00206	0.00320
5C/D	0.00320	0.00320	0.00206	0.00320

TABLE 3.8-1
SEASONAL DENSITY ESTIMATES FOR SEA TURTLES IN THE VACAPES STUDY AREA WHERE EXPLOSIVE ORDNANCE MAY OCCUR (Continued)

Species and Training Area	Density (animals/km^2)			
	Winter (Dec-Feb)	**Spring** (Mar-May)	**Summer** (June-Aug)	**Fall** (Sept-Nov)
7C/D and 8C/D	0.00320	0.00320	0.00206	0.00320
Kemp's ridley Turtle				
W-50	<0.0001	<0.0001	<0.0001	<0.0001
W-72A (2)	0.00722	0.00722	0.00722	0.00722
Air-E, F, I, J	0.00923	0.00923	0.00923	0.00923
Air-K	0.13728	0.13728	0.13728	0.13728
Air-3B	0.00001	0.00001	0.00001	0.00001
1C1/2	0.14161	0.14161	0.14161	0.14161
5C/D	0.14161	0.14161	0.14161	0.14161
7C/D and 8C/D	0.14161	0.14161	0.14161	0.14161
Hardshell Turtles(1)				
W-50	0.00388	0.00388	0.01777	0.00388
W-72A (2)	0.02403	0.02403	0.05378	0.02403
Air-E, F, I, J	0.04807	0.04807	0.11583	0.04807
Air-K	0.09093	0.09093	0.09818	0.09093
Air-3B	0.00620	0.00620	0.02523	0.00620
1C1/2	0.08873	0.08873	0.09602	0.08873
5C/D	0.08873	0.08873	0.09602	0.08873
7C/D and 8C/D	0.08873	0.08873	0.09602	0.08873

Source: (DoN, 2007)
(1)Hardshell turtle density estimates include all sightings of unidentified hardshell turtles, green, and hawksbill turtles.

3.8.1.3 Warfare Areas and Associated Environmental Stressors

The Navy used a screening process to identify aspects of the proposed action that could act as stressors to sea turtles. Navy subject matter experts de-constructed the warfare areas and operations included in the proposed action to identify specific activities that could act as stressors. Public and agency scoping comments, previous environmental analyses, previous agency consultations, laws, regulations, Executive Orders, and resource-specific information were also evaluated. This process was used to focus the information presented and analyzed in the affected environment and environmental consequences sections of this EIS/OEIS. As summarized in Table 3.8-2, potential stressors to sea turtles include vessel movements (disturbance and strikes), aircraft overflights (disturbance), towed Mine Warfare (MIW) devices (strikes), non-explosive mine shape deployment/recovery (habitat alteration), weapons firing/ordnance use (disturbance and strikes), explosions, and Military Expended Materials (ordnance related materials, targets, chaff, self-protection flares, and marine markers). The potential effects of these stressors on sea turtles are analyzed in detail in Section 3.8.3.

TABLE 3.8-2
SUMMARY OF POTENTIAL STRESSORS TO SEA TURTLES[11]

Warfare Area and Operation	Training Areas	Vessel Movements	Aircraft Overflights	Towed Mine Warfare (MIW) Devices	Non-explosive Mine Shape Deployment/Recovery	Weapons Firing/ Non-explosive Practice Munitions Use	Underwater Detonations/ Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)								
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓	✓			
Mine Countermeasures Exercise (MCM)	W-50 A/C, W-72, W-386	✓	✓	✓	✓		✓	✓
Mine Neutralization	W-50C	✓	✓		✓	✓	✓	✓
Surface Warfare (SUW)								
Bombing Exercise (Air-to-Surface) (at sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B		✓			✓	✓	✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A		✓			✓	✓	✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C		✓			✓		✓
GUNEX (Surface-to-Surface) Boat	W-50C, R-6606	✓				✓		✓
GUNEX (Surface-to-Surface) Ship	W-386, W-72	✓				✓		✓
Laser Targeting	W-386 (Air-K)		✓					

[11] For detailed information on the numbers and types of ordnance, specific weapons platforms, types of targets used and location of operations, see Table 2.2-4 and Appendix D.

TABLE 3.8-2
SUMMARY OF POTENTIAL STRESSORS TO SEA TURTLES
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements	Aircraft Overflights	Towed Mine Warfare (MIW) devices	Non-explosive Mine Shape Deployment/Recovery	Weapons Firing/Ordnance Use	Underwater Detonations/ Explosive Ordnance	Military Expended Materials
Air Warfare (AAW)								
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)		✓					✓
GUNEX (Air-to-Air)	W-72A		✓			✓		✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A		✓			✓	✓	✓
GUNEX (Surface-to-Air)	W-386, W-72		✓			✓		✓
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)	✓	✓			✓		✓
Air Intercept Control (AIC)	W-386, W-72	✓	✓					
Strike Warfare (STW)								
HARM Missile Exercise	W-386 (Air E,F,I,J)	✓	✓			✓		✓
Amphibious Warfare (AMW)								
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA	✓						

TABLE 3.8-2
SUMMARY OF POTENTIAL STRESSORS TO SEA TURTLES
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements	Aircraft Overflights	Towed Mine Warfare (MIW) devices	Non-explosive Mine Shape Deployment/Recovery	Weapons Firing/Ordnance Use	Underwater Detonations/ Explosive Ordnance	Military Expended Materials
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓					
Firing Exercises (FIREX) –Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386	✓				✓	✓	✓
Electronic Combat (EC)								
Chaff Exercise- aircraft	W-386, W-386 (Air-K) and W-72		✓					✓
Chaff Exercise- ship	W-386 and W-72	✓						✓
Flare Exercise- aircraft	W-386, W-386 (Air-K) and W-72		✓					✓
Electronic Combat (EC) Operations- aircraft	W-386 (Air-K)		✓					
EC Operations- ship	VACAPES OPAREA	✓						
Test and Evaluation								
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓						

As discussed in Section 3.3 – Water Resources and Section 3.4 – Air Quality, some water and air pollutants would be released into the environment as a result of the proposed action. The analyses presented in Sections 3.3 and 3.4 indicate that any increases in water or air pollutant concentrations resulting from Navy training in the Study Area would be negligible and localized, and impacts to water and air quality would be less than significant. Based on the analyses presented in Sections 3.3 and 3.4, water and air quality changes would have no effect or negligible effects on sea turtles. Accordingly, the effects of water and air quality changes on sea turtles are not addressed further in this EIS/OEIS.

3.8.2 Affected Environment

3.8.2.1 Regional Overview

Five sea turtle species are known to occur in the VACAPES Study Area (Table 3.8-3). Along the U.S. Atlantic coast, four sea turtle species (leatherback, loggerhead, Kemp's ridley, and green) migrate seasonally from offshore and warmer southern waters far into northern latitudes each summer (Morreale, 2005). Nesting is also documented for beaches bordering the region.

TABLE 3.8-3
SEA TURTLES KNOWN TO OCCUR IN THE VACAPES STUDY AREA

Common Name	Scientific Name	Status
Green turtle	*Chelonia mydas*	Threatened[(1)]
Hawksbill turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley turtle	*Lepidochelys kempii*	Endangered
Leatherback turtle	*Dermochelys coriacea*	Endangered
Loggerhead turtle	*Caretta caretta*	Threatened

[(1)]As a species, the green turtle is listed as threatened. However, the Florida and Mexican Pacific coast nesting populations are listed as endangered. It should be noted that not all green turtles found in the VACAPES Study Area come from the Florida population.

Sea turtle distribution in temperate waters generally shifts on a seasonal basis off the U.S. Atlantic coast in response to changes in water temperature and prey availability (Lutcavage and Musick, 1985; Musick and Limpus, 1997; Coles and Musick, 2000). During winter months, sea turtle distribution shifts either south or offshore, where water temperatures are warmer and their prey are more abundant (Epperly *et al*., 1995b; Epperly *et al*., 1995a). Throughout the rest of the year, sea turtles are common residents of inshore and nearshore waters along the U.S. Atlantic coast as far north as Massachusetts. A notable distinction is the increasing proportion of small and apparently young individuals along a northward gradient (Morreale and Standora, 2005). This pattern is evident in loggerheads and greens, and is "starkly obvious" in Kemp's ridleys (Morreale and Standora, 2005). In North Carolina and Virginia, the proportion of breeding adult loggerheads in bays and estuaries is smaller than in Georgia and Florida, with most individuals classified as medium-sized juveniles. Most Kemp's ridleys along the U.S. Atlantic coast are immature. However, a latitudinal gradient still exists (Morreale and Standora, 2005). Only small-sized Kemp's ridleys have been documented in the northeastern waters of New York and Massachusetts, and while a few larger individuals have been reported in the southern and mid-Atlantic states (Florida, Georgia, South Carolina, Virginia), the vast majority are also small individuals (Morealle and Standora, 2005).

Current sea turtle estimates in the Chesapeake Bay (based on aerial surveys), corrected for seasonal surfacing behavior, and extrapolated for the entire Bay, range between 2,500 and 5,500 turtles compared to 6,500 to 9,000 turtles observed in the lower Chesapeake Bay alone in the 1980s (Mansfield, 2006). These estimates represent all sea turtles observed and are not broken down by species. There are no specific density estimates for sea turtles in the lower Chesapeake Bay region.

3.8.2.2 Green Turtle

General Description - The green turtle is the largest hard-shelled sea turtle; adults commonly reach 100 cm in carapace length and 150 kg in weight (NMFS and USFWS, 1991).

Very young green turtles are omnivorous, leaning to carnivory (Bjorndal 1985, 1997). Salmon *et al*. (2004) reported that posthatchling green turtles were found to feed near the surface on floating *Thalassia* and *Sargassum* or at shallow depths on ctenephores and unidentified gelatinous eggs but ignored large jellyfish (*Aurelia*) off southeastern Florida. Adult green turtles feed primarily on seagrasses (*e.g.*, turtle grass, manatee grass, shoal grass, and eelgrass), macroalgae, and reef-associated organisms (Burke *et al*., 1992; Bjorndal, 1997). They also consume jellyfish, salps, and sponges (Mortimer, 1995; Bjorndal, 1997).

Green turtles typically make dives shallower than 30 m (Hays *et al*. 1999, 2000; Hochscheid *et al*., 1999; Godley *et al*., 2002; Hatase *et al*., 2006). However, green turtles are also known to forage and rest at depths of 20 to 50 m (Balazs, 1980; Brill *et al*., 1995).

Status and Management - The green turtle is classified as threatened under the ESA, with the Florida and Mexican Pacific coast nesting populations listed as endangered (NMFS and USFWS, 1991). There is designated critical habitat for the species in the Caribbean that includes the waters surrounding Culebra, Puerto Rico (NMFS, 1998). Recent population estimates for green turtles in the western Atlantic area are not available (NMFS, 2006). NMFS and USFWS share jurisdictional responsibility for sea turtles under the ESA. USFWS has responsibility in the terrestrial environment while NMFS has responsibility in the marine environment.

Habitat - Post-hatchling and early juvenile green turtles reside in convergence zones in the open ocean, where they spend an undetermined amount of time in the pelagic environment (Carr, 1987; Witherington and Hirama, 2006). Once green turtles reach a carapace length of 20 to 25 cm (7.9 to 9.8 inches), they migrate to shallow nearshore areas (<50 m deep) where they spend the majority of their lives as late juveniles and adults. The optimal developmental habitats for late juveniles and foraging adults are warm, shallow waters (3 to 5 m in bottom depth), with an abundance of submerged aquatic vegetation, and located proximal to nearshore reefs or rocky areas, used by green turtles for resting (Holloway-Adkins and Provancha, 2005; Witherington *et al*., 2006a).

General Distribution - The green turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Seminoff and MTSG, 2004). Green turtles found in U.S. waters come from nesting beaches widely scattered throughout the Atlantic (Witherington *et al*., 2006a). In U.S. Atlantic and Gulf of Mexico waters, greens are found around the U.S. Virgin Islands (USVI), Puerto Rico, and along the continental United States from Texas to Massachusetts (NMFS and USFWS, 1991). Juvenile green turtles utilize estuarine waters along the U.S. Atlantic coast as summer developmental habitat, as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Epperly *et al*., 1995b; Epperly *et al*., 1995a; Musick and Limpus, 1997). Limited information is available regarding the occurrence of green turtles in the Chesapeake Bay, although they are presumably present in very low numbers (NMFS, 2006). Nearshore water temperatures play a major role in determining green turtle distribution along the Atlantic and Gulf coasts of the United States (Musick and Limpus, 1997; Witherington *et al*., 2006a). Adults are predominantly tropical and are only occasionally found north of southern Florida. Most sightings of individuals north of Florida occur between late spring and early fall, and are juveniles (Lazell, 1980; CETAP, 1982; Burke *et al*., 1992; Epperly *et al*., 1995a).

Optimal feeding habitats for green turtles in the continental U.S. include waters in Florida and southern Texas such as the Indian River Lagoon, Florida Keys, Florida Bay, Homosassa Springs, Crystal River, Cedar Keys, and Laguna Madre Complex (NMFS and USFWS, 1991; Hirth, 1997). The inshore waters of North Carolina are also an important feeding habitat for juveniles of this species (Epperly *et al*., 1995a).

Green turtles nest on both island and continental beaches between 30ºN and 30ºS (Witherington *et al*., 2006a). Although Florida is near the northern extent of the green turtle's Atlantic nesting range, it hosts a significant proportion of green turtle nesting (Witherington *et al*., 2006a). Green turtle nesting in Florida has occurred in every coastal county except those bordering the Big Bend area (Meylan *et al*., 1995; Witherington *et al*., 2006a). Approximately 99 percent of the green turtle nesting in Florida occurs on the Atlantic coast, with Brevard through Broward counties hosting the greatest nesting activity (Meylan *et al*., 1995; Witherington *et al*., 2006a). There are scattered nesting records in Georgia, and the Carolinas (Peterson *et al*., 1985; Schwartz, 1989; NMFS and USFWS, 1991).

VACAPES OPAREA Green Turtle Occurrence **-** Green turtles may occur year-round in the area with few occurrences during the winter. Summer represents the peak time for green turtle occurrence in the OPAREA due to the presence of summer developmental foraging habitat along the coast. One green turtle has been documented nesting on Virginia beaches. Therefore, few, if any, green turtle nesting is expected to occur on beaches landward of the VACAPES Study Area (DoN, 2008).

Lower Chesapeake Bay Green Turtle Occurrence **-** Little is known on habitat usage by the green turtle in the Chesapeake Bay. The occurrence of greens in the Bay is very rare, with only one or two individuals recorded every few years (DoN, 2007b).

VACAPES OPAREA Green Turtle Density **-** The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES Study Area are provided in Table 3.8-1. Seasonal density estimates for the hardshell turtle group in the VACAPES Study Area, include greens, hawksbills, and unidentified hardshell turtles. Methods and results are detailed in the NODE Report (DoN, 2007).

3.8.2.3 Hawksbill Turtle

General Description **-** The hawksbill turtle is a small to medium-sized sea turtle; adults range between 65 and 90 cm in carapace length and typically weigh around 80 kg (Witzell, 1983; NMFS and USFWS, 1993). Hawksbills are considered to be omnivorous during the later juvenile stage, feeding on encrusting organisms such as sponges, tunicates, bryozoans, algae, mollusks, and a variety of other items such as crustaceans and jellyfish (Bjorndal, 1997). Older juveniles and adults are more specialized, feeding primarily on sponges, which comprise as much as 95 percent of their diet in some locations (Witzell, 1983; Meylan, 1988).

Hawksbills may have one of the longest routine dive times of all the sea turtles. Starbird *et al*. (1999) reported that inter-nesting females at Buck Island, USVI had an average dive time of 56.1 minutes. Average mean dive times during the day ranged from 34 to 65 minutes, while those at night were between 42 and 74 minutes. Data from time-depth recorders indicate that foraging dives of immature hawksbills in Puerto Rico range from 8.6 to 14 minutes in duration, with a mean depth of 4.7 m (Van Dam and Diez, 1996). These individuals were found to be most active during the day. Changes in water temperature have an effect on the behavioral ecology of hawksbill turtles, with an increase in nocturnal dive duration with decreasing water temperatures during the winter (Storch *et al*., 2005).

Status and Management **-** The hawksbill turtle is listed as endangered under the ESA. This species is second only to the Kemp's ridley in terms of endangerment (NMFS and USFWS, 1993; Bass, 1994). There is designated critical habitat for the species in the Caribbean that includes the waters surrounding Mona and Monito Islands, Puerto Rico (NMFS and USFWS, 1998a). NMFS and USFWS share jurisdictional responsibility for sea turtles under the ESA. USFWS has responsibility in the terrestrial environment while NMFS has responsibility in the marine environment.

Habitat **-** Hawksbill turtles inhabit oceanic waters as post-hatchlings and small juveniles, where they are sometimes associated with driftlines and floating patches of *Sargassum* (Parker, 1995; Witherington and Hirama, 2006). The developmental habitats for juvenile benthic-stage hawksbills are the same as the primary feeding grounds for adults. They include tropical, nearshore waters associated with coral reefs, hard bottoms, or estuaries with mangroves (Musick and Limpus, 1997). Coral reefs are recognized as optimal hawksbill habitat for juveniles, sub-adults, and adults (NMFS and USFWS, 1993; Diez and Van Dam, 2003). In neritic habitats, resting areas for late juvenile and adult hawksbills are typically located in deeper waters than their foraging areas, such as sandy bottoms at the base of a reef flat (Houghton *et al*., 2003). Late juveniles generally reside on shallow reefs less than 18 m deep. However, as they mature into adults, hawksbills move to deeper habitats and may forage to depths greater than 90 m. Benthic-stage hawksbills are seldom found in waters beyond the continental or insular shelf, unless they are in transit between distant foraging or nesting grounds (NMFS and USFWS, 1993).

General Distribution **-** Hawksbill turtles are circum-tropical in distribution, generally occurring from 30°N to 30°S within the Atlantic, Pacific, and Indian oceans (Witzell, 1983). The hawksbill turtle has only rarely been recorded away from the tropics. In the Atlantic Ocean, this species is found throughout the Gulf of Mexico, the Greater and Lesser Antilles, and southern Florida, as well as along the mainland of Central America south to Brazil (NMFS and USFWS, 1993). The hawksbill is rare north of Florida (Lee and Palmer, 1981; Keinath *et al*., 1991; Parker, 1995; Plotkin, 1995; USFWS, 2001). Small hawksbills have stranded as far north as Cape Cod, Massachusetts (NMFS, 2006). In 2000 there was one hawksbill stranding in the Chesapeake Bay and one was reported as being taken incidentally in a fishery just south of the Chesapeake Bay (NMFS, 2006). Adult hawksbills are rarely documented in Florida waters, although nesting females occasionally visit beaches along the southeastern coast and the Florida Keys (Meylan and Redlow, 2006).

Major foraging populations in U.S. waters occur in the vicinity of the coral reefs surrounding Mona Island, Puerto Rico and Buck Island, St. Croix, USVI (Starbird *et al*., 1999). Smaller populations of hawksbills reside in the hard bottom habitats that surround the Florida Keys and other small islands in Puerto Rico and the USVI (Witzell, 1983; NMFS and USFWS, 1993). There is designated critical habitat for the species in the Caribbean that includes the waters surrounding Mona and Monito islands, Puerto Rico (NMFS and USFWS, 1998a).

Virtually all nesting is restricted between latitudes 25ºN and 35ºS. Hawksbill nesting in Florida has been reported from Cape Canaveral National Seashore south to Boca Grande Key and the Marquesas Islands and a single locality on the west coast (Longboat Key) (Meylan and Redlow, 2006).

VACAPES OPAREA Hawksbill Turtle Occurrence **-** The hawksbill turtle is rare north of Florida (Lee and Palmer, 1981; Keinath *et al*., 1991; Parker, 1995; Plotkin, 1995; USFWS, 2001). There have been a few sightings, strandings and bycatch records that indicate hawksbills may occur on a rare basis in the OPAREA. Nesting does not occur on beaches landward of the VACAPES OPAREA (DoN, 2008).

Lower Chesapeake Bay Hawksbill Turtle Occurrence **-** Hawksbills are extralimital to Chesapeake Bay. Only three records of hawksbill strandings exist for Virginia waters, all were juveniles (DoN, 2007b).

VACAPES OPAREA Hawksbill Turtle Density **-** The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES Study Area are provided in Table 3.8-1. Seasonal density estimates for the hardshell turtle group in the VACAPES Study Area, include greens, hawksbills, and unidentified hardshell turtles. Methods and results are detailed in the NODE Report (DoN, 2007).

3.8.2.4 Kemp's Ridley Turtle

General Description - The Kemp's ridley is the smallest living sea turtle. This species has a straight carapace length of approximately 60 to 70 cm (with shell length and width being nearly equal) and weigh about 45 kg (USFWS and NMFS, 1992; Gulko and Eckert, 2004). Kemp's ridley turtles feed primarily on portunids (swimming crabs) and other types of crabs, but are also known to prey on mollusks, shrimp, fish, jellyfish, and plant material (Marquez-M., 1994; Frick *et al*., 1999; Lutcavage and Musick, 1985; Keinath *et al*., 1987; Seney and Musick, 2005). Kemp's ridleys may also feed on shrimp fishery bycatch (Landry and Costa, 1999).

Few data are available on the maximum dive duration. Satellite-tagged juvenile Kemp's ridley turtles demonstrate different mean surface intervals and dive depths depending on whether the individual is located in shallow coastal areas (short surface intervals) or in deeper, offshore areas (longer surface intervals). Dive times range from a few seconds to a maximum of 167 minutes, with routine dives lasting between 16.7 and 33.8 minutes (Mendonça and Pritchard, 1986; Renaud, 1995). In Cedar Keys, Florida, the average submergence duration was found to be approximately 8.4 minutes (Schmid *et al*., 2002). Renaud and Williams (2005) noted seasonal differences in dive durations, with longer dives (>30 minutes) during the winter and dive duration of 15 minutes the remainder of the year. Sasso and Witzell (2006) reported longer dives at night than during the day for this species. Over a 12-hour period, Kemp's ridleys spend as long as 96 percent of their time submerged (Byles, 1989; Gitschlag, 1996; Renaud and Williams, 2005; Sasso and Witzell, 2006).

Status and Management - The Kemp's ridley turtle is classified as endangered under the ESA; this is considered the world's most endangered sea turtle species (USFWS and NMFS, 1992). The worldwide population declined from tens of thousands of nesting females in the late 1940s to approximately 300 nesting females in 1985 (TEWG, 2000). From 1985 to 1999, the number of nests at Rancho Nuevo increased at a mean rate of 11.3 percent per year (TEWG, 2000). Positive trends in 2005 were recorded in Rancho Nuevo, Tamaulipas (6,947 nests) on the eastern coast of Mexico, Barra del Tordo (701 nests), and Barra de Tepehuajes (1,610 nests) (USFWS, 2005). Nesting levels at Padre Island National Seashore in Texas, the site of a Kemp's ridley head-starting and imprinting program from 1978 to 1988, show a slow but steady rise throughout time (Shaver and Wibbels, 2007). NMFS and USFWS share jurisdictional responsibility for sea turtles under the ESA. USFWS has responsibility in the terrestrial environment while NMFS has responsibility in the marine environment.

Habitat - Kemp's ridley turtles occur in open-ocean and *Sargassum* habitats of the North Atlantic Ocean as post-hatchlings and small juveniles (Manzella *et al*., 1991; Witherington and Hirama, 2006). They move as large juveniles and adults to benthic, nearshore feeding grounds along the U.S. Atlantic and Gulf coasts (Morreale and Standora, 2005). Habitats frequently utilized include warm-temperate to subtropical sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters where preferred food, including the blue crab, occurs (Lutcavage and Musick, 1985; Landry and Costa, 1999; Seney and Musick, 2005). Models indicate that the most suitable habitats are less than 10 m in bottom depth with sea surface temperatures between 22° and 32°C (Coyne *et al*., 2000). Seagrass beds and mud bottom, as well as live bottom, are important developmental habitats (Schmid and Barichivich, 2006). Postnesting Kemp's ridleys travel along coastal corridors generally shallower than 50 m in bottom depth (Morreale *et al*., 2007).

General Distribution - Feeding grounds and developmental areas are found on the Atlantic and Gulf coasts of the United States. Henwood and Ogren (1987) and Gitschlag (1996) documented sightings and movements of juveniles within and among preferred habitats along both the Atlantic and Gulf coasts. Some Kemp's ridley juveniles may migrate as far north as New York and New England, arriving in these areas around June (Morreale and Standora, 2005). During the winter, they are prompted by cooler water temperatures to leave northern developmental habitats and migrate south to warmer waters in Florida (Marquez-M., 1994). Migrations tend to take place in nearshore waters along the mid-Atlantic coast (Morreale and Standora, 2005; Morreale *et al*., 2007); juvenile and adults typically travel inshore of the 18 m isobath (Renaud and Williams, 2005). This migratory corridor is a narrow band running within continental shelf waters, possibly spanning the entire length of the U.S. Atlantic coast (Morreale and Standora, 2005; Morreale *et al*., 2007). Next to loggerheads, the Kemp's ridley is the second most abundant sea turtle found in nearshore and inshore mid-Atlantic waters (Keinath *et al*., 1987; Musick and Limpus, 1997). Seasonal movements continue until turtles reach sexual maturity, at which time, they return to breeding grounds in the Gulf of Mexico (Henwood and Ogren, 1987).

The western coast of Florida (particularly the Cedar Keys area), the coast of Alabama, the mouth of the Mississippi River, and the coastal waters off western Louisiana and eastern Texas are identified as important developmental regions for the Kemp's ridley (Márquez-M., 1990; USFWS and NMFS, 1992; Marquez-M., 1994; Schmid *et al*., 2002). The Gulf of Campeche in the southern Gulf of Mexico is also important foraging habitat.

Individuals are known to overwinter in areas south of Cape Hatteras, North Carolina, although the majority of Kemp's ridleys stay in Florida near Cape Canaveral (Henwood and Ogren, 1987). Overwintering individuals may occasionally bury in the mud to hibernate (Schwartz, 1989; Marquez-M., 1994). Individuals that overwinter in southern North Carolina may subsequently move into warmer waters (*e.g*., Gulf Stream or areas off South Carolina) during the mid-winter (Renaud, 1995; Morreale and Standora, 2005). For example, an individual satellite tagged in Beaufort in 1989 stayed in Onslow Bay, North Carolina during the winter and subsequently moved into the Gulf Stream when temperatures cooled close to shore in January 1990 (Renaud, 1995).

VACAPES OPAREA Kemp's Ridley Turtle Occurrence - Kemp's ridleys may occur within the VACAPES OPAREA year-round, although occurrence is most common during the summer. Water temperature is the most influential factor in the seasonal occurrence of Kemp's ridleys within the OPAREA. There is no Kemp's Ridley nesting on the beaches landward of the VACAPES OPAREA.

Lower Chesapeake Bay Kemp's Ridley Turtle Occurrence - In the Chesapeake Bay, Kemp's ridleys are resident from May through October (DoN 2008).

VACAPES OPAREA Kemp's Ridley Turtle Density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES Study Area are provided in Table 3.8-1. Methods and results are detailed in the NODE Report (DoN, 2007).

3.8.2.5 Leatherback Turtle

General Description - The leatherback turtle is the largest living sea turtle. Mature males and females can be as long as 2 m curved carapace length (NMFS and USFWS, 1992). Specimens less than 145 cm curved carapace length are considered to be juveniles (NMFS-SEFSC, 2001; Eckert, 2002). Adult leatherbacks weigh between 200 and 700 kg (NMFS and USFWS, 1992), although larger individuals are documented (Eckert and Luginbuhl, 1988). Leatherbacks feed throughout the epipelagic and into the mesopelagic zones of the water column (Davenport, 1988; Eckert *et al*., 1989; Grant and Ferrell, 1993; Salmon *et al*., 2004; James *et al*., 2005b). Prey is predominantly gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomas) (NMFS and USFWS, 1992; Grant and Ferrell, 1993; Bjorndal, 1997; James and Herman, 2001; Salmon *et al*., 2004).

The leatherback is the deepest diving sea turtle with a recorded maximum depth of 1,230 m (Hays *et al*., 2004a), though most dives are much shallower than this (usually less than 200 m) (Hays *et al*., 2004a; Sale *et al*., 2006). Leatherbacks spend the majority of their time in the upper 65 m of the water column regardless of their behavior (Jonsen *et al*., 2007). The aerobic dive limit for the leatherback turtle is estimated between 33 and 67 minutes (Southwood *et al*., 1999; Hays *et al*., 2004b; Wallace *et al*., 2005). Tagging data revealed that changes in individual turtle diving activity appear to be related to water temperature, suggesting an influence of seasonal prey availability on their diving behavior (Hays *et al*., 2004b).

Leatherbacks dive deeper and longer in the lower latitudes versus the higher (south versus the north) (James *et al*., 2005b). In northern waters, they are also known to dive to waters with temperatures just above freezing (James *et al*., 2006; Jonsen *et al*., 2007). James *et al*. (2006) noted a considerable variability in surface time between the northern and southern latitudes. Dives in the north are punctuated by longer surface intervals (equating to much more time spent at the surface per 24-hour period), with individuals spending up to 50 percent of their time at or near the surface in northern foraging areas, perhaps in part to thermoregulate (*i.e*., bask).

Status and Management - Leatherback turtles are listed as endangered under the ESA. Critical habitat for leatherbacks is designated in the Caribbean at Sandy Point, St. Croix, USVI (NMFS, 1979). NMFS and USFWS share jurisdictional responsibility for sea turtles under the ESA. USFWS has responsibility in the terrestrial environment while NMFS has responsibility in the marine environment.

Habitat - Throughout their lives, leatherbacks are essentially oceanic, yet they enter into coastal waters for foraging and reproduction. There is limited information available regarding the habitats utilized by post-hatchling and early juvenile leatherbacks as these age classes are entirely oceanic (NMFS and USFWS 1992). These life stages are restricted to waters greater than 26°C and, therefore, spend much time in tropical waters (Eckert 2002a). Late juvenile and adult leatherback turtles are known to range from mid-ocean to continental shelf and nearshore waters (Schroeder and Thompson 1987; Shoop and Kenney 1992; Grant and Ferrell 1993). Juvenile and adult foraging habitats include both coastal feeding areas in temperate waters and offshore feeding areas in tropical waters (Frazier 2001). Adults may also feed in cold waters at high latitudes (James *et al.* 2006a). The movements of adult leatherbacks appear to be linked to the seasonal availability of their prey and the requirements of their reproductive cycle (Collard 1990; Davenport and Balazs 1991; Luschi *et al.* 2006).

General Distribution - The leatherback turtle is distributed circumglobally in tropical, subtropical, and warm-temperate waters throughout the year and into cooler temperate waters during warmer months (NMFS and USFWS, 1992; James *et al*., 2005a) as far north as Nova Scotia, Newfoundland, Labrador, Iceland, the British Isles, and Norway (Bleakney, 1965; Brongersma, 1972; Threlfall, 1978; Goff and Lien, 1988). The leatherback is the most oceanic and wide-ranging of sea turtles, undertaking extensive migrations for hundreds to thousands of kilometers (Morreale *et al*. 1996; Hughes *et al*., 1998). Adult leatherback turtles forage in temperate and subpolar regions in all oceans and migrate to tropical nesting beaches between 30°N and 20°S.

According to aerial survey data, there is a northward movement of individuals along the southeast coast of the United States in the late winter/early spring. In February and March, most leatherbacks along the U.S. Atlantic coast are found in the waters off northeast Florida. By April and May leatherbacks begin to occur in larger numbers off the coasts of Georgia and the Carolinas (NMFS, 1995; 2000). In late spring/early summer, leatherbacks appear off the mid-Atlantic and New England coasts, while by late summer/early fall, many will have traveled as far north as the waters off eastern Canada, remaining in the northeast from approximately May through October (CETAP, 1982; Shoop and Kenney, 1992; Wyneken *et al*., 2005). Leatherback foraging areas in the western Atlantic are located on the continental shelf (30 to 50°N) as well as offshore (42°N, 65°W) (Eckert *et al*., 2006). The location of these foraging areas changes seasonally. From March through November, foraging areas occur on the North American continental shelf yet shift to off-shelf waters from December through February (Eckert *et al*., 2006).

Leatherback nesting occurs on isolated mainland beaches in tropical (mainly Atlantic and Pacific, few in Indian Ocean) and temperate oceans (southwest Indian Ocean) (NMFS and USFWS, 1992) and to a lesser degree on some islands, such as the Greater and Lesser Antilles. In the United States, the densest nesting occurs in Florida along the Atlantic coast from Jensen Beach south to Palm Beach (Stewart and Johnson, 2006). Sporadic nesting occurs in Georgia, South Carolina, and as far north as North Carolina (Rabon *et al*., 2003).

VACAPES OPAREA Leatherback Turtle Occurrence - Leatherbacks are found year-round in the VACAPES OPAREA, and could be expected in both shallow and deep waters. Leatherback presence is expected to peak off Virginia's coast in May and July and off North Carolina's coast from mid-April through mid-October. A leatherback nest in North Carolina occurred in 1966. No leatherback nests were recorded after that until 1998. Since then, a handful of nests have been confirmed in North Carolina (Cape Hatteras National Seashore is the northernmost recorded nest). Confirmed nests include 2 in 1998, 4 in 2000, 1 in 2002, 1 in 2003, 2 in 2004 and 1 in 2006 (NPS, 2007). These nests all occur south of the western boundary of the VACAPES OPAREA. Nesting does not occur on the beaches landward of the western boundary of the VACAPES OPAREA.

Lower Chesapeake Bay Leatherback Turtle Occurrence - Leatherbacks are occasionally observed in the Chesapeake Bay, but do not appear to be regular inhabitants. Hardy (1969) noted that individuals appear to enter the Bay between June and mid-September. Live leatherbacks have been reported in the upper Chesapeake Bay and in the Severn River in the Mobjack Bay system (Musick *et al*., 1988; Keinath and Musick, 1990) during June and July.

Aerial surveys off the Virginia coastline have documented leatherbacks congregating off the Bay mouth, especially May to July, presumably to feed on abundant jellyfish (Musick *et al*., 1988; Barnard *et al*., 1989; Keinath and Musick, 1990). Leatherbacks may occur rarely within the lower Chesapeake Bay region.

VACAPES OPAREA Leatherback Turtle Density - The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES Study Area are provided in Table 3.8-1. Methods and results are detailed in the NODE Report (DoN, 2007).

3.8.2.6 Loggerhead Turtle

General Description - The loggerhead turtle is a large hard-shelled sea turtle named for its disproportionately large head. The average straight carapace length of an adult female loggerhead is between 90 and 95 cm and the average weight is 100 to 150 kg (Dodd, 1988; NMFS and USFWS, 1998b).The diet of the loggerhead turtles progressively changes with age and size (Godley *et al*., 1998). The gut contents of post-hatchlings found in masses of *Sargassum* contained parts of *Sargassum*, zooplankton, jellyfish, larval shrimp and crabs, and gastropods (Carr and Meylan, 1980; Richardson and McGillivary, 1991; Witherington, 1994). Juvenile and subadult loggerhead turtles are omnivorous, foraging on pelagic crabs, mollusks, jellyfish, and vegetation captured at or near the surface (Dodd, 1988; Frick *et al*., 1999). Adult loggerheads are carnivorous, often foraging on fish, in nearshore waters, as well as benthic invertebrates (mollusks, crustaceans, and coelenterates) (Dodd, 1988).

On average, loggerhead turtles spend over 90 percent of their time underwater (Byles, 1988; Renaud and Carpenter, 1994; Narazaki *et al*., 2006). Loggerheads tend to remain at depths shallower than 100 m (Houghton *et al*., 2002; Polovina *et al*., 2003; Hawkes *et al*., 2006; Narazaki *et al*., 2006; McClellan, 2007). Routine dive depths are typically shallower than 30 m (Houghton *et al*., 2002), although dives of up to 233 m were recorded for a post-nesting female loggerhead off Japan (Sakamoto *et al*., 1990). Routine dives typically can last from 4 to 120 minutes (Byles, 1988; Sakamoto *et al*., 1990; Renaud and Carpenter, 1994; Bentivegna *et al*., 2003; Dodd and Byles, 2003).

Status and Management **-** Loggerhead turtles are listed as threatened under the ESA. The loggerhead is the most abundant sea turtle occurring in U.S. waters. In the continental United States there are four demographically independent loggerhead nesting groups or subpopulations: (1) Northern: North Carolina, South Carolina, Georgia, and northeast Florida; (2) South Florida: occurring from 29°N on the east coast to Sarasota on the west coast; (3) Florida Panhandle: Eglin Air Force Base and the beaches near Panama City, and (4) Dry Tortugas (Witherington *et al*., 2006b). Bowen *et al*. (1995) noted that under a conventional interpretation of the nuclear deoxyribonucleic acid (DNA) data, all breeding populations in the entire southeastern United States would be regarded as a single management unit, yet the mitochondrial DNA data indicate multiple isolated populations, and further suggest this complex population structure mandates a different management strategy at each life stage. The South Florida nesting subpopulation is the largest loggerhead rookery in the Atlantic Ocean (and the second largest in the world), followed by the Northern, Florida Panhandle, and Dry Tortugas subpopulations (Ehrhart *et al*., 2003; Witherington *et al*., 2006b). The south Florida nesting subpopulation produced between 43,500 and 83,400 nests annually over the past decade (USFWS and NMFS, 2003). NMFS and USFWS share jurisdictional responsibility for sea turtles under the ESA. USFWS has responsibility in the terrestrial environment while NMFS has responsibility in the marine environment.

Habitat **-** The loggerhead turtle occurs worldwide in habitats ranging from coastal estuaries to waters far beyond the continental shelf (Dodd, 1988). The species may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Results from tagging data of juvenile loggerheads in both the eastern and western North Atlantic suggest that the location of currents and associated frontal eddies is important to the foraging ecology of the pelagic stage of this species (McClellan, 2007). The neritic juvenile stage and adult foraging stage both occur in the neritic (nearshore) zone. Coral reefs, rocky places, and ship wrecks are often used as feeding areas. The turtles here are active and feed primarily on the bottom (epibenthic/demersal), though prey is also captured throughout the water column (Bjorndal, 2003; Bolten, 2003). The neritic zone not only provides crucial foraging habitat, but can also provide inter-nesting and overwintering habitat. Tagging data revealed that migratory routes may be coastal or may involve crossing deep ocean waters; an oceanic route may be taken even when a coastal route is an option (Schroeder *et al*., 2003).

General Distribution **-** Loggerhead turtles are widely distributed in subtropical and temperate waters (Dodd, 1988). Loggerhead turtles can be found along the U.S. Atlantic coast from Cape Cod to the Florida Keys during any season. Loggerheads seem generally restricted to waters of the North Atlantic Ocean south of 38°N, with mean sea surface temperatures around 22.2 °C. In the Mid-Atlantic Bight, loggerheads concentrate in continental shelf waters but are also commonly sighted in deeper, offshore waters (Shoop and Kenney, 1992). Low water temperatures affect loggerhead turtle activity. Cold-stunned loggerheads have been found in various locales, including off the northeastern United States (Morreale *et al*., 1992). Immature loggerheads inhabiting cool-temperate areas in the western North Atlantic usually migrate seasonally to avoid cold-stunning (lethargy due to cold water temperatures that could lead to death) (Musick and Limpus, 1997). Some loggerheads are believed to escape cold conditions by burying themselves in the bottom sediment and hibernating (Carr *et al*., 1980; Ogren and McVea, 1995; Hochscheid *et al*., 2005). In early spring, juvenile loggerheads over-wintering in southeastern U.S. waters begin to migrate north to developmental feeding habitats (Morreale and Standora, 2005).

The generally accepted life-history model for the species is summarized well by Musick and Limpus (1997), Bolten and Witherington (2003), and Hawkes *et al*. (2006). Hatchlings travel to oceanic habitats, often occurring in *Sargassum* drift lines (Carr, 1986, 1987; Witherington and Hirama, 2006). When juveniles reach sizes between 40 and 60 cm carapace length (about 14 years old), some individuals begin to recruit to the neritic zone (benthic habitat in shallow coastal waters) close to their natal area, while others remain in the oceanic habitat or move back and forth between the two (Musick and Limpus, 1997; Laurent *et al*., 1998). Turtles either may utilize the same neritic developmental habitat all through maturation, or they may move among different areas and finally settle in an adult foraging habitat. At sexual maturity (about 30 years old), adults switch from subadult to adult neritic foraging habitats (Musick and Limpus, 1997; Godley *et al*., 2003). In direct contrast with the accepted life-history model for this species, Hawkes *et al*. (2006) recently reported that tagging work at the Cape Verde Islands (Africa) revealed two distinct adult foraging strategies that appear to be linked to body size. The larger turtles foraged in coastal waters, whereas smaller individuals foraged oceanically. Likewise, off Japan, epipelagic foraging has been recorded for adult female loggerheads (Hatase *et al*., 2002). Hawkes *et al*. (2006) also found that movements of adult loggerheads off Cape Verde were in part driven by local surface currents, with active movement by individuals to remain in areas of high productivity.

VACAPES OPAREA Loggerhead Turtle Occurrence **-** Loggerheads may occur year-round in the VACAPES OPAREA, using waters of the OPAREA for foraging and transit to nesting beaches. Seasonal water temperatures influence loggerhead occurrence within the OPAREA. Loggerheads may occur in higher numbers in the shelf waters offshore Maryland during the spring and northern North Carolina during the fall. During spring and fall, loggerheads are likely transiting the OPAREA to access summer foraging or overwintering habitats. Virginia is the northernmost nesting area regularly used by loggerheads along the U.S. Atlantic Coast (Musick, 1988). Between two and 10 nests are documented annually along Virginia's Atlantic coastal beaches (BBNWR, 1993; Mansfield *et al*., 2001). Virginia's nesting season begins in late May/early June, continuing through mid- to late August.

Lower Chesapeake Bay Loggerhead Turtle Occurrence **-** The residency season for Chesapeake Bay loggerhead turtles is between May and late October/early November. Once loggerheads are within the Bay, it is assumed they are likely in the tributaries, at least within the lower portions (Mansfield, 2007). The Chesapeake Bay is considered an important developmental habitat for neritic juvenile loggerheads originating from the genetic stocks found within the eastern United States (Norrgard, 1995; Musick and Limpus, 1997). Adult loggerheads are known to use the Chesapeake Bay as an inter-nesting or foraging habitat; adult loggerheads compose approximately five percent of the turtle population within the Bay (Lutcavage and Musick, 1985; Mansfield, 2006). Loggerheads may occur in the lower Chesapeake Bay region throughout the year. No regular nesting by loggerheads occurs within Chesapeake Bay.

VACAPES OPAREA Loggerhead Turtle Density **-** The density estimates for training areas where explosions and/or ordnance use may occur in the VACAPES Study Area are provided in Table 3.8-1. Methods and results are detailed in the NODE Report (DoN, 2007).

3.8.3 Environmental Consequences

3.8.3.1 Explosive Ordnance Exposure Analysis

The exercises that use explosives are BOMBEX (W-386, Air-K and W-72A/B), MINEX (W-50A/C), FIREX (W-386 Area 7C/D, 8C/D,, 5C/D, and W-72 Area 1C1/2), and MISSILEX (W-386 Air-K and W-72A). Table 2.2-7 summarizes the number of events per year and specific areas where each occurs for each type of explosive ordnance used.

3.8.3.2 Summary of Thresholds and Criteria for Sea Turtles

Documentation of PTS or TTS in sea turtles is extremely scarce; limited to scattered, solitary records that would be difficult to extrapolate to a population-wide generality. However, it is assumed that acoustic exposure may elicit a physiological or behavioral response (startle) to detonations. Presumably the same broad categories of responses that were examined for marine mammals may also apply here to sea turtles (See Section 3.7.3.1). Few experiments have been conducted to attempt to quantify explosive exposures on turtles; and unfortunately, the methods of these experiments do not allow for their results to be analyzed. Navy analysts have compared the injury levels reported by the best of these experiments to the injury levels that would be predicted using the modified Goertner method (Goertner, 1982). For this assessment, in the absence of criteria specifically set for sea turtles, the criteria for marine mammals, as established in the Churchill FEIS (DoN, 2001), are used to estimate potential exposures for turtles. Non-injurious effects are determined by either the dual physiological criteria for single detonations or by the behavioral criterion for multiple detonations. The criterion for behavioral disturbance used in this analysis is based on use of multiple explosives that only take place during a FIREX (w/IMPASS) event or a BOMBEX event where the MK-82 or MK-83 bombs are used. Table 3.8-4 shows the criteria used in the assessment for impulsive sounds for sea turtles. Section 3.7.3.2 provides a more detailed explanation for each criteria level, metric, and threshold for small explosives and a full explanation of the acoustic affects analysis.

TABLE 3.8-4
EFFECTS, CRITERIA, AND THRESHOLDS FOR IMPULSIVE SOUNDS

Effect	Criteria	Metric	Threshold
Mortality	Onset of Extensive Lung Injury	Goertner modified positive impulse	indexed to 30.5 psi-msec (assumes 100% small animal at 26.9 lbs)
Injurious Physiological	50% Tympanic Membrane Rupture—PTS*	Energy flux density	1.17 in-lb/in^2 (about 205 dB re 1 μPa^2-sec)
Injurious Physiological	Onset Slight Lung Injury	Goertner modified positive impulse	indexed to 13 psi-msec (assumes 100% small animal at 26.9 lbs)
Non-Injurious Physiological	TTS **	Greatest energy flux density level in any 1/3-octave band (above 100 Hz for toothed whales/sea turtles and above 10 Hz for baleen whales) - for total energy over all exposures	182 dB re 1 μPa^2-sec
Non-Injurious Physiological	TTS**	Peak pressure for any single l exposure	23 psi
Non-injurious Behavioral	Behavioral Disturbance	Greatest energy flux density level in any 1/3-octave (above 100 Hz for sea turtles) - for total energy over all exposures (multiple explosions only)	177 dB re 1 μPa^2-sec

* *PTS: Permanent Threshold Shift*
** *TTS: Temporary Threshold Shift*

<u>Acoustic Effects Analysis</u>

BOMBEX, FIREX, MISSILEX and MINEX

Section 3.7.3.2 for marine mammals outlines the analysis and also applies here to sea turtles. In addition, a more in-depth effects analysis may be found in Appendix J.

3.8.3.3 No Action Alternative

<u>Vessel Movements</u>

Many of the ongoing and proposed operations within the VACAPES Study Area involve maneuvers by various types of surface ships, boats, and submarines (collectively referred to as vessels). Vessel movements have the potential to affect sea turtles by directly striking or disturbing individual animals. The probability of ship and sea turtle interactions occurring in the VACAPES Study area is dependent on several factors including numbers, types, and speeds of vessels; the regularity, duration, and spatial extent of operations; the presence/absence and density of sea turtles; and mitigation measures implemented by the Navy. Currently, the number of Navy vessels operating in the VACAPES Study Area varies based on training schedules and can range from 0 to about 10 vessels at any given time. Ship sizes range from 362 feet for a nuclear submarine (SSN) to 1,092 feet for a nuclear aircraft carrier (CVN). Speeds for operations and training typically range from 10 to 14 knots. Operations involving vessel movements occur intermittently and are short in duration, ranging from a few hours up to a few weeks. These operations are widely dispersed throughout the VACAPES OPAREA, which is a vast area encompassing 27,661 nm^2 (an area approximately the size of Indiana). The Navy logs about 1,400 total steaming days within the Study Area during a typical year.

Also, it should be noted that a variety of smaller craft, such as service vessels for routine operations and opposition forces used during training events will be operating within the Study Area. Small craft types, sizes and speeds vary. The Navy's rigid hull inflatable boat (RHIB) is one representative example of a small craft that may be used during training exercises. By way of example, the Naval Special Warfare RHIB is 35 feet in length and has a speed of 40+ knots. Other small craft, such as those used in maritime security training events, are of similar length and speed to the RHIB and often resemble, and often are, recreational fishing boats (*i.e.*, a 30 - 35 foot center consol boat with twin outboard engines).

During training speeds generally range from 10 to 14 knots; however, it should be expected that ships/craft can and will, on occasion, operate within the entire spectrum of their specific operational capabilities. It may be necessary for vessels/craft to operate at higher speeds for specific events, such as, but not limited to, pursuing and overtaking hostile vessels, evasive maneuvers, and maintenance/performance checks, such as ship trials. In all cases, the vessels/craft will be operated in a safe manner consistent with the local conditions.

While the lookout requirements described above do not apply to small boats, small boat crews are trained to detect and avoid all objects on or near the water surface as a standard safety measure. In addition, some training exercises that involve small boats also involve a ship that has lookouts. In such cases, observations of marine species by shipboard lookouts would be transmitted to the small boats and the avoidance measures applicable to the ship would apply to the small boats.

Disturbance Associated with Vessel Movements

The ability of turtles to detect approaching vessels via auditory and/or visual cues would be expected based on knowledge of their sensory biology (Bartol and Musick, 2003; Ketten and Bartol, 2006; Moein Bartol and Ketten, 2006; Bartol and Musick, 2001; Levenson *et al*., 2004). Little information is available on how turtles respond to vessel approaches. Hazel *et al*. (2007) reported that greater vessel speeds increased the probability turtles would fail to flee from an approaching vessel. Turtles fled frequently in encounters with a slow-moving (2.2 knots) vessel, but infrequently in encounters with a moderate-moving (5.9 knots) vessel, and only rarely in encounters with a fast-moving (10.3 knots) vessel. It is difficult to differentiate whether a sea turtle reacts to a vessel due to the produced sound, the presence of the vessel itself, or a combination of both.

Sea turtle hearing sensitivity is not well studied. Several studies using green, loggerhead, and Kemp's ridley turtles suggest sea turtles are most sensitive to low-frequency sounds, although this sensitivity varies slightly by species and age class (Ridgway *et al*., 1969; Lenhardt *et al*., 1994; Bartol *et al*., 1999; Ketten and Moein Bartol, 2006).

Sea turtles possess an overall hearing range of approximately 100 to 1,000 Hz, with an upper limit of 2,000 Hz (Ridgway *et al*., 1969; Lenhardt *et al*., 1994; Bartol *et al*., 1999; Ketten and Moein Bartol, 2006). Although it is difficult to determine whether sea turtle response to vessel traffic is visual or auditory in nature, it is assumed sea turtles can hear approaching vessels given their hearing range.

Hazel *et al*. (2007) found that sea turtles reacted to approaching vessels in a variety of ways. Benthic turtles launched upwards at a shallow angle and began swimming. The majority of the turtles swam away from the vessel while some swam along the vessel's track and some crossed in front of the vessel's track before swimming away. Sea turtle reaction time was greatly dependent on the speed of the vessel; sea turtles were able to react faster to slower moving vessels than to faster moving vessels. Sea turtle reactions to vessels elicited short-term responses.

Given the current ambient sound levels in the marine environment, the amount of sound contributed by the use of Navy vessels in the proposed exercises is very low. It is anticipated that any sea turtles exposed would exhibit only short-term reactions and would not suffer any long-term consequences from ship sound.

Human disturbance to wild animals may elicit similar reactions to those caused by natural predators (Gill *et al*., 2001; Beale and Monaghan, 2004). Behavioral responses may also be accompanied by a physiological response (Romero, 2004), although this is very difficult to study in the wild. Immature Kemp's ridley turtles show physiological responses to the acute stress of capture and handling through increased levels of corticosterone (Gregory and Schmid, 2001). In the short term, exposure to stressors results in changes in immediate behavior (Frid, 2003). For turtles, this can include intense behavioral reactions such as biting and rapid flipper movement (Gregory and Schmid, 2001). Repeated exposure to stressors, including human disturbance such as vessel disturbance and anthropogenic sound, can result in negative consequences to the health and viability of an individual or population (Gregory and Schmid, 2001). Chronic stress can result in decreased reproductive success (Lordi *et al*., 2000; Beale and Monaghan, 2004), decreased energy budget (Frid, 2003), displacement from habitat (Southerland and Crockford, 1993), and lower survival rates of offspring (Lordi *et al*., 2000). At this time, it is unknown what the long-term implications of chronic stress may be on sea turtle species.

Sea turtles may become habituated to sounds, including high levels of ambient noise found in areas of high vessel traffic (Moein *et al*., 1994; Hazel *et al*., 2007). Moein *et al*. (1994) conducted a study using a fixed sound source to repel sea turtles away from hopper dredges. Three decibel levels (175, 177, and 179 dB re 1 µPa at 1 m) were used for the study. It was found that while sea turtles avoided the sound upon first exposure, they appeared to habituate to the stimuli over a period of time (Lenhardt, 1994; Moein *et al*., 1994). Adult loggerheads have been observed to initially respond (*i.e*., increase swimming speeds) and avoid air guns when received levels range from 151 to 175 dB re: 1 µPa, but they eventually habituate to these sounds (Lenhardt, 2002). One turtle in the study was reported to exhibit a TTS for up to two weeks after exposure to these levels (Lenhardt, 2002). Viada *et. al*. (2008) reported on sea turtle strandings attributed to underwater explosions used in demolishing oil platforms; two juvenile turtles, 100 and 150 ft away from an explosion were killed. Sea turtles exposed to the general disturbance associated with a passing Navy ship could exhibit a short-term behavioral response such as fleeing. Therefore, general ship disturbance under the No Action Alternative may affect ESA-listed sea turtles. In accordance with NEPA, disturbance from vessels in territorial waters would have no significant impact on sea turtles. Furthermore, disturbance from vessels in non-territorial waters would not cause significant harm to sea turtles in accordance with EO 12114.

Vessel Strikes

Vessel strikes are known to affect sea turtles in the Study Area. Turtles swimming or feeding at or just beneath the surface of the water are particularly vulnerable to a vessel strike. According to Florida Fish and Wildlife Conservation Commission (unpublished data) there was a significantly increasing trend in the percent occurrence of propeller wounds among the loggerheads found dead or debilitated each year in Florida during 1986-2004. In addition, sound from surface vessel traffic may cause behavioral responses of sea turtles.

Accordingly, the Navy has adopted standard operating procedures and mitigation measures to reduce the potential for strikes with surfaced sea turtles (for more details refer to Chapter 5). These mitigation measures include:

- Using lookouts trained to detect all objects on the surface of the water, including sea turtles.
- Implementing reasonable and prudent actions to avoid the close interaction of Navy assets and sea turtles.
- Maneuvering to keep away from any observed sea turtle.

Vessel strikes under the No Action Alternative may affect listed sea turtles. The Navy is consulting with NMFS in accordance with the Endangered Species Act. In accordance with NEPA, vessel strikes in territorial waters would have no significant impact on sea turtles. Furthermore, vessel strikes in non-territorial waters would not cause significant harm to sea turtles in accordance with EO 12114.

Aircraft Overflights

Fixed-Wing Aircraft Overflights

The general aircraft overflight exposure information presented for marine mammals in Section 3.7.4.1 is also applicable to sea turtles. As discussed in Section 3.7.4.1, aircraft overflights would produce airborne noise and some of this energy would be transmitted into the water. Sea turtles could be exposed to noise associated with subsonic and supersonic fixed-wing aircraft overflights and helicopter operations while at the surface or while submerged. In addition, low-flying aircraft passing overhead could create a shadow effect that could induce a reaction in sea turtles. It is difficult to differentiate between reactions to the presence of aircraft and reactions to sound. Exposure to elevated noise levels would be brief (seconds) and infrequent based on the transitory and dispersed nature of the overflights. Sound exposure levels would be relatively low because a majority of the overflights would be above 3,000 feet. Fixed-wing aircraft overflights may occur throughout the VACAPES OPAREA.

Very little information regarding sea turtle reactions to fixed-wing aircraft overflights is available. Based knowledge of their sensory biology (Bartol and Musick, 2003; Ketten and Bartol, 2006; Lenhardt, 1994; Ridgway *et al*., 1969; Bartol *et al*., 1999), sound from low flying aircraft could be heard by a sea turtle at or near the surface. Turtles might also detect low flying aircraft via visual cues such as the aircraft's shadow. Hazel *et al*. (2007) suggested that green turtles rely more on visual cues than auditory cues when reacting to approaching water vessels. This suggests that sea turtles might not respond to aircraft overflights based on noise alone. As discussed in Section 3.7.4.1, subsonic and supersonic fixed-wing aircraft overflights are not expected to generate underwater sound levels that would result in harm of sea turtles (Eller and Cavanagh, 2000; Laney and Cavanagh, 2000).

Sea turtles exposed to aircraft overflights may exhibit no response or behavioral reactions such as quick diving. Any behavioral avoidance reaction would be short-term and would not permanently displace animals or result in physical harm. Fixed-wing aircraft overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed to low altitude overflights. Therefore, fixed-wing aircraft overflights under the No Action Alternative may affect sea turtles, but the effects would be insignificant. In accordance with NEPA, fixed-wing aircraft overflights over territorial waters would have no significant impact on sea turtles. Furthermore, fixed-wing aircraft overflights over non-territorial waters would not cause significant harm to sea turtles in accordance with EO 12114.

Helicopter Overflights

Approximately 1,968 helicopter sorties would occur in the VACAPES Study Area annually under the No Action Alternative. Helicopter overflights can occur throughout the VACAPES Study Area, but most would occur in W-50 and the lower Chesapeake Bay under the No Action Alternative. Unlike fixed-wing aircraft, helicopter training operations often occur at low altitudes (75 to 100 feet).

Based on results of a comprehensive literature review, no information regarding sea turtle reactions to helicopter overflights is available. However, based on knowledge of turtle auditory capabilities (Lenhardt, 1994, Bartol *et al.,* 1999, Ridgway, 1969, Bartol and Musick, 2003; Bartol *et al*., 2002; Levenson *et al.,* 2004), as well as their response to visual cues (Hazel *et al.,* 2007) discussed in the fixed-wing aircraft overflights section, it is reasonable to assume that if exposed, sea turtles may react to helicopter overflights. Animals would only be exposed to the sound and water disturbance if they are at or near the water surface. The sound exposure levels would be relatively low to sea turtles since they spend the majority or their time underwater. In addition to the auditory and visual cues, animals may react to the disturbance of the water by the downdraft. Sea turtles exposed to low-altitude helicopter overflights under the No Action Alternative could exhibit a short-term behavioral response, but these reactions would not permanently displace animals or result in physical harm. Helicopter overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed. Helicopter overflights under the No Action Alternative may affect sea turtles. In accordance with NEPA, helicopter overflights over territorial waters would have no significant impact on sea turtles. Furthermore, helicopter overflights over non-territorial waters would not cause significant harm to sea turtles in accordance with EO 12114.

Towed Mine Warfare (MIW) Devices

As described in Chapter 2 and Appendix D, Mine Warfare Exercises conducted in the Study Area include the use of various underwater mine detection and countermeasures systems towed through the water by helicopters flying approximately 75 feet above the water at low airspeeds. Approximately 1,358 towed Mine Warfare (MIW) device sorties would occur under the No Action Alternative in the lower Chesapeake Bay and portions of the OPAREA closest to the Bay (areas within 45 nm of NS Norfolk, see Figures 2.2-3 and 2.2-4). All five species of sea turtles may occur in areas where towed MIW devices would be used.

Helicopter crew members monitor the water's surface during training to identify and avoid any objects that might damage the equipment. Based on the low flight altitudes and relatively slow air speeds, it is likely that crew members would be able see turtles at or near the surface and avoid them. Sea turtles at or near the surface may also see or hear the oncoming helicopter or feel the downdraft, which could initiate avoidance behavior. The water column disturbance and sound created by the towed MIW device may elicit short-term behavioral responses similar to those discussed for vessel movements and aircraft overflights. The use of towed MIW devices under the No Action Alternative may affect sea turtles, but the effects of strikes would be discountable because they are extremely unlikely to occur and the effects of disturbance would be insignificant. In accordance with NEPA, the use of towed MIW devices in territorial waters would have no significant impact on sea turtles. Towed MIW devices would not be used in non-territorial waters would have no effect on sea turtles in non-territorial waters in accordance with EO 12114.

Weapons Firing/Non-explosive Practice Munitions Use

Non-explosive Practice Munitions Strikes

Current Navy training operations in the VACAPES Study Area include firing a variety of weapons and employ a variety of non-explosive practice munitions and explosive rounds, including bombs, missiles, naval gun shells, cannon shells, small caliber ammunition, and grenades. The majority of ordnance fired in the Study Area consists of non-explosive practice munitions (Table 2.2-6). The analysis presented in this section focuses on non-explosive practice munitions, while potential effects of explosive rounds are analyzed below in the explosions section. Training exercises that involve weapons firing and ordnance use take place in several training areas (see Table 2.2-6 for a summary of ordnance use by training area). Ordnance use is not authorized in W-110 and W-387 (total area approximately 4,168 nm^2) or in the lower Chesapeake Bay.

Direct ordnance strikes and disturbance associated with sound from firing weapons are potential stressors to sea turtles. Ingestion of expended ordnance is also a potential concern for some sea turtles and is analyzed below under Military Expended Materials. The primary concern is potential exposure of sea turtles at or near the water's surface, which could result in injury or mortality.

The potential for sea turtles to be struck by fired ordnance was evaluated using statistical probability modeling as described in Appendix I. Model input values include ordnance use data (frequency and type) and sea turtle density data for each season and training area where ordnance use occurs. The model first calculates the probability of a turtle being struck and then calculates the number of exposures (sea turtle/ordnance strikes) for the given season and training area. The model outputs for sea turtle/ordnance strikes are biased by the following assumptions and data/model limitations:

- The model is two-dimensional and assumes that all sea turtles would be at or near the surface 100 percent of the time, when in fact, sea turtles spend the majority of their time under water - up to 96 percent (Lutcavage and Lutz, 1997).
- The model does not take into account standard mitigation measures used by the Navy to avoid and minimize sea turtle/ordnance strikes.
- The model assumes the animal is stationary and does not account for any movement of the sea turtle or any potential avoidance of the training.

The ordnance strike model is not expected to produce false negatives because the assumptions will more likely produce an overestimate of impacts. A model output of less than one exposure provides a high level of certainty that sea turtles would not be struck and that ordnance strikes would have no effect on ESA-listed sea turtles.

Appendix I provides a breakdown of the model input/output values for each group of turtles by training area where ordnance is fired or released. All model output values are substantially less than one (Appendix I), indicating that sea turtle/ordnance strikes are extremely unlikely to occur. The probability of a direct ordnance strike is further reduced by Navy mitigation measures (see Chapter 5). Non-explosive practice munitions would have no effect on sea turtles.

Weapons Firing Disturbance

Transmitted Gunnery Sound

A gun fired from a ship on the surface of the water propagates a blast wave away from the gun muzzle. This spherical blast wave reflects off and diffracts around objects in its path. As the blast wave hits the water, it reflects back into the air, transmitting a sound pulse back into the water in proportions related to the angle at which it hits the water.

Propagating energy is transmitted into the water in a finite region below the gun. A critical angle (about 13°, as measured from the vertical) can be calculated to determine the region of transmission in relation to a ship and gun (DoN, 2006).

The largest proposed shell size for these operations is a five-inch shell. This will produce the highest pressure and all analysis will be done using this as a conservative measurement of produced and transmitted pressure, assuming that all other smaller ammunition sizes would fall under these levels.

Aboard the USS Cole in June 2000, a series of pressure measurements were taken during the firing of a five-inch gun. Average pressure measured approximately 200 decibels (dB) with reference pressure of one micro Pascal (dB re: 1 µPa) at the point of the air and water interface. Based on the USS Cole data, down-range peak pressure levels were calculated to be less than 186 dB re: 1 µPa at 100 m (DoN, 2000) and as the distance increases, the pressure would decrease.

In reference to the energy flux density (EFD) harassment criteria, the EFD levels (greatest in any 1/3 octave band above 10 Hz) of a five inch gun muzzle blast were calculated to be 190 decibels with reference pressure of one microPascal squared in one second (dB re: 1 μPa^2-sec) directly below the gun muzzle decreasing to 170 dB re: 1 μPa^2-sec at 100 m (328 feet) into the water (DoN, 2006). The rapid dissipation of the sound pressure wave coupled with the mitigation measures implemented by the Navy (see Chapter 5 for details) to detect sea turtles in the area prior to implementing operations, would result in a blast from a gun muzzle having no effect on sea turtle species.

Sound Transmitted Through Ship Hull

A gun blast will also transmit sound waves through the structure of the ship that can propagate into the water. The 2000 study aboard the USS Cole also examined the rate of sound pressure propagation through the hull of a ship (DoN, 2000). The structurally borne component of the sound consisted of low-level oscillations on the pressure time histories that preceded the main pulse, due to the air blast impinging on the water (DoN, 2006).

The structural component for a standard round was calculated to be 6.19 percent of the air blast (DoN, 2006). Given that this component of a gun blast was a small portion of the sound propagated into the water from a gun blast, and far less than the sound from the gun muzzle itself, the transmission of sound from a gun blast through the ship's hull would have no effect on listed species.

Underwater Detonations and Explosive Ordnance

Explosions that occur in the OPAREA are associated with training exercises that use explosive ordnance, including bombs (BOMBEX), missiles (MISSILEX), and naval gun shells (FIREX with IMPASS, 5-inch high explosive rounds), as well as underwater detonations associated with Mine Neutralization training (MINEX). Explosive ordnance use and underwater detonation is limited to a few specific training areas (see Table 2.2-7 for a summary of explosions by training area and Figure 3.7-5 for a summary of the areas where high explosives would be used). Explosive ordnance is not used in the lower Chesapeake Bay.

An explosive analysis was conducted to estimate the number of sea turtles that could be exposed to impacts from explosions. Appendix J contains a technical report describing the scientific basis, methods, assumptions, and all results of the explosive analysis. Tables 3.8-5 and 3.8-6 provide summaries of the explosive analysis for the No Action Alternative, which indicates that all species of sea turtles would be exposed to impacts from explosions. The modeling results indicate that Kemp's ridley, leatherback, loggerhead, and hardshell (which includes green, hawksbill, and unidentified hardshell turtles) sea turtles may be exposed to levels that could result in non-injurious (physiological and behavioral) and injurious effects. The modeling results also indicate that one Kemp's ridley and one loggerhead sea turtle may be exposed to levels that could result in mortality.

The analysis presented above indicates that underwater detonations and explosive ordnance use under the No Action Alternative may affect ESA listed green, hawksbill, leatherback, Kemp's ridley, and loggerhead sea turtles. Underwater detonations and HE ordnance use under the No Action Alternative would affect individual sea turtles, but any effects observed at the population or species level would be negligible. Therefore, in accordance with NEPA, there would be no significant impact to sea turtle populations from explosive ordnance use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to sea turtle populations resulting from explosive ordnance use during training exercises in non-territorial waters.

TABLE 3.8-5
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR SEA TURTLES IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Hardshell turtles			
BOMBEX training	16	1	0
MISSILEX Training	10	0	0
MINEX training	0	0	0
Total Exposures	26	1	0
Kemp’s Ridley turtle			
BOMBEX training	23	1	0
MISSILEX Training	13	0	0
MINEX training	0	0	0
Total Exposures	36	1	0
Leatherback turtle			
BOMBEX training	1	0	0
MISSILEX Training	1	0	0
MINEX training	0	0	0
Total Exposures	2	0	0
Loggerhead turtle			
BOMBEX training	26	1	0
MISSILEX Training	15	0	0
MINEX training	1	0	0
Total Exposures	42	1	0

TABLE 3.8-6
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR SEA TURTLES IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Hardshell turtles			
BOMBEX training	2,673	21	0
FIREX training	9	0	0
Total Exposures	2,682	21	0
Kemp’s Ridley turtle			
BOMBEX training	3,806	30	1
FIREX training	14	1	0
Total Exposures	3,820	31	1

TABLE 3.8-6
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR SEA TURTLES IN THE VACAPES STUDY AREA—NO ACTION ALTERNATIVE (Continued)

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Leatherback turtle			
BOMBEX training	114	1	0
FIREX training	0	0	0
Total Exposures	114	1	0
Loggerhead turtle			
BOMBEX training	4,604	40	1
FIREX training	14	1	0
Total Exposures	4,618	41	1

Military Expended Materials

Overview

The Navy uses a variety of Military Expended Materials during training exercises conducted in the VACAPES Study Area. The types and quantities of expended materials used and information regarding fate and transport of these materials within the marine environment are discussed in Section 3.2. The analyses presented in Sections 3.2, 3.3, and 3.6 predict that the majority of the expended materials would rapidly sink to the sea floor, become encrusted by natural processes, and incorporated into the sea floor, with no significant accumulations in any particular area and no significant negative effects to water quality or marine benthic communities. Nonetheless, sea turtles could be exposed to some expended materials via contact and ingestion.

Sea turtles of all sizes and species are known to ingest a wide variety of marine debris, which might be mistaken for prey. Plastic bags and plastic sheeting are most commonly ingested by sea turtles but balloons, Styrofoam beads, monofilament fishing line, and tar are also known to be ingested (NRC, 1990; Lutz, 1990; Bjorndal, 1994; Tomas, 2002). Marine debris could pass through the digestive tract and be voided naturally without causing harm, or it could cause sublethal effects or lethal effects (Balazs, 1985). Sublethal effects may have a greater influence on populations than lethal effects through nutrient dilution.

Nutrient dilution occurs when non-nutritive debris displaces nutritious food in the gut leading to decreased nutrient gain and ultimately slowing somatic growth or reducing reproductive output (McCauley and Bjorndal, 1999). Lutz (1990) found that hungry sea turtles will actively seek and consume marine debris if other food is not available. In most cases, this debris passed through the gut within a few days, but latex was found to take up to 4 months to clear the intestinal system. While ingestion of marine debris has been linked to sea turtle mortalities, sublethal effects are more common (NRC, 1990; Bjorndal, 1994; Tomas, 2002; McCauley and Bjorndal 1999).

Ordnance Related Materials

Ordnance related materials include various sizes of non-explosive practice munitions and shrapnel from explosive rounds (Tables 2.2-5 and 2.2-6). These solid metal materials would quickly move through the water column and settle to the sea floor where they could be available for ingestion by benthic foraging sea turtles. Ingestion of expended ordnance is not expected to occur in the water column because ordnance quickly sinks.

The probability of sea turtles ingesting expended ordnance would depend on factors such as the size of the materials, the likelihood the materials would be mistaken for prey, and the level benthic foraging that occurs in the impact area, which is a function of benthic habitat quality, prey availability, and species-specific foraging strategies. Some materials such as an intact non-explosive training bomb would be too large to be ingested by a sea turtle, but other materials such as cannon shells, small caliber ammunition, and shrapnel are small enough to be ingested. While the literature indicates that commonly ingested items such as drifting balloons or plastic bags might be mistaken as jellyfish or other prey, there are cases of animals ingesting items such as plastic caps that do not resemble prey (Barreiros, 2001). It is possible that expended ordnance colonized by epibenthic fauna could be mistaken for prey or that expended ordnance could be incidentally ingested while foraging on natural prey items.

The amount of benthic foraging that occurs in areas where ordnance would be expended is unknown, but a majority of benthic foraging by green, hawksbill, Kemp's ridley, and loggerhead turtles is expected to occur in nearshore areas (Lutcavage, *et al.*, 1997). With the exception of R-6606 and W-50, all ordnance use would occur in areas more than 12 nm offshore where minimal benthic foraging is expected. R-6606 is located from 0 to 3 nm offshore and the maximum depth is approximately 50 feet; suggesting that benthic foraging could occur throughout this area. However, only about 2 percent of the total rounds would be expended in R-6606 (about 20,000 cannon shells, small caliber, and grenades per year, see Table 2.2-6). Assuming even distribution, the concentration of rounds expended per year in R-6606 would be $611/nm^2$ or $0.00002/ft^2$. W-50 is located from 3 to 12 nm offshore and water depth ranges from about 50 feet to 65 feet. About 25 percent of the total rounds would be expended in W-50 (about 261,220 cannon shells, small caliber, and grenades per year, see Table 2.2-6). Assuming even distribution, the concentration of rounds expended per year in W-50 would be $2,122/nm^2$ or $0.00006/ft^2$. The probability of a benthic foraging sea turtle to ingest ordnance appears to be low based on the low environmental concentrations. Ingestion of ordnance under the No Action Alternative may affect green, hawksbill, Kemp's ridley, and loggerhead turtles.

Leatherbacks feed throughout the epipelagic and into the mesopelagic zones of the water column (Davenport, 1988; Eckert, *et al.*, 1989; Grant and Ferrell, 1993; Salmon, *et al.*, 2004; James, *et al.*, 2005a). Prey is predominantly gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomas) (NMFS and USFWS, 1992; Grant and Ferrell, 1993; Bjorndal, 1997; James and Herman, 2001; Salmon, *et al.*, 2004). Leatherbacks would not ingest expended ordnance because they are not expected to feed in the benthic environment.

Ingestion of ordnance would have no effect on leatherback turtles, but may affect other sea turtle species. In accordance with NEPA, ordnance related materials would have no significant impact on sea turtles in territorial waters. Furthermore, ordnance related materials would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

Target Related Materials

A variety of at-sea targets are used in the OPAREA, ranging from high-tech remotely operated airborne and surface targets (*e.g.*, airborne drones and Seaborne Powered Targets) to low-tech floating at-sea targets (*e.g.*, inflatable targets, 55-gallon metal drums) and airborne towed banners. Many of the targets are designed to be recovered for reuse and are not destroyed during training because ordnance is set to detonate before impacting the target. The only expendable airborne targets used in the OPAREA are Tactical Air-Launched Decoys, which are non-powered, constructed of extruded aluminum, weigh about 400 pounds, and are about 7 feet long. Expendable targets such as floating at-sea inflatable targets are recovered after use and properly disposed of onshore. Some targets such as 55-gallon metal drums cannot be recovered and sink to the sea floor after use. Unrecoverable floating materials generated by target use are expected to be minimal. Descriptions of the targets used in the OPAREA and information on fate and transport are provided in Section 3.2.

As discussed above for ordnance related materials, turtles that feed on or near the bottom may encounter an expended target while feeding; however, the size of the target would prohibit any listed species from ingesting it. Therefore, the use of targets under the No Action Alternative would have no effect on sea turtles. In accordance with NEPA, target-related material would have no significant impact on sea turtles in territorial waters. Furthermore, target-related material would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

Chaff Fibers, End-caps, and Pistons

The background information and general exposure analysis presented in Section 3.7.4.1 for marine mammals and chaff is also applicable to sea turtles and is not repeated here. Similar to marine mammals, sea turtles could be exposed to chaff through direct body contact, inhalation, and ingestion. Sea turtles are not expected to respond to direct contact with chaff or inhalation of chaff. In addition, any changes in water quality from chaff use would be negligible and would not be expected to affect sea turtles.

Based on the small size of chaff fibers, sea turtles would not confuse the fibers with prey items or purposefully feed on them. However, sea turtles could occasionally ingest low concentrations of chaff incidentally while feeding on prey items on the surface, in the water column, or on the bottom. While no studies have been conducted to evaluate the effects of chaff ingestion on sea turtles or other reptiles, the effects are expected to be negligible based the low concentrations that could reasonably be ingested, the small size of chaff fibers, and available data on the toxicity of chaff and aluminum (as described in Section 3.7.4.1). A young sea turtle weighing 1 kg would need to ingest more than 83,000 chaff fibers per day to receive a daily aluminum dose equal to 1,000 mg/kg (based on chaff consisting of 40 percent aluminum by weight and a 150-g chaff canister containing five million fibers). An adult loggerhead turtle weighing 113 kg or more would need to ingest more than nine million chaff fibers per day to receive a daily aluminum dose equal to 1,000 mg/kg. It is highly unlikely that a sea turtle would ingest a toxic dose of chaff based on the anticipated environmental concentration of chaff (1.8 fibers/ft^2 for a worst-case scenario of 360 chaff cartridges simultaneously released at a single drop point).

Silicon dioxide, also known as silica, is an abundant compound in nature that is prevalent in soil, rocks, and sand (USAF, 1997). Silicon is the second most abundant element in the earth's crust, making up approximately 28.2 percent by weight (Jefferson Lab, 2007). As such, the diet of benthic foraging marine animals that routinely ingest sediment while feeding likely contains relatively high concentrations of silicon dioxide. Silicon dioxide is chemically unreactive in the environment (USEPA, 1991) and the acute and chronic oral toxicity of silicon dioxide is low. No significant toxicity or mortality has been reported in animals given doses of up to 3,000 mg/kg of body weight per day (EVM, 2003). No observed adverse effect levels of 2,500 and 7,500 mg/kg of body weight per day were obtained for mice and rats, respectively in long-term studies (up to 24 months) (Takizawa *et al*., 1988).

The potential also exists for sea turtles to ingest chaff end-caps and pistons. However, the probability of sea turtles ingesting plastic end-caps and pistons is low because these materials sink in saltwater (Spargo, 2007) and the environmental concentration would be low (approximately 0.6 to 2.0 pieces/nm^2/year). A majority of the end-caps and pistons are expected to sink in offshore, deepwater areas and ultimately become incorporated into bottom sediments where minimal turtle foraging occurs. A very small percentage of the end-caps and pistons released could land on *Sargassum* mats or be transported by currents to benthic foraging areas, where the probability of ingestion would be higher. Since young pelagic turtles feed indiscriminately within *Sargassum* mats and are known to ingest anthropogenic debris (McCauley and Bjorndal, 1999), it is possible that sea turtles would be exposed to and ingest endcaps and pistons. However, the overall probability of turtles ingesting an end-cap or piston appears to be extremely unlikely.

If ingested, it is likely the small (1.3-inch diameter, 0.13-inch thick) round end-cap or piston would pass through the digestive tract of adult turtles without causing harm, as with other instances of debris ingestion (Balazs, 1985). Although ingestion of anthropogenic debris can result in serious injury or death, sea turtles are known to ingest small plastic items without noticeable negative consequence to health and viability (Barreiros, 2001; Mascarenhas, 2004). Based on their smaller size, subadult and juvenile turtles would be more susceptible to digestive tract blockage if they ingested these materials. Should a sea turtle encounter and ingest a discarded piston or endcap, the animal could experience effects ranging from sublethal effects such as nutritional dilution (McCauley and Bjorndal, 1999) to mortality (NRC, 1990; Bjorndal, 1994; Tomas, 2002). However, these effects are not expected because ingestion of end-caps and pistons would be extremely unlikely due to the low concentration of 0.6 pieces/nm^2/year. The effects of chaff use on sea turtles would be discountable and/or insignificant. Chaff use under the No Action Alternative may affect ESA-listed sea turtles, but the effects would be discountable and/or insignificant. In accordance with NEPA, chaff use would have no significant impact on sea turtles in territorial waters. Furthermore, chaff use would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

Self-Protection Flares

Self-protection flares consist of a magnesium/Teflon formulation that, when ignited and released from an aircraft, burn for a short period of time (less than 10 seconds) at very high temperatures. Flares release heat and light to disrupt tracking of Navy aircraft by enemy infrared tracking devices or weapons. Flares are designed to burn completely, thus reducing the amount of material that falls to the sea surface. Under normal operations, the only material that would enter the water would be a small, round plastic end-caps (approximately 1.4 inch diameter). About 465 self-protection flares would be used in the OPAREA (W-72 and W-386) per year under the No Action Alternative.

An extensive literature review and controlled experiments conducted by the Air Force revealed that self-protection flare use poses little risk to the environment or animals (USAF, 1997). Nonetheless, sea turtles within the OPAREA could be exposed to light generated by the flares and flare plastic end-caps. The light generated by flares would have no effect on sea turtles based on short burn time, relatively high altitudes where they are used, and the widely dispersed and infrequent use. Similar to chaff end-caps and pistons, sea turtles could potentially ingest flare end-caps. Ingestion of flare end-caps under the No Action Alternative may affect sea turtles, but the effects would be considered discountable because ingestion is extremely unlikely to occur based on the low number of end-caps (465 per year). In accordance with NEPA, flares would have no significant impact on sea turtles in territorial waters. Furthermore, flares would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

Marine Markers

The MK-25 and MK-58 marine markers produce chemical flames and regions of surface smoke and are used in various training exercises to mark a surface position to simulate divers, ships, and points of contact on the surface of the ocean. When the accompanying cartridge is broken, an area of smoke is released. The smoke dissipates in the air having little effect on the marine environment. The marker burns similar to a flare, producing a flame until all burn components have been used. While the light generated from the marker is bright enough to be seen up to three miles away in ideal conditions, the resulting light would either be reflected off the water's surface or would enter the water and attenuate in brightness over depth. The point source of the light would be focused and be less intense than if an animal were to look to the surface and encounter the direct path of the sun. The MK-58 is composed of tin and contains two red phosphorus pyrotechnic candles and a seawater-activated battery. The MK-58 marine marker is 21.78 inches long and 5.03 inches in diameter, weighs 12.8 lbs, and produces a yellow flame and white smoke for a minimum of 40 minutes and a maximum of 60 minutes (The Ordnance Shop, 2007). The marker itself is not designed to be recovered and would eventually sink to the bottom and become encrusted and/or incorporated into the sediments. Approximately 300 marine markers would be used in the Study Area under the No Action Alternative.

Expended marine markers are a potential ingestion hazard for sea turtles while they are floating or after they sink to the bottom. However, the probability of ingestion is extremely low based on the low number of marine markers expended per year (300) and the low concentration (0.01/nm^2/year). Marine marker ingestion under the No Action Alternative may affect sea turtles, but the effects would be considered discountable because ingestion is extremely unlikely to occur. In accordance with NEPA, marine markers would have no significant impact on sea turtles in territorial waters. Furthermore, marine markers would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

3.8.3.4 Alternative 1

Vessels Movements

The number of operations involving vessel movements would increase in the VACAPES Study Area under Alternative 1 with a total of 1,420 steaming days per year; an increase of one percent over the No Action Alternative (Table 2.2-5). These changes would result in increased potential for short-term behavioral reactions to vessels. Potential for collision would increase slightly compared to the No Action Alternative; however, Navy mitigation measures (see Chapter 5) would reduce the probability.

Vessel movements under Alternative 1 may affect sea turtles. In accordance with NEPA, vessel movements in territorial waters would have no significant impact on sea turtles. Furthermore, vessel movements in non-territorial waters would not cause significant harm to sea turtles in accordance with EO 12114.

Aircraft Overflights

The number of operations involving aircraft overflights (both fixed-wing aircraft and helicopters) would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5). The number of fixed-wing sorties under Alternative 1 would increase 10 percent to 6,558 and helicopter sorties would increase 88 percent to 3,463. These changes would result in increased exposures of sea turtles to overflights. Elevated numbers of overflights would increase the potential for behavioral disturbance due to sound, shadow-effects, and/or, in the case of helicopters, water column disturbance. Behavioral reactions to fixed-wing and helicopter overflights would be the same as discussed under the No Action Alternative. Aircraft overflights under Alternative 1 may affect sea turtles, but the effects are expected to be insignificant. In accordance with NEPA, aircraft overflights over territorial waters would have no significant impact on sea turtles. Furthermore, aircraft overflights over non-territorial waters would not cause significant harm to sea turtles in accordance with EO 12114.

Towed Mine Warfare (MIW) devices

Towed Mine Warfare (MIW) device sorties would increase by 60 percent to 2,172 per year under Alternative 1 (Table 2.2-5). The additional sorties would increase the potential for sea turtles to be struck by a towed MIW device. As noted in the analysis of the No Action Alternative, there are no documented instances of this occurring. Helicopter crew members monitor the water's surface during training to identify and avoid any objects that might damage the equipment. Based on the low flight altitudes and relatively slow air speeds, it is likely that crew members would be able see turtles at or near the surface and avoid them. Sea turtles at or near the surface would likely see or hear the oncoming helicopter or feel the downdraft, which could initiate avoidance behavior. The water column disturbance and sound created by the towed MIW device would likely elicit short-term behavioral responses similar to those discussed for vessel movements and aircraft overflights. The use of towed MIW devices under Alternative 1 may affect sea turtles, but the effects of strikes would be discountable because they are extremely unlikely to occur and the effects of disturbance would be insignificant. In accordance with NEPA, the use of towed devices in territorial waters would have no significant impact on sea turtles. Towed MIW devices would not be used in non-territorial waters and would have no effect on sea turtles in non-territorial waters in accordance with EO 12114.

Weapons Firing/Non-explosive Practice Munitions Use

Non-explosive Practice Munitions Strikes

The amount of ordnance fired would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5 and 2.2-6). These changes would result in increased potential exposure for sea turtle ordnance strikes compared to baseline conditions. However, ordnance strike modeling predicts that substantially less than one sea turtle would be exposed to direct ordnance strikes under Alternative 1 (see Appendix I). Additionally, Navy mitigation measures further reduce the probability of ordnance-related exposure. The use of non-explosive practice munitions under Alternative 1 would have no effect on sea turtles.

Weapons Firing Disturbance

The number of weapons firings in the VACAPES Study Area would increase under Alternative 1. Based on the discussion under the No Action Alternative above, firing of weapons would not result in an exposure of sea turtles, additional weapon firings would have no effect on sea turtles.

Underwater Detonations and Explosive Ordnance Use

The number and location of explosions occurring in the Study Area would not change under Alternative 1, with the exception of Hellfire missiles, 5 lb and 20 lb net explosive weight underwater detonation charges (Table 2.2-7 and Figure 3.7-5). Under Alternative 1, 30 additional Hellfire missile explosions would occur in the OPAREA, 30 additional 5 lb underwater detonations and 12 additional 20 lb underwater detonation charges would occur in W-50 under Alternative 1.

An explosive analysis was conducted to estimate the number of sea turtles that could be exposed to impacts from explosions. Appendix J contains a technical report describing the scientific basis, methods, and assumptions of the explosive analysis. Tables 3.8-7 and 3.8-8 provide summaries of the explosive analysis for Alternative 1. The modeling results indicate that Kemp's ridley, leatherback, loggerhead, and hardshell (which includes green, hawksbill, and unidentified hardshell turtles) sea turtles may be exposed to levels that could result in non-injurious (physiological and behavioral) and injurious effects. The modeling results also indicate that one Kemp's ridley and one loggerhead sea turtle may be exposed to levels that could result in mortality.

The analysis presented above indicates that underwater detonations and explosive ordnance use under the Alternative 1 may affect ESA listed green, hawksbill, leatherback, Kemp's ridley, and loggerhead sea turtles. Underwater detonations and HE ordnance use under the No Action Alternative would affect individual sea turtles, but any effects observed at the population or species level would be negligible. Therefore, in accordance with NEPA, there would be no significant impact to sea turtle populations from explosive ordnance use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to sea turtle populations resulting from explosive ordnance use during training exercises in non-territorial waters.

Military Expended Materials

Ordnance Related Materials

The amount of ordnance fired would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5 and 2.2-6). Similar to the No Action Alternative, green, hawksbill, Kemp's ridley, and loggerhead turtles would potentially be exposed to expended ordnance via ingestion from foraging off the bottom. Leatherback turtles would not ingest expended ordnance because they do not feed on the bottom. Therefore, ingestion of ordnance would have no effect on leatherback turtles under Alternative 1.

TABLE 3.8-7
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR SEA TURTLES IN THE VACAPES STUDY AREA—ALTERNATIVE 1

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Hardshell turtles			
BOMBEX training	16	1	0
MISSILEX Training	11	0	0
MINEX training	0	0	0
Total Exposures	27	1	0
Kemp's Ridley turtle			
BOMBEX training	23	1	0
MISSILEX Training	15	0	0
MINEX training	0	0	0
Total Exposures	38	1	0
Leatherback turtle			
BOMBEX training	1	0	0
MISSILEX Training	1	0	0
MINEX training	0	0	0
Total Exposures	2	0	0
Loggerhead turtle			
BOMBEX training	26	1	0
MISSILEX Training	18	1	0
MINEX training	3	0	0
Total Exposures	47	2	0

TABLE 3.8-8
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR SEA TURTLES IN THE VACAPES STUDY AREA—ALTERNATIVE 1

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Hardshell turtles			
BOMBEX training	2,673	21	0
FIREX training	9	0	0
Total Exposures	2,682	21	0
Kemp's Ridley turtle			
BOMBEX training	3,806	30	1
FIREX training	14	1	0
Total Exposures	3,820	31	1
Leatherback turtle			
BOMBEX training	114	1	0
FIREX training	0	0	0
Total Exposures	114	1	0
Loggerhead turtle			
BOMBEX training	4,604	40	1
FIREX training	14	1	0
Total Exposures	4,618	41	1

As discussed for the No Action Alternative, benthic foraging by sea turtles is more likely to occur in R-6606 and W-50 compared to other areas farther offshore. The number of rounds expended in R-6606 would increase from 20,054 to 22,060 per year, and the resulting concentration of rounds per year would be 673/nm^2 or 0.00002/ft^2. The number of rounds expended in W-50 would increase from 261,226 to 330,650 per year, and the resulting concentration of rounds per year would be 2,686/nm^2 or 0.00007/ft^2. These concentration increases are negligible when compared to the No Action Alternative. The probability of a benthic foraging sea turtle to ingest ordnance would continue to be low under Alternative 1. Ingestion of ordnance under Alternative 1 may affect green, hawksbill, Kemp's ridley, and loggerhead turtles. In accordance with NEPA, ordnance related materials would have no significant impact on sea turtles in territorial waters. Furthermore, ordnance related materials would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

Target Related Materials

The number of expendable targets used in the Study Area would increase by about 10 percent per year under Alternative 1 (Table 2.2-5). Analysis of both remotely operated and floating at-sea targets under the No Action Alternative indicates that the use of targets would have no effect on listed sea turtles due to the large size of the target which would prohibit any sea turtle from ingesting it. Increased numbers of these targets under Alternative 1 would have no effect on listed sea turtles.

Chaff Fibers, End-caps, and Pistons

The amount of chaff used in the OPAREA would increase by about 12 percent per year under Alternative 1 (Tables 2.2-5 and 3.7-28). This increase in chaff use would result in negligible increases in relative environmental concentrations of chaff fibers, end-caps, and pistons (Table 3.7-28). Similar to the No Action Alternative, effects of direct body contact, inhalation, and any changes to water or sediment quality would continue to be insignificant. The potential for sea turtles to ingest chaff fibers would increase under Alternative 1, but ingestion of a toxic dose (greater than 1,000 mg/kg) would continue to be highly unlikely based on the anticipated low environmental concentration (1.8 fibers/ft^2). Sea turtles could ingest chaff end-caps and pistons under Alternative 1, but the likelihood of ingestion remains extremely low based on the low environmental concentration (0.7 to 2.2 pieces/nm^2). Chaff use under Alternative 1 may affect ESA-listed sea turtles, however the effects would be insignificant or discountable. In accordance with NEPA, chaff use would have no significant impact on sea turtles in territorial waters. Furthermore, chaff use would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

Self-Protection Flares

The number of self-protection flares used in the Study Area would increase under Alternative 1 from 465 to 825 per year, a 77 percent increase. Similar to the No Action Alternative, ingestion of flare end-caps under Alternative 1 may affect sea turtles, but the effects would be considered discountable because ingestion is extremely unlikely to occur based on the low number of end-caps (825 per year). In accordance with NEPA, flare use would have no significant impact on sea turtles in territorial waters. Furthermore, flare use would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

Marine Markers

The number of marine markers used in the Study Area would increase under Alternative 1 from 300 to 495 per year. The probability of a sea turtle ingesting an expended marine marker would be extremely low based on the low concentration in the Study Area (0.02/nm^2/year). Marine marker ingestion under Alternative 1 may affect sea turtles, but the effects would be considered discountable because ingestion is extremely unlikely to occur. In accordance with NEPA, marine markers would have no significant impact on sea turtles in territorial waters. Furthermore, marine markers would not cause significant harm to sea turtles in non-territorial waters in accordance with EO 12114.

3.8.3.5 Alternative 2 (Preferred Alternative)

Vessel Movements

Vessel movements that would occur under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2. Vessel movements under Alternative 2 may affect sea turtles. In accordance with NEPA, vessel movements in territorial waters would have no significant impact on sea turtles. Furthermore, vessel movements in non-territorial waters would not cause significant harm to sea turtles in accordance with Executive Order 12114.

Aircraft Overflights

As detailed in Chapter 2 and Table 2.2-5, Alternative 2 would include 324 less fixed-wing sorties and 60 additional helicopter sorties than Alternative 1. These changes would result in an overall decrease in exposures of sea turtles to aircraft overflights from Alternative 1. Behavioral reactions to fixed-wing and helicopter overflights would be the same as discussed under the No Action Alternative. Aircraft overflights under Alternative 2 may affect sea turtles, but the effects are expected to be insignificant. In accordance with NEPA, aircraft overflights over territorial waters would have no significant impact on sea turtles. Furthermore, aircraft overflights over non-territorial waters would not cause significant harm to sea turtles in accordance with Executive Order 12114.

Towed Mine Warfare (MIW) Devices

As detailed in Chapter 2 and Table 2.2-5, Alternative 2 would include an additional 50 Towed MIW device sorties over Alternative 1. Therefore, the potential for sea turtles to be struck by towed devices would increase. Helicopter crew members monitor the water's surface during training to identify and avoid any objects that might damage the equipment. Based on the low flight altitudes and relatively slow air speeds, it is likely that crew members would be able see turtles at or near the surface and avoid them. Sea turtles at or near the surface would likely see or hear the oncoming helicopter or feel the downdraft, which could initiate avoidance behavior. The water column disturbance and sound created by the towed MIW device would likely elicit short-term behavioral responses similar to those discussed for vessel movements and aircraft overflights. The use of towed MIW devices under Alternative 1 may affect sea turtles, but the effects of collisions would be discountable because they are extremely unlikely to occur and the effects of disturbance would be insignificant. In accordance with NEPA, the use of towed devices in territorial waters would have no significant impact on sea turtles. Towed MIW devices would not be used in non-territorial waters and would have no effect on sea turtles in non-territorial waters in accordance with EO 12114.

Mine Warfare Training Area Establishment (Non-explosive Mine Shape Deployment/Recovery)

As discussed in Chapter 2 (Section 2.2.5), new Mine Warfare Training Areas would be designated in W-50 A/C and the lower Chesapeake Bay under Alternative 2. This section addresses potential effects on sea turtles associated with establishing and maintaining these training areas (*i.e.*, non-explosive mine shape deployment/recovery). The effects of conducting training exercises in these areas are analyzed under aircraft overflights, towed MIW devices, and explosions.

The effects of Mine Warfare Training Area establishment would be limited to short-term and localized disturbances of the water column and benthic habitat associated with deployment and recovery of non-explosive mine shapes. As discussed in Chapter 2, the mine shape assembly would include a concrete anchor, mooring line, and the non-explosive mine shape. Approximately 20 permanent concrete anchors would be placed in the proposed Mine Warfare Training Area in W-50 A/C and approximately 60 VEMS would be placed in the proposed training areas in the lower Chesapeake Bay (see Figures 2.2-2, 2.2-3 and 2.2-4 for specific locations). In some cases the entire assembly (mine shape, mooring line, and anchor) would be deployed concurrently from a boat or aircraft and recovered immediately following the exercise. In other cases concrete anchors would be permanently placed on the sea floor and divers would attach the mooring lines and mine shapes for specific exercises. The non-explosive mine shape deployment and recovery process would have no effect on sea turtles. The mooring lines would not present an entanglement risk for sea turtles because they would be held taut by the anchor and mine shape. Mooring lines would only be left in place for as long as the mine shape is in the water. Establishment of Mine Warfare Training Areas under Alternative 2 would have no effect on sea turtles.

Weapons Firing/Non-explosive Practice Munitions Use

Non-explosive Practice Munitions Strikes

The amount of ordnance fired would increase in the VACAPES Study Area under Alternative 2 (Table 2.2-5 and 2.2-6). These changes would result in increased potential exposure for sea turtle ordnance strikes compared to baseline conditions. However, ordnance strike modeling predicts that substantially less than one sea turtle would be exposed to direct ordnance strikes under Alternative 1 (see Appendix I). Additionally, Navy mitigation measures further reduce the probability of ordnance-related exposure. The use of non-explosive practice munitions under Alternative 1 would have no effect on sea turtles.

Underwater Detonations and Explosive Ordnance Use

Explosions associated with BOMBEX that would occur under Alternative 2 would decrease substantially from Alternative 1 and the No Action Alternative, by 96 percent (Table 2.2-7). See Figure 3.7-6 for a summary of areas where high explosives would be used under Alternative 2.

An explosive analysis was conducted to estimate the number of sea turtles that could be exposed to impacts from explosions. Appendix J contains a technical report describing the scientific basis, methods, assumptions, and all results of the explosive analysis. Tables 3.8-9 and 3.8-10 provide summaries of the explosive analysis for Alternatives 2, which indicates that all species of sea turtles would be exposed to impacts from explosions. The modeling results indicate that Kemp's ridley, leatherback, loggerhead, and hardshell (which includes green, hawksbill, and unidentified hardshell turtles) sea turtles would be exposed to levels that could result in non-injurious (physiological and behavioral) effects. The modeling results indicate that Kemp's ridley, loggerhead, and hardshell (which includes green, hawksbill, and unidentified hardshell turtles) sea turtles would be exposed to levels that could result in injurious (physiological) effects. The modeling results indicate that no sea turtles would be exposed to levels that could result in mortality under this alternative.

TABLE 3.8-9
SUMMARY OF POTENTIAL EXPOSURES FROM SINGLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR SEA TURTLES IN THE VACAPES STUDY AREA—ALTERNATIVE 2

Species/Training Operation	Potential Exposures @ 182 dB re 1 μPa^2-s or 23 psi (peak)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Hardshell turtles			
MISSILEX Training	10	0	0
MINEX training	0	0	0
Total Exposures	10	0	0
Kemp's Ridley turtle			
MISSILEX Training	15	0	0
MINEX training	0	0	0
Total Exposures	15	0	0
Leatherback turtle			
MISSILEX Training	0	0	0
MINEX training	0	0	0
Total Exposures	0	0	0
Loggerhead turtle			
MISSILEX Training	16	1	0
MINEX training	3	0	0
Total Exposures	19	1	0

TABLE 3.8-10
SUMMARY OF POTENTIAL EXPOSURES FROM MULTIPLE DETONATION EXPLOSIVE ORDNANCE (PER YEAR) FOR SEA TURTLES IN THE VACAPES STUDY AREA—ALTERNATIVE 2

Species/Training Operation	Potential Exposures @ 177 dB re 1 μPa^2-s (multiple detonations only)	Potential Exposures @ 205 dB re 1 μPa^2-s or 13 psi-ms	Potential Exposures @ 30.5 psi-ms
Hardshell turtles			
BOMBEX training	327	3	0
FIREX training	9	0	0
Total Exposures	336	3	0
Kemp's Ridley turtle			
BOMBEX training	613	5	0
FIREX training	14	1	0
Total Exposures	627	6	0
Leatherback turtle			
BOMBEX training	10	0	0
FIREX training	0	0	0
Total Exposures	10	0	0
Loggerhead turtle			
BOMBEX training	482	4	0
FIREX training	14	1	0
Total Exposures	496	5	0

Military Expended Materials

Military Expended Materials that would occur under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2. Military Expended Materials under Alternative 2 may affect sea turtles. In accordance with NEPA, Military Expended Materials in territorial waters would have no significant impact on sea turtles. Furthermore, Military Expended Materials in non-territorial waters would not cause significant harm to sea turtles in accordance with Executive Order 12114.

Summary of Effects for Alternative 2: The analysis presented above indicates that underwater detonations and explosive ordnance use under the Alternative 2 may affect ESA listed green, hawksbill, leatherback, Kemp's ridley, and loggerhead sea turtles. Underwater detonations and HE ordnance use under the No Action Alternative would affect individual sea turtles, but any effects observed at the population or species level would be negligible. Therefore, in accordance with NEPA, there would be no significant impact to sea turtle populations from explosive ordnance use during training exercises within territorial waters. In accordance with EO 12114, there would be no significant harm to sea turtle populations resulting from explosive ordnance use during training exercises in non-territorial waters.

3.8.4 Unavoidable Significant Environmental Effects

The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that unavoidable significant effects to sea turtles do not result from implementation of the proposed action.

3.8.5 Summary of Environmental Effects

3.8.5.1 Endangered Species Act

Table 3.8-11 provides a summary of the Navy's determination of effect for Alternative 2 (the Preferred Alternative) for federally listed sea turtles that occur in the VACAPES Study Area. The analysis presented indicates that actions may affect ESA-listed sea turtles. Accordingly, the Navy requested formal ESA Section 7 consultation with NMFS to ensure the proposed action would not likely jeopardize ESA-listed sea turtles. The Study Area does not contain designated critical habitat for any listed species. Consequently, the proposed action would have no effect on critical habitat.

TABLE 3.8-11
SUMMARY OF THE NAVY'S DETERMINATION OF EFFECT FOR FEDERALLY LISTED SEA TURTLES THAT OCCUR IN THE VACAPES STUDY AREA – ALTERNATIVE 2

Stressor	Green Turtle	Hawksbill Turtle	Kemp's Ridley Turtle	Leatherback Turtle	Loggerhead Turtle
Vessel Movements					
Vessel Disturbance	May Affect	May Affect	May Affect	May Affect	May Affect
Vessel Strikes	May Affect	May Affect	May Affect	May Affect	May Affect
Aircraft Overflights					
Aircraft Disturbance	May Affect	May Affect	May Affect	May Affect	May Affect
Towed MIW Devices					
Towed MIW device Strikes	May Affect	May Affect	May Affect	May Affect	May Affect
Mine Warfare Training Area Establishment					
Non-explosive Mine Shape Deployment/Recovery	No Effect	No Effect	No Effect	No Effect	No Effect
Non-Explosive Practice Munitions					
Weapons Firing Disturbance	No Effect	No Effect	No Effect	No Effect	No Effect
Ordnance Strikes	No Effect	No Effect	No Effect	No Effect	No Effect
Undet and HE Ordnance					
Live Ordnance	May Affect	May Affect	May Affect	May Affect	May Affect
Underwater Detonation	May Affect	May Affect	May Affect	May Affect	May Affect
Military Expended Materials					
Ordnance Related Materials	May Affect	May Affect	May Affect	No Effect	May Affect
Target Related Materials	No Effect	No Effect	No Effect	No Effect	No Effect
Chaff	May Affect	May Affect	May Affect	May Affect	May Affect
Self Protection Flares	May Affect	May Affect	May Affect	May Affect	May Affect
Marine Markers	May Affect	May Affect	May Affect	May Affect	May Affect

3.8.5.2 National Environmental Policy Act and Executive Order 12114

As summarized in Table 3.8-12, the No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on sea turtles in territorial waters in accordance with NEPA. Furthermore, in accordance with EO 12114 the No Action Alternative, Alternative 1, and Alternative 2 would not cause significant harm to sea turtles in non-territorial waters.

TABLE 3.8-12
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON SEA TURTLES IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
No Action		
Vessel Movements	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel strikes.	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel strikes.
Aircraft Overflights	Potential for short-term behavioral responses to overflights. No long-term population-level effects.	Potential for short-term behavioral responses to overflights. No long-term population-level effects.
Towed MIW Devices	Low potential for towed MIW device strikes. No long-term population-level effects.	Not applicable
Non-Explosive Mine Shape Deployment/ Recovery	No effect.	Not applicable.
Weapons Firing/Non-explosive Practice Munitions Use	No effect based on extremely low probability of direct strikes.	No effect based on extremely low probability of direct strikes.
Underwater Detonations and Explosive Ordnance	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI.	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI.
Military Expended Materials	Low potential for ingestion of chaff and/or flare plastic end-caps and pistons.	Low potential for ingestion of chaff and/or flare plastic end-caps and pistons.
Impact Conclusion	No significant impact to sea turtles.	No significant harm to sea turtles.
Alternative 1		
Vessel Movements	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel strikes. Slight increase compared to No Action.	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel strikes. Slight increase compared to No Action.
Aircraft Overflights	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.
Towed MIW Devices	Low potential for towed MIW device strikes. Slight increase compared to No Action. No long-term population-level effects.	Not applicable.

TABLE 3.8-12(Continued)
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON SEA TURTLES IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Non-Explosive Mine Shape Deployment/ Recovery	No effect.	Not applicable.
Weapons Firing/Non-explosive Practice Munitions Use	No effect based on extremely low probability of direct strikes.	No effect based on extremely low probability of direct strikes.
Underwater Detonations and Explosive Ordnance	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI. Slight increase compared to No Action.	Potential for short-term behavioral responses. Potential for injury or mortality within limited ZOI. Slight increase compared to No Action.
Military Expended Materials	Low potential for ingestion of chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.	Low potential for ingestion of chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.
Impact Conclusion	No significant impact to sea turtles.	No significant harm to sea turtles.
Alternative 2		
Vessel Movements	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel strikes. Slight increase compared to No Action.	Short-term behavioral responses from general vessel disturbance. Potential for injury or mortality from vessel strikes. Slight increase compared to No Action.
Aircraft Overflights	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.	Potential for short-term behavioral responses to overflights. Slight increase compared to No Action. No long-term population-level effects.
Towed MIW Devices	Low potential for towed MIW device strikes. Slight increase compared to No Action. No long-term population-level effects.	Not applicable.
Non-Explosive Mine Shape Deployment/ Recovery	No effect.	Not applicable.
Weapons Firing/Non-explosive Practice Munitions Use	No effect based on extremely low probability of direct strikes.	No effect based on extremely low probability of direct strikes.
Underwater Detonations and Explosive Ordnance	Potential for short-term behavioral responses. Potential for injury within limited ZOI. Slight increase compared to No Action.	Potential for short-term behavioral responses. Potential for injury within limited ZOI. Substantial decrease compared to No Action.
Military Expended Materials	Low potential for ingestion of chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.	Low potential for ingestion of chaff and/or flare plastic end-caps and pistons. Slight increase compared to No Action.
Impact Conclusion	No significant impact to sea turtles.	No significant harm to sea turtles.

3.9 FISH AND ESSENTIAL FISH HABITAT

3.9.1 Introduction and Methods

3.9.1.1 Regulatory Framework

The primary laws that make up the regulatory framework for fish and essential fish habitat (EFH) are described in detail in Appendix K and include the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) , the Sustainable Fisheries Act (SFA), and the Endangered Species Act (ESA).

One of the most significant mandates in the SFA is the EFH provision, which provides the means to conserve fish habitat. The SFA requires that regional fishery management councils (FMC) identify EFH for federally managed species (*i.e.*, species covered under fishery management plans [FMP]). The SFA requires federal agencies to consult with the NMFS on activities that may adversely affect EFH, or when the NMFS independently learns of a federal activity that may adversely affect EFH. An adverse effect is defined as "any impact which reduces quality and/or quantity of EFH [and] may include direct (*e.g.,* contamination or physical disruption), indirect (*e.g.,* loss of prey or reduction in species' fecundity), site-specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions" (50 CFR 600.810). As discussed in Section 3.9.2 - Affected Environment, EFH has been designated in the VACAPES Study Area.

This section of the EIS/OEIS includes the Navy's EFH Assessment for the VACAPES Range Complex. An EFH Assessment is a critical review of the proposed project and its potential impacts to EFH. As set forth in 50 CFR 600.920[e][3], EFH Assessments must include (1) a description of the proposed action (see Chapters 1 and 2); (2) an analysis of the effects of the action on EFH and managed species; (3) the federal agency's conclusions regarding the effects of the action on EFH; and (4) proposed mitigation (see Chapter 5), if applicable. Once NMFS learns of a federal or state activity that may have adverse effects on designated EFH, NMFS is required to develop EFH conservation recommendations for the activity. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH (NMFS, 2004a; 2004b).

As discussed in Appendix K, the ESA established protection over and conservation of threatened and endangered species. Portions of the VACAPES Study Area are within the historic ranges of the shortnose sturgeon and smalltooth sawfish, which are federally listed as endangered. Therefore, the ESA requirements discussed in Appendix K are applicable to the analysis for the shortnose sturgeon and smalltooth sawfish. The Navy is consulting with the NMFS in accordance with Section 7 of the ESA. Critical habitat for listed species has not been designated under the ESA in the Study Area.

3.9.1.2 Assessment Methods and Data Used

General Approach to Analysis

The general approach to analysis for fish and EFH is the same as the approach described for marine mammals in Section 3.7.1.2.

Study Area

The Study Area for fish and EFH is described in Section 1.5 and is shown in Figure 1.5-1. The Study Area is analogous to the "action area," for purposes of analysis under Section 7 of the ESA.

Data Sources

A comprehensive and systematic review of relevant literature and data has been conducted to complete the EFH Assessment, this analysis for fish and EFH, and to ensure that best available information has been used. Of the available scientific literature (both published and unpublished), the following types of documents were utilized in the assessment: journals, books, periodicals, bulletins, Department of Defense operations reports, EISs, and other technical reports published by government agencies, private businesses, consulting firms, or non-governmental conservation organizations. The scientific literature was also consulted during the search for geographic location data on the occurrence of resources within the Study Area. The primary sources of information used to describe the affected environment for fish and EFH were in the Navy's marine resources assessments (MRA) for VACAPES (DoN, 2008a) and the lower Chesapeake Bay (DoN, 2007). The MRAs provide compilations of the most recent data and information on the occurrence of marine resources in the Study Area. Descriptions of literature and data searches conducted during preparation of the MRAs are described in detail in those documents.

Factors Used to Assess Effects

This EIS/OEIS analyzes potential effects to fish and EFH in the context of the MSFCMA and SFA (federally managed species and EFH), ESA (species listed under the ESA only), NEPA, and EO 12114. The factors used to assess the significance of effects vary under these Acts. Pursuant to 50 CFR 600.910(a), an "adverse effect" on EFH is defined as any impact that reduces the quality and/or quantity of EFH. To help identify Navy activities falling within the adverse effect definition, the Navy has determined that temporary or minimal impacts are not considered to "adversely affect" EFH. 50 CFR 600.815(a)(2)(ii) and the EFH Final Rule (67 Fed. Reg. 2354) were used as guidance for this determination, as they highlight activities with impacts that are more than minimal and not temporary in nature, as opposed to those activities resulting in inconsequential changes to habitat. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (NMFS, 2002). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions (NMFS, 2002). Whether an impact is minimal depends on a number of factors:

- The intensity of the impact at the specific site being affected.
- The spatial extent of the impact relative to the availability of the habitat type affected.
- The sensitivity/vulnerability of the habitat to the impact.
- The habitat functions that may be altered by the impact (*e.g.,* shelter from predators).
- The timing of the impact relative to when the species or life stage needs the habitat.

The factors outlined above were also considered in determining the significance of effects under NEPA and EO 12114. For purposes of ESA compliance, effects of the action were analyzed to make the Navy's determination of effect for listed species. The definitions used in making the determination of effect under Section 7 of the ESA are based on the USFWS and NMFS *Endangered Species Consultation Handbook* (USFWS and NMFS, 1998) and are provided in Section 3.7.1.1.

3.9.1.3 Warfare Areas and Associated Environmental Stressors

The Navy used a screening process to identify aspects of the proposed action that could act as stressors to fish and EFH. Navy subject matter experts analyzed the warfare areas and operations included in the proposed action to identify specific activities that could act as stressors. Public and agency scoping comments, previous environmental analyses, previous agency consultations, laws, regulations, Executive Orders, and resource-specific information were also evaluated. This process was used to focus the information presented and analyzed in the affected environment and environmental consequences sections of this EIS/OEIS. As summarized in Table 3.9-1, potential stressors to fish and EFH include vessel movements (disturbance and strikes), aircraft overflights (disturbance), towed Mine Warfare devices (strikes), non-explosive mine shape deployment/recovery (habitat alteration), NEPM (disturbance and

TABLE 3.9-1
SUMMARY OF POTENTIAL STRESSORS TO FISH AND ESSENTIAL FISH HABITAT[12]

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Strikes)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)										
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓		✓	✓			
Mine Countermeasures Exercise (MCM)	W-50A/C W-386, W-72	✓	✓	✓		✓	✓		✓	
Mine Neutralization	W-50C	✓	✓	✓		✓	✓	✓	✓	✓
Surface Warfare (SUW)										
Bombing Exercise (Air-to-Surface) (at sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B			✓				✓	✓	✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A			✓				✓	✓	✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C			✓				✓		✓
GUNEX (Surface-to-Surface) Boat	W-50C, R-6606	✓	✓					✓		✓
GUNEX (Surface-to-Surface) Ship	W-386, W-72	✓	✓					✓		✓

[12] For detailed information on the numbers and types of ordnance, specific weapons platforms, types of targets used and location of operations see Table 2.2-4 and Appendix D.

TABLE 3.9-1
SUMMARY OF POTENTIAL STRESSORS TO FISH AND ESSENTIAL FISH HABITAT
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Strikes)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Laser Targeting	W-386 (Air-K)			✓						
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA	✓	✓							
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓	✓	✓					
Air Warfare (AW)										
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)			✓						
GUNEX (Air-to-Air)	W-72A			✓				✓		✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A			✓				✓	✓	✓
GUNEX (Surface-to-Air)	W-386, W-72	✓	✓	✓				✓		✓
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)	✓	✓	✓				✓		✓
Air Intercept Control (AIC)	W-386, W-72	✓	✓	✓						
Detect to Engage (DTE)	W-386, W-72	✓	✓	✓						
Strike Warfare (STW)										
HARM Missile Exercise	W-386 (Air E,F,I,J)			✓				✓	✓	✓

TABLE 3.9-1
SUMMARY OF POTENTIAL STRESSORS TO FISH AND ESSENTIAL FISH HABITAT
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Strikes)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Amphibious Warfare (AMW)										
FIREX (Surface-to-Surface) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓	✓					✓	✓	✓
Electronic Combat (EC)										
Chaff Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓						✓
Chaff Exercise- ship	W-386 and W-72	✓	✓							✓
Flare Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓						✓
Electronic Combat (EC) Operations-aircraft	W-386 (Air-K)			✓						
EC Operations- ship	VACAPES OPAREA	✓	✓							
Test and Evaluation										
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓	✓							

strikes), underwater detonations and HE ordnance, and MEM (ordnance related materials, targets, chaff, self-protection flares, and marine markers). The potential effects of these stressors on fish and EFH are analyzed in detail in Section 3.9.3.

As discussed in Section 3.3 – Water Resources and Section 3.4 – Air Quality, some water and air pollutants would be released into the environment as a result of the proposed action. The analyses presented in Sections 3.3 and 3.4 indicate that any increases in water or air pollutant concentrations resulting from Navy training in the Study Area would be negligible and localized, and impacts to water and air quality would not be significant. Based on the analyses presented in Sections 3.3 and 3.4, water and air quality changes would have no effect or negligible effects on fish and any impacts to EFH would be temporary and/or minimal. Accordingly, the effects of water and air quality changes on fish and EFH are not addressed further in this EIS/OEIS.

3.9.2 Affected Environment

3.9.2.1 Regional Overview

The Study Area encompasses marine habitats in the Atlantic Ocean and estuarine habitats in the lower Chesapeake Bay. These habitats support diverse, abundant, and dynamic fish assemblages, many of which are recreationally and commercially important.

The OPAREA includes the nearshore area from just off the mouth of the Delaware Bay south to Cape Hatteras and extends seaward into waters more than 4,000 m deep. Cape Hatteras is generally considered to be a transition zone between the warm, tropical waters found to the south and the cool, temperate waters to the north. Cape Hatteras separates the oceanic provinces of the South-Atlantic Bight from those of the Mid-Atlantic Bight. The South-Atlantic Bight encompasses the area from the Florida Straights to Cape Hatteras while the Mid-Atlantic Bight extends from Cape Hatteras to the southwestern flank of Georges Bank (Brown *et al.*, 1987; Schmitz *et al.*, 1987; Pickard and Emery, 1990; Churchill *et al.*, 1993). A majority of the OPAREA is located in the Mid-Atlantic Bight but the southernmost section of the OPAREA is located in the northernmost limit of the South-Atlantic Bight province. Thus both oceanic provinces influence the physical environment of the OPAREA.

Ichthyofauna of the Mid-Atlantic Bight and OPAREA is dynamic and highly variable, due to seasonal and climatic changes, varying life history strategies, hydrographic phenomena, fishing pressure, and natural cycles of abundance. However, the fauna is diverse because numerous species migrate seasonally through this region to spawn. This fauna is composed of both northern (temperate) and southern (subtropical/tropical) fish populations that undergo extensive migrations as they follow temperature isotherms (Olney and Bilkovic, 1998). While the boundary for faunal change in the Mid-Atlantic Bight is not distinct, Cape Hatteras has long been recognized as a zoogeographic boundary between the warm-temperate and cold-temperate faunas (Ekman, 1953; Briggs, 1974). At least 250 fish species may occur in the Mid-Atlantic Bight with over 75 percent (190 species) having southern (warm water) affinities (Briggs, 1974). According to more recent information by Able and Fahay (1998), the ichthyofauna of the central part of the Mid-Atlantic Bight comprises 336 marine and estuarine species. In addition to the fish fauna, numerous pelagic and bottom-dwelling invertebrate species (*e.g.,* bivalve mollusks, shrimp, crab, and squid) and macroalgae also occur in the Mid-Atlantic Bight (Saila and Pratt, 1973).

Grosslein and Azarovitz (1982) noted that all year "significant quantities of fish larvae" could be found throughout the Mid-Atlantic Bight. This may be due to the large number of spawning species, extensive dispersal of eggs and larvae throughout the region and into habitats (*i.e.,* inshore or estuarine nursery grounds) different than the spawning grounds, and spawning periods of long duration (spring and/or summer), as well as the continuous influx/outflux of northern and southern species. Warm-water species, such as bluefish and weakfish, enter the region as temperatures rise in the spring and summer, while cold water species (*e.g.,* Atlantic cod, Atlantic herring, and American shad) migrate north. Similarly, as fall approaches, warm-water species (*e.g.,* summer flounder, butterfish, and black sea bass) may migrate offshore toward deeper waters and then move southward while coldwater species move south into the Mid-Atlantic Bight area.

Sharks are a well-represented coastal group in the VACAPES area (Grosslein and Azarovitz, 1982). They are primarily vagrants from their principal distributional range. Oceanic epipelagic species are also well-represented by highly migratory game fish, including Atlantic yellowfin tuna, Atlantic bluefin tuna, Atlantic bigeye tuna, white marlin, blue marlin, sailfish, swordfish, dolphin-fish, and wahoo. Such species are often attracted to natural structures such as underwater hills, lumps, and canyons, as well as the shelf edge, the Gulf Stream, and *Sargassum* mats. The western front of the Gulf Stream provides significant spawning habitat for prey and game fish species that migrate into North Carolina coastal waters at an area known as “The Point” or “Hatteras Corner” (located at approximately 35°31’N by 74°45’W, see Figure 3.10-1). The Point supports large concentrations of oceanic game fish and is one of the most productive offshore fishing grounds along the U.S. east coast. Large numbers of hammerhead, silky, and mako sharks also occur here, adding to the dynamics and productivity of this area. The year-round abundance of upper trophic-level game fish implies a plentiful supply of prey (baitfish, squid, and mesopelagic fish) (Minerals Management Service, 1990).

The shelf edge habitat north of Cape Hatteras has a jagged broken bottom, over which many groupers, snappers, and porgies abound (Schwartz, 1989). Both shipwrecks and artificial reefs in the open continental shelf habitat north of Cape Hatteras can enhance bottom habitat and provide high-quality fishing grounds for species such as groupers, snappers, porgies, and sea bass.

The fish fauna of the Chesapeake Bay is extremely diverse, being represented by more than 295 species with 32 species considered year-round residents (*i.e.,* killifish, gobies, silversides, *etc*.) (Murdy *et al*., 1997). This diverse ichthyofauna is divided into the five major groups: freshwater, estuarine, marine, anadromous/semi-anadromous, and catadromous. With the exception of freshwater species, representatives from all these groups are expected to occur at least seasonally in the proposed lower Chesapeake Bay Mine Warfare Training Areas. Estuarine fish (*e.g.,* bay anchovy and weakfish) typically inhabit the tidal waters with salinities ranging from 0 to 30 practical salinity units (psu), whereas the marine component (*e.g.,* Atlantic menhaden and spot) live and reproduce in the coastal or oceanic waters with salinities greater than 30 psu. Anadromous forms, represented by clupeids of the genus *Alosa* (shad and river herring) and the striped bass, migrate from ocean waters to freshwater to spawn. Semi-anadromous fish move from waters of high salinity to waters of low salinity to spawn. These fish include such species as the white perch that move from brackish water to freshwater, and the black drum that migrates from ocean waters to the slightly reduced salinities just inside the Chesapeake Bay. Catadromous fish such as the American eel display a migration pattern that allows them to travel to the high-salinity ocean waters (*i.e.,* Sargasso Sea in the central North Atlantic) to spawn (CBP, 1993; Murdy *et al*., 1997; Reshetiloff, 2004).

Ichthyofaunal distribution within the Chesapeake Bay is influenced by the diversity of the available habitats (*e.g.,* river tributaries, coastal lagoons/estuaries, shallow water shorelines, wetlands, tidal flats, live/hard bottom areas, artificial structures, and open bay) and various physical processes (*i.e.,* wind direction/currents, extreme seasonal temperature changes) (Olney and Boehlert, 1988; Reshetiloff, 2004). In particular, extreme seasonal temperature changes influence fish distribution within the Chesapeake Bay. Fish population diversity peaks from August to September, when rarer tropical species join the warm-temperate and subtropical summer residents. In early autumn, most marine species begin their coastal migration to the south or to offshore waters, or both. Large numbers of smaller sciaenids, mullets, Atlantic menhaden, bluefish, and weakfish followed by predators such as sandbar and dusky sharks, migrate south to around Cape Hatteras, North Carolina. Other species such as clearnose skate, black sea bass, scup, butterfish, and some summer flounder migrate eastward to the continental shelf edge influenced by slope water and moderate bottom temperatures of 46º to 54ºF to overwinter at depths of 90 to 180 m. As autumn progresses, boreal species enter the lower Chesapeake Bay to feed, but move out onto the continental shelf with the arrival of winter and colder temperatures. In mid-winter, many of the mobile estuarine resident species (*e.g.,* white perch, striped bass) move into the deeper channels of the river tributaries where water temperatures become stable, density and diversity of the demersal fish decline, and some boreal species (*e.g.,* Atlantic herring and spiny dogfish) visit the lower Chesapeake Bay. From February to March, anadromous species enter the Chesapeake Bay and ascend the tributaries to spawn. By late April, some of the sciaenids and summer flounder return to the lower Chesapeake Bay with most of the warm-temperate and subtropical summer residents returning by late May to complete the seasonal cycle (Murdy *et al*., 1997).

While not located within the VACAPES Study Area, other estuaries such as the Delaware Bay, Albemarle Sound, and Pamlico Sound play an important role for many fish species found in the Study Area. Similar to the Chesapeake Bay, the fish fauna of the these estuaries are extremely diverse and include freshwater, estuarine, marine, anadromous/semi-anadromous, and catadromous species.

3.9.2.2 Essential Fish Habitat

Essential Fish Habitat in VACAPES Range Complex is generally categorized as (DoN, 2005; ASMFC, 2007; GMFMC, 2007; MAFMC, 2007a; NEFMC, 2007; SAFMC, 2007a):

- *Benthic Habitat* - rocks, gravel, cobbles, pebbles, sand, clay, mud, silt, shell fragments, and hard bottom as well as the water-sediment interface used by many species for spawning/nesting, development, dispersal, and feeding.
- *Structured Habitat* - including artificial reefs, shipwrecks, and biogenic habitat created by living organisms such as sponges, mussels, algae, and corals.
- *Sargassum Habitat* - mats of *Sargassum fluitans* and *S. natans* which provide important habitat for numerous fish, and their larval stages.
- *Gulf Stream Habitat* - a diverse and productive pelagic habitat which enhances the dispersal of larvae of many fish species.
- *Water Column Habitat* - extending from the ocean surface to the ocean floor. Depending upon the species, the habitat may only include a part of the water column (*e.g.*, surface waters)
- *Estuarine Habitat* - tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partially obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land

The FMCs classify EFH for temperate and subtropical-tropical managed species in terms of five basic life stages: (1) eggs, (2) larvae, (3) juveniles, (4) adult, and (5) spawning adult. Eggs are those individuals that have been spawned but not hatched and are completely dependent on the egg's yolk for nutrition. Larvae are individuals that have hatched and can capture prey, while juveniles are those individuals that are not sexually mature but possess fully formed organ systems that are similar to adults. Adults are sexually mature individuals that are not necessarily in spawning condition. Finally, spawning adults are those individuals capable of spawning.

Although the individual life stage terms and definitions are the same as those defined by the FMCs, NMFS categorizes the life stages of managed tuna, swordfish, and billfish somewhat differently, resulting in three categories that are based on common habitat usage by all life stages in each group: (1) spawning adults, eggs, and larvae; (2) juveniles and subadult; and (3) adult. Subadults are those individuals just reaching sexual maturity. The category of spawning adult, eggs, and larvae is associated with spawning location and the circulation patterns that control the distribution of the eggs and larvae.

NMFS uses a different life stage classification system for sharks; the system bases the life stage combinations on the general habitat shifts that accompany each developmental stage. The three resulting categories are: (1) neonate and early juvenile (including newborns and pups less than one year old), (2) late juvenile and subadult (age one to adult), and (3) adult (sexually mature sharks). In Amendment 1 to the Fisheries Management Plan for the Atlantic Tunas, Swordfish, and Sharks, the first two life stages were modified as follows: the neonate and early juvenile category was renamed "neonate," which primarily includes neonates and small young-of-the-year sharks; and the late juveniles and subadults category was renamed "juveniles," which includes all immature sharks from young to late juveniles.

Detailed descriptions of individual species, their life-histories, distribution, and maps of species designated EFH-HAPC are contained in the *Marine Resource Assessment for the Virginia Capes Operating Area* (DoN, 2008) and the *Essential Fish Habitat Study for the Southeast Operating Areas: Virginia Capes, Cherry Point, and Charleston/Jacksonville* (DoN, 2005). Section 3.6 – Marine Communities also provides descriptions of benthic habitats and maps artificial habitats (Figure 3.6-1 and 3.6-2).

At least 94 species (not including corals) with designated EFH for at least one life stage are expected to occur within the Study Area (Table 3.9-2). These include fish, invertebrate, and macroalgal species. Twenty-five of the species in Table 3.9-2 have designated EFH within the lower Chesapeake Bay Study Area. These species may be grouped as temperate, subtropical/ tropical, or highly migratory:

- **Temperate Water Fish and Invertebrate Species (T) –** Thirty-one temperate finfish and shellfish with defined EFH/HAPC may occur in the Study Area. They include groundfish (*e.g.*, haddock and silver hake), flounders, pelagic species (*e.g.*, Atlantic herring and bluefish), and invertebrates (*e.g.*, sea scallop, surf clam, squid, and quahog).
- **Subtropical/Tropical Fish and Invertebrate Species (ST/T) –** Thirty-six subtropical/tropical species with defined EFH/HAPC may occur in the Study Area. They include members of the snapper-grouper complex, coastal migratory pelagic species complex, red drum, shrimps, golden crab, calico scallops, spiny lobsters, and *Sargassum* species.
- **Highly Migratory Species (HMS) –** Twenty-seven Highly Migratory Species with defined EFH/HAPC may occur in the Study Area. They include billfish, swordfish, tunas, and many shark species.

The South Atlantic Fishery Management Council (SAFMC) is adopting an ecosystem approach to fisheries management with the development of a Fishery Ecosystem Plan that would amend the Council's fishery management and habitat plans (SAFMC, 2007b). The transition from single species management to ecosystem management will help define the complex relationships among humans, harvested fish and prey in the South Atlantic Ecosystem. This effort would improve the understanding of the social and economic impacts of management and the ecological consequences of conservation and management. It will also likely result in additional EFH areas and likely broaden areas currently designated as EFH.

The New England, Mid-Atlantic and South Atlantic FMCs, and NMFS manage the commercial and recreational fisheries in federal waters, as well as the designated EFH fish species and their HAPC that occur in the lower Chesapeake Bay. Within Virginia's waters of Chesapeake Bay, the Fisheries Management Division of the Virginia Marine Resources Commission (VMRC) administers current and long-term state policies affecting commercial and recreational saltwater fisheries in Virginia's tidal waters. Both the ASMFC and MAFMC participate as management bodies pertinent to Virginia fisheries and in the developing important species FMPs.

TABLE 3.9-2
REPRESENTATIVE SPECIES WITH ESSENTIAL FISH HABITAT AND HABITAT AREAS OF PARTICULAR CONCERN THAT ARE EXPECTED TO OCCUR IN THE VACAPES RANGE COMPLEX

Species	Group(1)	HAPC(2)	Jurisdiction(3)
Atlantic albacore (*Thunnus alalunga*)	HM		5
Atlantic angel shark (*Squatina dumeril*)	HM		5
Atlantic bluefin tuna (*Thunnus thynnus*)	HM		5
Atlantic butterfish (*Peprilus triacanthus*)	T		2
Atlantic calico scallop (*Agopecten gibbus*)	ST/T	✓	3
Atlantic cod (*Gadus morhua*)	T	✓	1
Atlantic herring (*Clupea harengus*)(4)	T		1
Atlantic mackerel (*Scomber scombrus*)	T		2
Atlantic sea scallop (*Placopecten magellanicus*)	T		1
Atlantic sharpnose shark (*Rhizoprionodon terraenovae)*(4)	HM		5
Atlantic spadefish (*Chaetodipterus faber*)	ST/T		3
Atlantic surf clam (*Spisula solidissima*)	T		2
Banded rudderfish (*Seriola zonata*)	ST/T		3,4
Bank sea bass (*Centropristis ocyurus*)	ST/T		3
Basking shark (*Cetorhinus maximus*)	HM		5
Bigeye thresher shark (*Alopias superciliosus*)	HM		5
Bigeye tuna (*Thunnus obesus*)	HM		5
Bignose shark (*Carcharhinus altimus*)	HM		5
Blackfin snapper (*Lutjanus buccanella*)	ST/T	✓	3
Black sea bass (*Centropristis striata*)(4)	T		2,3
Blacktip shark (*Carcharhinus limbatus*)	HM		5
Blue marlin (*Makaira nigricans*)	HM		5
Blue shark (*Prionace glauca*)	HM		5
Bluefin tuna (*Thunnus thynnus*)	HM		5
Bluefish (*Pomatomus saltatrix)*(4)	T		2,3,4,6
Blueline tilefish (*Caulolatilus microps*)	ST/T	✓	3,4
Brown shrimp (*Penaeus aztecus)*	ST/T	✓	3,4
Brown rock shrimp (Sicyonia brevirostris)	ST/T	✓	2
Butterfish (Peprilus triacanthus)(4)	T		2
Clearnose skate (Raja eglanteria)(4)	T		1
Cobia (Rachycentron canadum)(4)	ST/T	✓	3,4
Corals (>100 species including stony corals, octocorals)	ST/T	✓	3

TABLE 3.9-2
REPRESENTATIVE SPECIES WITH ESSENTIAL FISH HABITAT AND HABITAT AREAS OF PARTICULAR CONCERN THAT ARE EXPECTED TO OCCUR IN THE VACAPES RANGE COMPLEX
(Continued)

Species	Group[(1)]	HAPC[(2)]	Jurisdiction[(3)]
Cubera snapper *(Lutjanus cyanopterus)*	ST/T		3,4
Deep-sea red crab *(Chacon quinquedens)*	T		1
Dolphin (*Coryphaena hippurus)*	ST/T	✓	3,4
Dusky shark (*Carcharhinus obscurus*)[(4)]	HM		5
Finetooth shark (*Carcharhinus isodon*)	HM		5
Golden crab (*Chaceon fenneri*)	ST/T		3
Goliath grouper (*Epinephelus itajara*)	ST/T	✓	3
Gray snapper (*Lutjanus griseus*)	ST/T	✓	3,4
Greater amberjack (*Seriola dumerili*)	ST/T	✓	3,4
Haddock (*Melanogrammus aeglefinus*)	T		1
King mackerel (*Scomberomorus cavalla*)[(4)]	ST/T	✓	3,4
Lesser amberjack *(Seriola fasciata)*	ST/T		3,4
Little skate *(Leucoraja erinacea)*[(4)]	T		1
Longbill spearfish (*Tetrapturus pfluegeri*)	HM		5
Longfin inshore squid (*Loligo pealeii*)	T		2
Longfin mako shark (*Isurus paucus*)	HM		5
Misty grouper (*Epinephelus mystacinus*)	ST/T		3,4
Monkfish (goosefish) (*Lophius americanus*)	T		1,2,3,4
Mutton snapper (*Lutjanus analis*)	ST/T	✓	3
Night shark (*Carcharhinus signatus*)	HM		5
Northern shortfin squid (*Illex illecebrosus*)	T		2
Ocean pout (*Zoarces americanus*)	T		1
Ocean quahog (*Arctica islandica*)	T		2
Oceanic whitetip shark (*Carcharhinus longimanus*)	HM		5
Offshore hake (*Merluccius albidus*)	T		1
Pink shrimp (*Penaeus duorarum)*	ST/T	✓	3,4
Pompano dolphin (*Coryphaena equiselis*)	ST/T	✓	3,4
Queen triggerfish (*Balistes vetula*)	ST/T		3
Red drum (*Sciaenops ocellatus*)[(4)]	ST/T	✓	3,4,6
Red hake (*Urophycis chuss*)[(4)]	T		1
Red porgy (*Pagrus pagrus*)	ST/T	✓	3
Red snapper (*Lutjanus campechanus*)	ST/T	✓	3,4
Ridged slipper lobster (*Scyllarides notifer*)	ST/T		3
Rock sea bass (*Centropristis philadelphica*)	ST/T		3

TABLE 3.9-2
REPRESENTATIVE SPECIES WITH ESSENTIAL FISH HABITAT AND HABITAT AREAS OF PARTICULAR CONCERN THAT ARE EXPECTED TO OCCUR IN THE VACAPES RANGE COMPLEX
(Continued)

Species	Group(1)	HAPC(2)	Jurisdiction(3)
Rock shrimp (*Sicyonia brevirostris*)	ST/T		3
Rosette skate (*Leucoraja garmani*)	T		1
Royal red shrimp (*Pleoticus robustus*)	ST/T	✓	3
Sailfish (*Istiophorus platypterus*)	HM		5
Sailors choice (*Haemulon parrai*)	ST/T		3
Sand tiger shark (*Carcharias taurus*)(4)	HM		5
Sandbar shark (*Carcharhinus plumbeus*)(4)	HM	✓	5
Sargassum weed (*Sargassum fluitans, S. natans*)	ST/T	✓	3
Scalloped hammerhead (*Sphyrna lewini*)(4)	HM		5
Scamp (*Mycteroperca phenax*)	ST/T	✓	3,4
Scup (*Stenotomus chrysops*)(4)	T		2,3
Shortfin mako shark (*Isurus oxyrinchus)*	HM		5
Silk snapper (*Lutjanus vivanus*)	ST/T	✓	3,4
Silky shark (*Carcharhinus falciformis)*	HM		5
Silver hake (whiting) (*Merluccius bilinearis*)(4)	T		1
Skipjack tuna (*Katsuwonus pelamis*)	HM		5
Snowy grouper (*Epinephelus niveatus*)	ST/T	✓	3,4
Spanish mackerel (*Scomberomorus maculatus*)(4)	ST/T	✓	3,4
Speckled hind (*Epinephelus drummondhayi)*	ST/T	✓	3,4
Spiny dogfish (*Squalus acanthias*)(4)	T		1,2
Spiny lobster (*Panulirus argus*)	ST/T		3,4
Summer flounder (*Paralichthys dentatus*)(4)	T	✓	2
Swordfish (*Xiphias gladius*)	HM		5
Tiger shark (*Galeocerdo cuvier*)(4)	HM		5
Tilefish (*Lopholatilus chamaeleonticeps*)	T and ST/T	✓	2
Vermilion snapper (*Rhomboplites aurorubens*)	ST/T	✓	3,4
Wahoo (*Acanthocybium solanderi*)	ST/T	✓	3
Warsaw grouper (*Epinephelus nigritus)*	ST/T	✓	3,4
White grunt (*Haemulon plumieri*)	ST/T	✓	3
White hake (*Urophycis tenuis*)	T		1
White marlin (*Tetrapturus albidus*)	HM		5
White shrimp (*Penaeus setiferus*)	ST/T	✓	3,4
Windowpane flounder (*Scophthalmus aquosus*)(4)	T		1
Winter flounder (*Pleuronectes americanus*)(4)	T		1
Winter skate (*Leuoraja ocellata*) (4)	T		1

TABLE 3.9-2
REPRESENTATIVE SPECIES WITH ESSENTIAL FISH HABITAT AND HABITAT AREAS OF PARTICULAR CONCERN THAT ARE EXPECTED TO OCCUR IN THE VACAPES RANGE COMPLEX
(Continued)

Species	Group[(1)]	HAPC[(2)]	Jurisdiction[(3)]
Witch flounder (*Glyptocephalus cynoglossus*)[(4)]	T		1
Wreckfish (*Polyprion americanus*)	ST/T	✓	3
Yellowfin tuna (*Thunnus albacares*)	HM		5
Yellowedge grouper (*Epinephelus flavolimbatus*)	ST/T	✓	3,4
Yellowtail flounder (*Pleuronectes ferrugineus*)[(4)]	T		1

(1)Group: T=temperate; ST/T=subtropical/tropical; HM= highly migratory.
(2) ✓ indicates Habitat Areas of Particular Concern have been designated for this species/group in the Study Area. Note that HAPC for the snapper grouper complex is the same for all species.
(3)Jurisdictions: 1=New England Fishery Management Council (NEFMC); 2=Mid-Atlantic Fishery Management Council (MAFMC); 3= SAFMC; 4=Gulf of Mexico Fishery Management Council (GMFMC); 5=NMFS; 6= Atlantic States Marine Fishery Commission (ASMFC).
(4)EFH has been designated for these species in the Atlantic Ocean and Chesapeake Bay portions of the Study Area.
Sources: ASMFC, 2007; GMFMC, 2007; MAFMC, 2007a; NEFMC, 2007; SAFMC, 2007a.

3.9.2.3 Fishery Management Plans and Managed Species

Fisheries occurring primarily in the Exclusive Economic Zone (EEZ) (which extends out 200 nm offshore) off the northeastern U.S. are managed under fishery management plans (FMPs) developed by the New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council (MAFMC); southern species whose range occurs in this region are managed under FMPs developed by SAFMC. MAFMC is the primary body responsible for management of fisheries in the federal waters encompassed by VACAPES Range Complex.

Twenty-two coastal species have FMPs managed by the Atlantic States Marine Fisheries Commission (ASMFC), a consortium of the 18 eastern U.S. coastal states with jurisdiction in State waters (generally 0-3 nm from shore) (ASMFC, 2007). MAFMC and the ASMFC jointly manage 4 coastal species found within VACAPES Range complex: black seabass, bluefish, scup, and summer flounder.

The FMCs and NMFS currently have twenty-one FMPs covering managed species and habitats that may occur in the area (Table 3.9-3). The individual species, and groups of species, managed through each FMP are often referred to as "management units (MU)" by fishery agencies. Recreational and commercial harvest of red drum from the EEZ was prohibited in 1990 and SAFMC is currently in the process of transferring management to ASMFC, as 100 percent of the catch is currently taken in state waters.

TABLE 3.9-3
FISHERY MANAGEMENT PLANS AND MANAGED SPECIES IN THE VACAPES RANGE COMPLEX

Agency and Fishery Management Plan	Representative Species Expected to Occur In VACAPES Range Complex	Reference
National Marine Fisheries Service		
Consolidated Atlantic Highly Migratory Species FMP	**Billfish MU** Blue marlin, longbill spearfish, sailfish, and white marlin **Swordfish MU** Swordfish **Tuna MU** Bluefin, bigeye, skipjack tuna, and yellowfin tuna and Atlantic albacore **Large Coastal Shark MU** Blacktip, sandbar, scalloped hammerhead, silky, and tiger sharks **Small Coastal Shark MU** Atlantic sharpnose and finetooth sharks **Pelagic Shark MU** Blue, oceanic whitetip, and shortfin mako sharks **Prohibited Species MU** Atlantic angel, basking, bigeye thresher, bignose, dusky, longfin mako, night, and sand tiger sharks	NMFS, 2006a
New England Fishery Management Council		
Atlantic Herring FMP	Atlantic herring	NEFMC, 2007
Atlantic Sea Scallop FMP	Atlantic sea scallop	NEFMC, 2007
Deep-sea Red Crab FMP	Deep-sea red crab	NEFMC, 2007
Northeast Multispecies FMP	Atlantic cod, haddock, ocean pout, offshore hake, red hake, silver hake/whiting, summer flounder, white hake, windowpane flounder, winter flounder, witch flounder, and yellowtail flounder	NEFMC, 2007
Northeast Skate Complex FMP	Clearnose skate, little skate, rosette skate, and winter skate	NEFMC, 2007
Monkfish FMP	Monkfish (goosefish)	MAFMC, 2007e
Mid-Atlantic Fishery Management Council		
Atlantic Mackerel, Squid and Butterfish FMP	Atlantic mackerel, butterfish, and longfin inshore squid	MAFMC, 2007b
Bluefish FMP	Bluefish	MAFMC, 2007c
Spiny Dogfish FMP	Spiny dogfish	MAFMC, 2007d
Summer Flounder, Scup and Black Sea Bass FMP	Summer flounder, scup, and black sea bass	MAFMC, 2007f
Surf Clam and Ocean Quahog FMP	Atlantic surf clam and ocean quahog	MAFMC, 2007g
Tilefish FMP	Tilefish	MAFMC, 2007h
South Atlantic Fishery Management Council		
Calico Scallop FMP	Atlantic calico scallop	SAFMC, 2007a
Coastal Migratory Pelagics FMP	Cobia, king mackerel, and Spanish mackerel	SAFMC, 2007a
Corals, Coral Reefs and Live-bottom Habitat FMP	Corals (stony corals and octocorals)	SAFMC, 2007a

TABLE 3.9-3
FISHERY MANAGEMENT PLANS AND MANAGED SPECIES IN THE VACAPES RANGE COMPLEX (Continued)

Agency and Fishery Management Plan	Representative Species Expected to Occur In VACAPES Range Complex	Reference
olphin and Wahoo FMP	Dolphin, pompano dolphin, and wahoo	SAFMC, 2007c
Golden Crab FMP	Golden crab	SAFMC, 2007a
Red Drum FMP	Red drum	SAFMC, 2007a
Shrimp FMP	Brown rock, brown, pink, royal red, and white shrimp	SAFMC, 2007a
Snapper/Grouper FMP	Blackfin snapper, blueline tilefish, goliath grouper, gray snapper, greater amberjack, mutton snapper, red porgy, red snapper, scamp, silk snapper, snowy grouper, speckled hind, tilefish, vermilion snapper, Warsaw grouper, white grunt, wreckfish, and yellowedge grouper	SAFMC, 2007a
Spiny Lobster FMP	Spiny lobster and ridged slipper lobster	SAFMC, 2007a

3.9.2.4 Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation. Regional FMCs may designate a specific habitat area as an HAPC based on one or more of the following reasons: (1) importance of the ecological function provided by the habitat, (2) the extent to which the habitat is sensitive to human-induced environmental degradation, (3) whether, and to what extent, development activities are, or will be, stressing the habitat type, and (4) rarity of the habitat type (NMFS, 2002a). The HAPC designation does not confer additional protection or restrictions upon an area, but can help prioritize conservation efforts.

As summarized in Table 3.9-4 several species have designated HAPC for some or all life stages in the Atlantic Ocean portion of the Study Area. Three of these species have HAPC in the lower Chesapeake Bay Study Area (summer flounder, red drum, sandbar shark). Figure 3.9-1 shows coral, coral reefs, and live or hard bottom HAPC. Other mapping for other HAPCs are provided in DoN (2008).

TABLE 3.9-4
HABITAT AREAS OF PARTICULAR CONCERN IN THE VACAPES RANGE COMPLEX

EFH Species	HAPC Description	Designations
Atlantic calico scallop	Medium-high profile, offshore, hard bottom habitat, *Sargassum*; hermatypic coral habitats/reefs; designated Artificial Reef Special Management Zones (SMZs), The Point (NC), seagrass, mangrove and oyster/shell habitats, inlets, state designated nursery habitats, near-shore hard-bottom habitat.	All life stages
Atlantic cod	Northern edge of Georges Bank.	Juveniles
Snapper Grouper Complex	Medium-high profile, offshore, hard bottom habitat, *Sargassum*; hermatypic coral habitats/reefs; designated Artificial Reef Special Management Zones (SMZs), The Point (NC), seagrass, mangrove and oyster/shell habitats, inlets, state designated nursery habitats, near-	All life stages

TABLE 3.9-4
HABITAT AREAS OF PARTICULAR CONCERN
IN THE VACAPES RANGE COMPLEX

EFH Species	HAPC Description	Designations
	shore hard-bottom habitat.	
Brown, Pink, White shrimp	All coastal inlets, state designated nursery areas, state identified over-wintering areas.	All life stages
Cobia	Sandy shoals of Cape Hatteras from shore to end of the shoal shoreward of the Gulf Stream. The Point; pelagic *Sargassum*.	All life stages
Corals	The Point (NC), all corals, gorgonians and octocorals.	All corals
Dolphin	The Point (NC), the Gulf Stream and associated eddies occurring within the EEZ.	All life stages
Golden tilefish	Between the 250 ft and 1,200 ft isobath from the US/Canada boundary to the Virginia/N. Carolina boundary.	Juvenile and adult
King mackerel	Sandy shoals of Cape Hatteras, shore to the ends of shoals but shoreward of the Gulf Stream. The Point, pelagic *Sargassum.*	All life stages
Red drum	Inlets, state designated nursery, documented spawn aggregations, barrier islands and their passes, SAV in Virginia, North Carolina, inlets, adjoining channels, sounds, and bars.	All life stages
Royal red shrimp	Medium-high profile, offshore, hard bottom habitat where spawning normally occurs; pelagic *Sargassum.* All hard bottom areas, SAV.	All life stages
Sandbar shark (HMS)	Shallows near mouth of lower/middle Delaware & Chesapeake Bays & outer banks of NC near Palmico Sound adjacent to Hatteras and Ocracoke islands, and offshore these islands.	All life stages
Sargassum *S. fluitans* *S. natans*	Waters of the Gulf Stream; state waters of NC; south of the state line of the Virginia/North Carolina border throughout the entire water column to edge of EEZ.	SAFMC FMP protection. HAPC under NMFS review.
Spanish mackerel	Sandy shoals of Cape Hatteras, shore to ends of shoals but shoreward of Gulf Stream; The Point (NC); pelagic *Sargassum*.	All life stages
Speckled hind	Medium-high offshore habitat where spawning normally occurs, pelagic *Sargassum,* hermatypic coral habitats, Artificial Reef SMZs, The Point. Mangrove, seagrass, oyster/shell habitats. Inlets, state-designated nursery habitats.	All life stages
Summer flounder	All native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations within adult and juvenile summer flounder EFH.	Juveniles and adults
Wahoo	The Point, NC.	All life stages

3.9.2.5 Endangered Species Act-Listed Fish Species

Shortnose Sturgeon

The shortnose sturgeon (*Acipenser brevirostrum*) was originally listed as an endangered species throughout its range under the Endangered Species Preservation Act of 1966 and remained on the endangered species list with the enactment of the ESA in 1973 (NMFS, 1998). Critical habitat has not been designated for this species. Historically, the range of the shortnose sturgeon extended along the Atlantic coast from Saint John River, New Brunswick, Canada to Indian River, Florida (Gruchy and Parker, 1980). Currently, NMFS recognizes 19 distinct population segments of shortnose sturgeons inhabiting 25 river systems from Saint John River, New Brunswick, Canada, to Saint Johns River, Florida (NMFS, 1998). Distinct population segments in the vicinity of the VACAPES Study Area include the

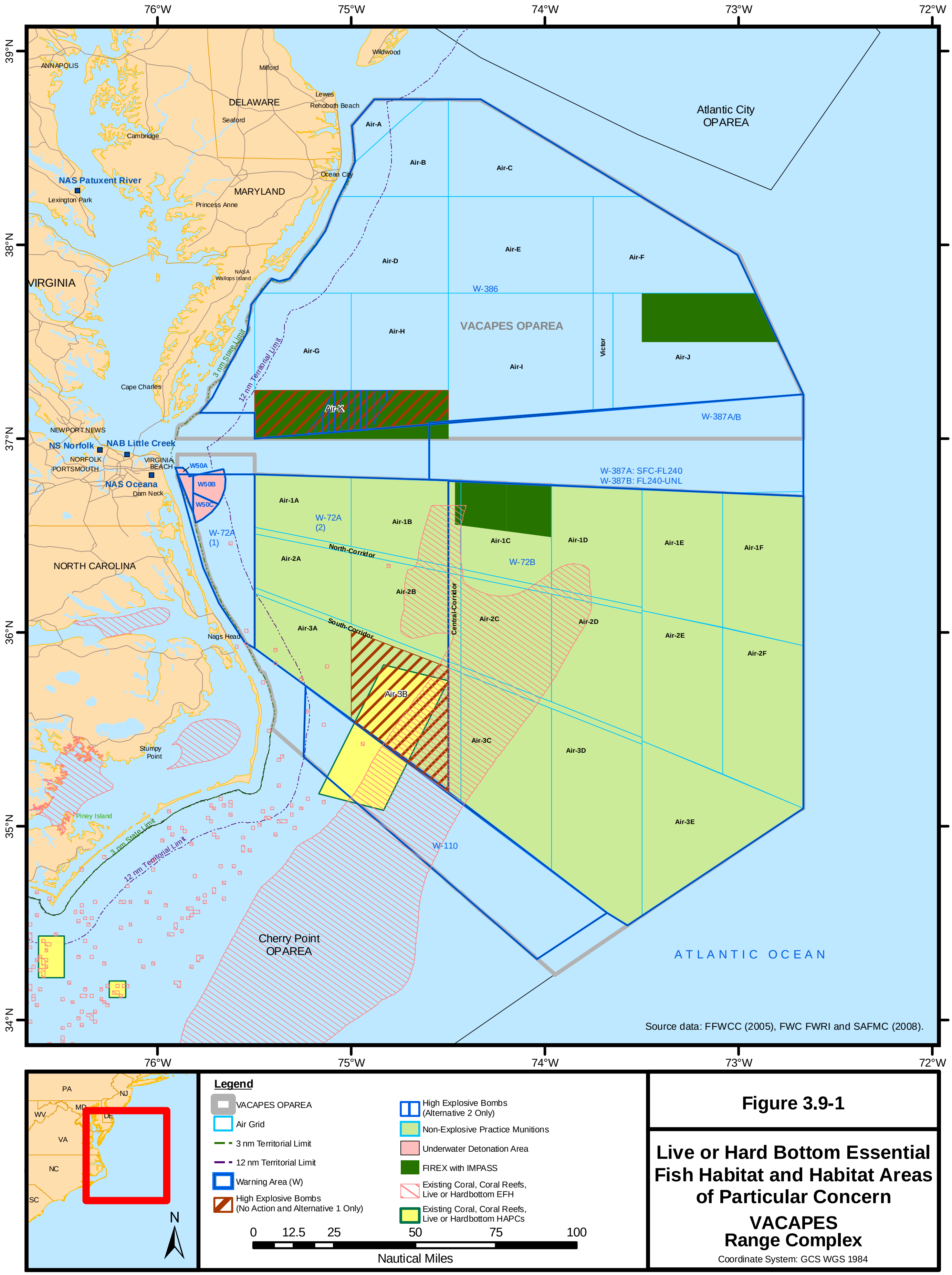


Figure 3.9-1

Live or Hard Bottom Essential Fish Habitat and Habitat Areas of Particular Concern

VACAPES Range Complex

Coordinate System: GCS WGS 1984

Delaware River (Delaware, Pennsylvania, and New York) and Chesapeake Bay/Potomac River (Maryland and Virginia). The Delaware River supports a well-documented population (8,445 individuals in 2004), but the Chesapeake Bay/Potomac River population is not well documented (Murdy *et al*., 1997; Welsh *et al*., 2002; Center for Biological Diversity, 2007).

Shortnose sturgeons inhabit rivers and estuaries, occasionally moving short distances to the mouths of estuaries and nearby coastal waters, with populations confined mostly to natal rivers and estuarine habitats (Dadswell *et al*., 1984). The species appears to be estuarine anadromous in the southern part of its range, but in some northern rivers it is "freshwater amphidromous" (adults spawn in freshwater but regularly enter saltwater habitats during their life) (NMFS, 1998). Spawning occurs in freshwater rivers, usually above tidal influence, and eggs are demersal and adhesive (Dadswell *et al*., 1984). Juveniles may remain inland of saline waters until they reach a length of 18 in (two to eight years) (Dadswell *et al*., 1984). In estuarine systems, the shortnose sturgeon occurs in areas with little or no current over a bottom composed primarily of mud and sand. Sturgeons prefer freshwater swamps or areas with fast flows and gravel cobble bottoms in the riverine areas (Gilbert, 1992). Adults are found in deep water (10 to 30 m) in winter and in shallow water (2 to 10 m) in summer. Juveniles are nonmigratory, typically inhabiting deep channels of swiftly flowing river above the salt wedge (Burkhead and Jenkins, 1991). Shortnose sturgeons are not known to participate in coastal migrations (NMFS, 1998). Based on this information the shortnose sturgeon is not expected to occur in the Atlantic Ocean portion of the Study Area (OPAREA and R-6606), and its potential occurrence in the Study Area is limited to the lower Chesapeake Bay.

The first published account of the shortnose sturgeon in the Chesapeake Bay system was an 1876 record from the Potomac River. Based on occurrence of the shortnose sturgeon north and south of the Chesapeake Bay, it was likely a resident of the Chesapeake Bay and occupied all four major riverine estuaries of Virginia (Burkhead and Jenkins, 1991). Other historical records support this observation by the reporting of this species in the upper Chesapeake Bay near the mouth of the Susquehanna River in the early 1980s and in the lower Chesapeake Bay near the mouths of the James and Rappahannock Rivers in the late 1970s (NMFS, 1998). Since implementation of the USFWS Atlantic sturgeon reward program, over 50 shortnose sturgeons have been captured in the Maryland waters of the upper Chesapeake Bay north of Hart-Miller Island by commercial fisherman between 1996 and 2000 (Litwiler, 2001). It has been determined that this species probably traverses the Chesapeake and Delaware Canal and may be a transient from the Delaware River where a well-documented population (8,445 individuals in 2004) currently exists (Murdy *et al*., 1997; Welsh, *et al*., 2002; Center for Biological Diversity, 2007).

According to the Virginia Department of Game and Inland Fisheries, this species has been extirpated from Virginia coastal rivers (VDGIF, 2006). However, one individual was captured at the mouth of the Rappahannock River in 1997 through the Atlantic sturgeon reward program for Virginia's major tributaries (James, York, and Rappahannock) (Welsh *et al*., 2002). Another individual was captured during trawling activities to relocate sea turtles near hopper dredging operations in Thimble Shoal Channel (north of Cape Henry) at the southern mouth of the Chesapeake Bay in 2003. Distribution and movement of this species in the Chesapeake Bay is poorly understood, in part because it is often confused with the Atlantic sturgeon. Population estimates are currently unavailable (NMFS, 2004c; NMFS, 2004d; NMFS, 2006b).

Shortnose sturgeon spawning has not been documented in Chesapeake Bay tributaries, but a prespawning migration by a prespawning female (egg-filled) was documented in the Potomac River in 2006. This was the first documented spawning run for a shortnose sturgeon for the entire Chesapeake Bay system, but it is unknown if the fish actually spawned (Blankenship, 2006).

Available data suggest that the shortnose sturgeon rarely occurs in the lower Chesapeake Bay portion of the Study Area. Individuals generally remain within their natal river or estuary, only occasionally moving to marine environments (Dadswell *et al*., 1984). The current Chesapeake Bay system population appears to be centered in the upper Chesapeake Bay (Welsh *et al*., 2002). Shortnose sturgeon spawn in freshwater (NMFS, 1998). Consequently, the lower Chesapeake Bay portion of the Study Area does not provide suitable spawning or nursery habitat.

Smalltooth Sawfish

The distinct population segment of smalltooth sawfish (*Pristis pectinata*) in the United States was listed as an endangered species in 2003. Critical habitat has not yet been designated for the smalltooth sawfish. However, NMFS anticipates proposing critical habitat for this species by March 2009 and designating critical habitat by September 2009 (Norton, 2008). Proposed critical habitat for the smalltooth sawfish is expected to be limited to portions of Florida. It is believed the current population is less than 5 percent of its historical size (Simpfendorfer and Wiley, 2006). Prior to around 1960, smalltooth sawfish occurred commonly in shallow waters of the Gulf of Mexico and eastern seaboard up to North Carolina, and more rarely as far north as New York. Currently its distribution is limited to peninsular Florida and, within that area, smalltooth sawfish can only be found with any regularity off the extreme southern portion of the state. The current distribution is centered in the Everglades National Park, including Florida Bay (NMFS, 2003). The smalltooth sawfish typically inhabits nearshore, shallow subtropical-tropical estuarine and marine waters, but may also be found utilizing freshwater habitats in large rivers (Simpfendorfer, 2002; Schultz, 2004).

Records of the smalltooth sawfish from Maryland and Virginia are from the late 1800s and early 1900s. This species was rarely taken in the lower Chesapeake Bay and has not been reported in Maryland or Virginia since 1928 (Burgess and Curtis, 2003; NMFS, 2006c). There have been multiple reports of the smalltooth sawfish in North Carolina waters from the late 1800s and early 1900s. This species was reported from Core Sound, Bogue Sound, New River, and Cape Lookout. Since 1915, there have been three published records of captures in North Carolina: 1937, 1963, and the latest in 1999 (Burgess and Curtis, 2003; NMFS, 2006c). The smalltooth sawfish is not expected to occur in the VACAPES Study Area because its current distribution is limited to peninsular Florida, no recent records exist for the Study Area, and it rarely occurs offshore.

Candidate Species

"Candidate species" refer to (1) species that are the subject of a petition to list under the ESA and for which NMFS determined that listing may be warranted, and (2) species that are not the subject of a petition but for which NMFS has announced the initiation of a status review in the *Federal Register*. In other words, any species undergoing a status review announced by the NMFS in a *Federal Register* notice will be considered a candidate species. Initiation of a status review does not mean that an ESA listing is imminent. Even after a status review has been conducted, it is possible the available information will be insufficient to make a determination on the status of the species or that the information will indicate that an ESA listing is not warranted. Candidate species do not carry any procedural or substantive protections under the ESA, and Section 7 consultation requirements do not apply. One candidate species, the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), occurs in the VACAPES Study Area.

The Atlantic sturgeon is found along the Atlantic coast from Labrador, Canada, to the St. Johns River, Florida. It is anadromous (migrates from the ocean into coastal estuaries and rivers to spawn), lives approximately 60 years, and reaches sexual maturity between years 5 and 34 years (NMFS, 2007a). Atlantic sturgeon feed on benthic invertebrates, mussels, worms, and shrimp. Atlantic sturgeon swim through the Chesapeake Bay in April and May on their way to spawn in tributaries. Atlantic sturgeon might have historically spawned in most tributaries of the Chesapeake Bay, but today limited spawning occurs in the James and York Rivers (ASMFC, 2007). First identified as a species of concern in 1988, its status was reviewed in 1998 and found not to warrant listing at that time although a country-wide moratorium on fishing was ordered by the federal government in 1998. Reasons for its decline are fishing (harvesting for flesh and eggs [caviar]), estuarine and freshwater habitat degradation, and locks and dams. The Atlantic sturgeon is managed under the Atlantic States Marine Fisheries Commission Fishery Management Plan, and rebuilding of stock is estimated to take 20 to 40 years (ASMFC, 2007). A second status review was initiated in 2005 to consider ESA listing (NMFS, 2007a).

Species of Concern

"Species of concern" are those species about which NMFS has concern regarding status and threats, but for which insufficient information is available to indicate a need to list the species under ESA. Species of concern do not carry any procedural or substantive protections under the ESA, and Section 7 consultation requirements do not apply. Species of concern status serves to promote conservation and research efforts for these species. The following species of concern potentially occur in the VACAPES Study Area: alewife (*Alosa pseudoharengus*), barndoor skate (*Dipturus laevis*), blueback herring (*Alosa aestivalis*), dusky shark (*Carcharhinus obscurus*), night shark (*Carcharinus signatus*), opossum pipefish (*Microphis brachyurus lineatus*), sand tiger shark (*Carcharias taurus*), speckled hind (*Epinephelus drummondhayi*), thorny skate (*Amblyraja radiata*), Warsaw grouper (*Epinephelus nigritus*), and Atlantic white marlin (*Tetrapturus albidus*) (NMFS, 2007c).

3.9.3 Environmental Consequences

3.9.3.1 No Action Alternative

Vessel Movements

Effects on Essential Fish Habitat

Vessel movements would have no effect on benthic or artificial habitats because Navy vessels are operated in relatively deep waters and have navigational capabilities to avoid contact with these habitats. Vessel movements would result in short-term, localized disturbances to water column and *Sargassum* habitats. Impacts to *Sargassum* habitats would be avoided and minimized by mitigation measures (Chapter 5). Impacts to EFH would be temporary and minimal. Vessel movements would not reduce the quality and/or quantity of EFH in the Study Area.

Disturbance to Fish

Studies documenting behavioral responses of fish to vessels show that fish may exhibit avoidance responses to engine sound, sonar, depth finders, and fish finders (Jorgensen *et al.,* 2004; Acoustic Ecology, 2007). Avoidance reactions are quite variable depending on the type of fish, its life history stage, behavior, time of day, and, the sound propagation characteristics of the water (Schwarz, 1985). Misund (1997) found that fish ahead of a ship, that showed avoidance reactions, did so at ranges of 160 to 490 ft. When the vessel passed over them, some species of fish responded with sudden escape responses that included lateral avoidance and/or downward compression of the school.

The low frequency sounds of large vessels or accelerating small vessels caused avoidance responses among herring (Chapman and Hawkins, 1973). Avoidance ended within 10 seconds after the vessel departed. Twenty five percent of the fish groups habituated to the sound of the large vessel and 75 percent of the responsive fish groups habituated to the sound of small boats.

Vessel movements under the No Action Alternative would expose fish to general disturbance, which could result in short-term behavioral and/or physiological responses (*e.g.,* swimming away and increased heart rate). Such responses would not be expected to compromise the general health or condition of individual fish.

Strikes with Fish

The probability of strikes between vessels and adult or juvenile fish, which could result in injury or mortality, would be extremely low because these life stages are highly mobile and Navy vessel density in the Study Area is low. Ichthyoplankton (fish eggs and larvae) in the upper portions of the water column could be displaced, injured, or killed by vessel and propeller movements. However, no measurable effects on fish recruitment would occur because the number of eggs and larvae exposed to vessel movements would be low relative to total ichthyoplankton biomass. Navy mitigation measures (see Chapter 5), which include avoidance of large *Sargassum* mats where some fish species tend to concentrate, further reduce the probability of injury or mortality. In accordance with NEPA, vessel movements in territorial waters under the No Action Alternative would have no significant impact on fish populations or habitat. Furthermore, vessel movements in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Aircraft Overflights

Effects on Essential Fish Habitat

As discussed in Section 3.7.3.3, aircraft overflights in the Study Area would produce intermittent airborne noise and some of this sound energy would be transmitted into the water. Based on the analysis presented in Section 3.7.3.3, aircraft overflights could increase ambient sound levels in the water column and possibly in shallow water benthic habitats. However, most fixed-wing overflights occur at 5,000 to 30,000 ft and low-altitude flights are infrequent. Furthermore, any increased sound levels in the water column would be short-term (a few seconds as the aircraft passes) and localized (a narrow cone under the aircraft). The downdraft from low altitude helicopter overflights could also result in short-term, localized disturbance to the water surface. Impacts from aircraft overflights to EFH would be temporary and minimal. Aircraft overflights would not reduce the quality and/or quantity of EFH in the Study Area.

Effects on Fish

Some species of fish could respond to noise associated with low-altitude aircraft overflights or to the surface disturbance created by downdrafts from helicopters. However, studies indicate that hearing specializations in marine fish are quite rare and that most marine fish are considered hearing generalists (Popper, 2008; Popper, 2003; Amoser and Ladich, 2005). Generalists are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich, 2005). As such, it is possible that many species of fish would not hear or respond to noise associated with most aircraft overflights. If fish were to respond to aircraft overflights, only short-term behavioral and/or physiological reactions (*e.g.,* swimming away and increased heart rate) would be expected. Such responses would not compromise the general health or condition of individual fish. In accordance with NEPA, aircraft overflights over territorial waters under the No Action Alternative would have no significant impact on fish populations or habitat. Furthermore, aircraft overflights over non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Towed Mine Warfare Devices

Effects on Essential Fish Habitat

As described in Chapter 2 and Appendix D, Mine Warfare Exercises conducted in the Study Area include the use of various underwater mine detection and countermeasures systems that are towed through the water by helicopters flying approximately 75 ft above the water at low airspeeds. This training would occur in the lower Chesapeake Bay and portions of the OPAREA that are within 45 nm of NS Norfolk (see Figures 2.2-1 through 2.2-4).

The use of towed devices would result in short-term and localized disturbances to the water column, but benthic habitats would not be affected because the devices are not towed on the bottom. Training with these devices is conducted in areas where little or no *Sargassum* habitat is expected to occur. In addition, Navy mitigation measures specify that the crew monitor for *Sargassum* rafts prior to and during the exercise. Visible *Sargassum* would be avoided to prevent fouling of the towed devices. Air crews operating the helicopters are expected to be able to see and avoid most *Sargassum* mats based on the relatively low flight altitude and low airspeeds. Therefore, any disturbance to *Sargassum* would be limited to very small patches that are not visible to the air crew. Impacts to EFH would be temporary and minimal. Use of towed Mine Warfare devices would not reduce the quality and/or quantity of EFH in the Study Area.

Effects on Fish

The probability of strikes between towed Mine Warfare devices and adult or juvenile fish, which could result in injury or mortality, would be extremely low because these life stages are highly mobile. Ichthyoplankton (fish eggs and larvae) in the upper portions of the water column could be displaced, injured, or killed by towed Mine Warfare devices. However, no measurable effects on fish recruitment would occur because the number of eggs and larvae exposed to towed devices would be low relative to total ichthyoplankton biomass. In accordance with NEPA, the use of towed Mine Warfare devices in territorial waters under the No Action Alternative would have no significant impact on fish populations or habitat. Furthermore, the use of towed Mine Warfare devices in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Mine Warfare Training Area Establishment (Non-explosive Mine Shape Deployment/Recovery)

The No Action Alternative does not include establishment of Mine Warfare Training Areas where non-explosive mine shapes would be deployed.

Non-Explosive Practice Munitions

Effects on Essential Fish Habitat

Current Navy operations in the Study Area include firing a variety of weapons and employ a variety of NEPM, including bombs, missiles, naval gun shells, cannon shells, and small caliber ammunition. NEPM may be used in several training areas (see Table 2.2-6 for a summary of ordnance use by training area), but is not authorized in W-110, W-387, 0r the lower Chesapeake Bay.

Disturbances to water column habitats from NEPM strikes would be short-term and localized. Navy mitigation measures require avoidance of *Sargassum*; therefore impacts to these habitats would be minimal. The potential for NEPM strikes to adversely affect benthic communities depends on several factors, including the size and speed of the ordnance, water depth, the number of rounds delivered, the frequency of training, and the presence/absence of sensitive benthic communities. As described in Section 3.6.2, a majority of the OPAREA consists of soft bottom habitats. While a broad area of soft bottom benthic habitat could be exposed to direct ordnance strikes, the training exercises are intermittent and widely dispersed, which decreases the likelihood that a given area would be subjected to repeated exposure. NEPM velocity would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, NEPM strikes would cause little or no physical damage to soft bottom benthic habitat and any damage would be localized.

Live hard bottom or artificial habitats would be vulnerable to damage from NEPM strikes. This is particularly true for areas that support coral because coral is fragile and could be easily broken by contact with larger objects such as non-explosive practice bombs. Repopulation and recovery of damaged hard bottom habitats would be relatively slow (*e.g.*, years to a decade or more) compared to soft bottom areas (*e.g.*, less than one year) (NRC, 2002).

Non-explosive practice bombs are the largest types of NEPM used in the OPAREA (Table 3.9-5). Based on their weight, non-explosive practice bombs could cause damage if they struck sensitive hard bottom habitat. A total of 295 non-explosive practice bombs would be dropped per year under the No Action Alternative in W-72A/B. Assuming an even distribution, the relative concentration of non-explosive practice bombs would be 2.1 per 100 nm^2/year. Actual concentrations would vary based on specific training scenarios, but would nonetheless be extremely low. The maximum area of benthic habitat affected by non-explosive practice bomb strikes would be approximately 3,306 ft^2 per year or 33,060 ft^2 over a ten-year period for the No Action Alternative, assuming that the area affected by a single non-explosive practice bomb would be two times its footprint (Table 3.9-6).

TABLE 3.9-5
SIZE OF NON-EXPLOSIVE PRACTICE BOMBS USED IN THE VACAPES OPAREA

NEPM Type	Weight (pounds)	Length (inches)	Diameter (inches)	Footprint (ft^2)[(2)]
BDU-45	500	66	11	5.0
MK-76	25	25	4	0.7
MK-20 Rockeye Cluster (each dispenses 247 bomblets)	1.32 (per bomblet)	6.5 (per bomblet)	2 (per bomblet)	22.3 (total per bomb)
MK-82	500	90	11	6.9
MK-83[(1)]	1,000	119	14	11.6
MK-84	2,000	129	18	16.1

[(1)]Alternative 2 only.
[(2)]Length x diameter.

TABLE 3.9-6
ESTIMATES OF MARINE BENTHIC HABITAT THAT WOULD BE AFFECTED BY NON-EXPLOSIVE PRACTICE BOMBS IN THE VACAPES OPAREA

NEPM Type	No Action Alternative		Alternative 1		Alternative 2	
	#/Yr	Area Affected/Yr (ft^2)[(1)]	#/Yr	Area Affected/Yr (ft^2)[(1)]	#/Yr	Area Affected/Yr (ft^2)[(1)]
BDU-45	45	450	50	500	50	500
MK-76	185	259	204	286	204	286
MK-20	51	2,275	56	2,498	68	3,033
MK-82	7	97	8	110	158	2,180
MK-83	0	0	0	0	50	1,160
MK-84	7	225	7	225	7	225
Total =	295	3,306	325	3,619	537	7,384

[(1)]Assumed that the area of marine benthic habitat affected per year = footprint x 2 x #/yr.

As shown in Figure 3.6-1, few artificial reefs are located in W-72-A/B and shipwrecks are widely dispersed. The probability of non-explosive practice bombs striking artificial habitats would be low because these resources occupy a relatively small area.

Based on the distribution of hard bottom EFH and HAPC (Figure 3.9-1), it is possible that a small percentage of non-explosive practice bombs would strike in these areas. The potential for strikes to adversely affect benthic communities in these areas would depend on the substrate and community types found at the point of physical impact. Given the dispersed nature of the training activities, often patchy distribution of community types, and relatively limited bottom mapping data, it is not possible to accurately determine the number of non-explosive practice bombs that would strike soft bottom habitats versus more sensitive areas such as live hard bottom. Nonetheless, the total area of benthic habitat affected by non-explosive practice bomb strikes would be small (about 3,306 ft^2 per year) and only a percentage of the total area affected (far less than 3,306 ft^2 per year) would be sensitive benthic habitat such as live hard bottom.

Non-explosive practice bomb strikes could result in long-term, minor effects to benthic EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to benthic EFH would be minimal based on the relatively small area affected by non-explosive practice bombs. Given the small area affected, NEPM use under the No Action Alternative would not reduce the quality and/or quantity of EFH in the Study Area.

Effects on Fish

NEPM and associated shrapnel have the potential to directly strike fish as it travels through the water column. NEPM could also generate physical shock entering the water, but would not explode. Shock waves could cause behavioral reactions or physical injury. Fish at the surface would be most susceptible to injury from strikes because NEPM velocity would rapidly decrease upon contact with the water and as it travels through the water column. Navy mitigation measures, which include avoidance of large *Sargassum* mats where some fish tend to concentrate, further reduce the probability of NEPM-related injury or mortality. As discussed in Section 3.7.3 and 3.8.3, statistical modeling conducted for the Study Area indicates that the probability of NEPM striking marine mammals and sea turtles is extremely low. Statistical modeling could not be conducted to estimate the probability of NEPM/fish strikes because fish density data are not available. A possibility exists that a small number of fish at or near the surface may be directly impacted if they are in the target area and near the point of physical impact at the time of NEPM delivery, but population-level effects would not occur.

Weapons firing could have acoustic effects from: 1) sound generated by firing the gun (muzzle blast), 2) vibration from the blast propagating through the ship's hull, and 3) sonic-booms generated by the shell flying through the air.

Firing a deck gun produces a shock wave in air that propagates away from the muzzle in all directions, including toward the air/water surface. Direct measurements of shock wave pressures transferred through the air/water interface from the muzzle blast of a 5-inch gun are well below levels known to be harmful at shallow depths (DoN, 2000a; Yagla and Stiegler, 2003). Sound produced during gunfire may disturb fish in the vicinity of the ship. Because the sound is brief, no extended disruption of fish behavior is expected.

Gun fire sends energy through the ship structure, into the water, and away from the ship. This effect was also investigated in conjunction with the measurement of 5-inch gun blasts described above (DoN, 2000a; Yagla and Stiegler, 2003). The energy transmitted through the ship to the water for a typical round was found to be about 6 percent of that from the air blast impinging on the water. Therefore, sound transmitted from the gun, through the hull into the water should have negligible impact on marine life.

The sound generated by a shell in its flight at supersonic speeds above the water is transmitted into the water in much the same way as a muzzle blast (Pater, 1981). The region of underwater sound influence from a single traveling shell is relatively small, diminishes quickly as the shell gains altitude, and is of short duration. The penetration of sound through the air\water interface is relatively limited (Miller, 1991; Yagla and Stiegler, 2003). Studies reviewed in DoN (2007) indicate only a small number of submerged species would be exposed to the pressure waves from sonic booms from 5-inch shells fired during routine training exercises. The potential exists for energy from multiple sonic booms to accumulate over time from multiple, possibly rapid firings of a gun. However, because the area directly below the shells' path, where the conditions are correct for energy to enter the ocean is small, it is highly unlikely that the energy from more than two or three shells would be additive.

In accordance with NEPA, NEPM use in territorial waters under the No Action Alternative would have no significant impact on fish populations or habitat. Furthermore, NEPM use in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Underwater Detonations and High Explosive Ordnance

Overview

Explosions that occur in the OPAREA are associated with training exercises that use HE ordnance, including bombs (BOMBEX), missiles (MISSILEX), and naval gun shells (FIREX with IMPASS, 5-inch HE rounds), as well as underwater detonations associated with Mine Neutralization training (MINEX). Underwater detonation and HE ordnance use is limited to specific training areas (see Table 2.2-7 for a summary of explosions by training area) and does not occur in the lower Chesapeake Bay or in state waters of the Atlantic Ocean (0 to 3 nm from shore). Potential effects to fish and EFH from underwater explosions include: habitat disturbance; disturbance, injury, or death from the shock (pressure) wave; acoustic effects; and indirect effects including those on prey species and other components of the food web.

Habitat Disturbance and Essential Fish Habitat

The underwater detonation of explosives can result in physical alteration of fish habitats (Wright and Hopky, 1998). As discussed above in Section 3.9.2, EFH has been designated for various federally managed species in training areas where underwater detonations and HE ordnance use occurs. All underwater detonations and HE ordnance use would result in disturbance to water column habitats, some of which could be designated as EFH for spawning adults. However, water column disturbances would be short-term (a few seconds) and localized, and associated effects to EFH would be temporary and minimal.

A primary concern is the potential for explosions to affect live hard bottom, coral reefs, artificial reefs, and shipwrecks, because these resources provide shelter and habitat for a wide variety of marine life and dense aggregations of fish (Cahoon *et al.,* 1990; Thompson *et al.,* 1999). As discussed in Section 3.6.2.2, hard bottom communities, corals, and coral reefs are limited in the Study Area except those hard bottom communities that exist on man-made structures such as shipwrecks and artificial reefs, as well as oyster reefs in the lower Chesapeake Bay (Figures 3.6-1 and 3.6-2). Mine Neutralization exercises conducted under the No Action Alternative in W-50C would include underwater detonations set on or near the sea floor, as well as in the water column. The Navy does not set underwater explosive charges associated with Mine Neutralization exercises within 1,000 ft of known live/hard bottom, artificial reefs, and shipwrecks (see Section 5.7 for detailed description of Navy mitigation measures). In addition, hard bottom habitat is not known to occur in W-50. Therefore, only unconsolidated, soft bottom and water column habitats would be exposed to impacts from underwater detonations associated with Mine Neutralization exercises.

Cratering of soft bottom habitats would result from Mine Neutralization charges set on or near the bottom. For a specific size of explosive charge, crater depths and widths would vary depending on depth of the charge and sediment type, but crater dimensions generally decrease as bottom depth increases. A 20-lb NEW charge detonated on the bottom can create depressions in the substrate up to 4 to 5 feet in diameter (12.6 to 19.6 ft^2) and 1 foot deep (DoN, 2000b). Assuming a worst –case scenario where all 12 20-lb charges were detonated directly on the bottom, up to 151 to 235 ft^2 of soft bottom benthic habitat could be disturbed by underwater detonations per year under the No Action Alternative. Crater effects are usually temporary in sand and mud bottoms. Short-term (a few hours) increases in turbidity, resuspension of bottom sediments, and localized mortality of benthic organisms and plankton would be expected. There have been no studies of sediment deposition rates in the area of the proposed action, but the Minerals Management Service (2002) indicates that sandy sediments are quickly redeposited within 1,312 feet of oil-well blowouts, and finer sediments are widely dispersed and redeposited over a period of 30 days or longer within 3,000 feet. Repopulation of displaced sediments should be relatively rapid (less than one year) compared to hard bottom areas (years to decades or more) (NRC, 2002). The effects to EFH from Mine Neutralization underwater detonations would be considered minimal based on the relatively small area affected. The effects would also be considered temporary based on the relatively rapid (less than one year) recovery of soft bottom habitats and associated benthic communities.

Explosions associated with BOMBEX, MISSILEX, and FIREX with IMPASS occur at or near the water's surface in areas where depths range from 20 m to over 2,900 m. Of the ordnance types used during these exercises, the MK-84 HE bomb has the highest net explosive weight (NEW) (944.7 lbs). Using the equation presented in Swisdak (1978), the maximum radius of the gas bubble produced by a MK-84 HE bomb explosion would be about 11.9 m (39 ft). The gas bubble would not extend to the bottom based on the minimum water depth (20 m) and a detonation depth of 1 m below the surface. Likewise, the gas bubbles produced by other ordnance types used in BOMBEX, MISSILEX, and GUNEX would not extend to the bottom because they have smaller NEWs. Therefore, explosions during BOMBEX, MISSILEX, and GUNEX are not expected to result in disturbance to benthic or artificial habitats because detonations would occur near the surface in deep waters. Effects of explosions on *Sargassum* habitats would be minimal because Navy mitigation measures specify that HE ordnance is not targeted to impact near observed *Sargassum* mats.

In summary, underwater detonations and HE ordnance use under the No Action Alternative would result in short-term and localized disturbances to water column habitats. Underwater detonations associated with Mine Neutralization training would disturb soft bottom benthic habitats, but the effects would be minimal and temporary. Underwater detonations and HE ordnance use are not expected to have adverse effects on live hard bottom, corals, coral reefs EFH or HAPCs, or artificial habitats. Navy mitigation measures further reduce the potential for these resources and *Sargassum* habitats to be affected by explosions. Underwater detonations and HE ordnance use would not result in a measurable decrease in the quantity or quality of EFH in the Study Area. In accordance with NEPA, underwater detonations and HE ordnance use in territorial waters under the No Action Alternative would not result in significant impacts to fish habitat. In accordance with EO 12114, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to fish habitat.

Pressure Effects and Acoustic Effects

An underwater explosion generates a shock wave that produces a sudden, intense change in local pressure as it passes through the water (DoN, 1998, 2001). Pressure waves extend to a greater distance than other forms of energy produced by the explosion (*i.e.*, heat and light) and are therefore the most likely source of negative effects to marine life from underwater explosions (Craig, 2001; SIO, 2005; DoN, 2006).

The shock wave from an underwater explosion is lethal to fish at close range, causing massive organ and tissue damage and internal bleeding (Keevin and Hempen, 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Wright, 1982; Keevin and Hempen, 1997). At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Yelverton *et al.,* 1975; Wiley *et al.,* 1981; O'Keefe and Young, 1984a,b; Edds-Walton and Finneran, 2006). Species with gas-filled organs have higher mortality than those without them (Goertner *et al.,* 1994; CSA, 2004).

Two aspects of the shock wave appear most responsible for injury and death to fish: the received peak pressure and the time required for the pressure to rise and decay (Dzwilewski and Fenton, 2003). Higher peak pressure and abrupt rise and decay times are more likely to cause acute pathological effects (Wright and Hopky, 1998). Rapidly oscillating pressure waves might rupture the kidney, liver, spleen, and sinus and cause venous hemorrhaging (Keevin and Hempen, 1997). They can also generate bubbles in blood and other tissues, possibly causing embolism damage (Ketten, 1998). Oscillating pressure waves might also burst gas-containing organs. The swim bladder, the gas-filled organ used by many pelagic fish to control buoyancy, is the primary site of damage from explosives (Yelverton *et al.,* 1975; Wright, 1982). Gas-filled fish swim bladders resonate at different frequencies than surrounding tissue and can be torn by rapid oscillation between high- and low-pressure waves. Swim bladders are a characteristic of bony fishes and are not present in sharks and rays. However, hemorrhaging of the liver in sharks exposed to the shock waves from explosives could have deleterious effects on the buoyancy function provided by the livers of these species (Edds-Walton and Finneran, 2006). Delayed lethality could result from the accumulation of sub-lethal injuries (DoN, 2001).

Studies that have documented fish killed during planned underwater explosions indicate that most fish that die do so within one to four hours, and almost all die within a day (Hubbs and Rechnizer, 1952; Yelverton *et al.,* 1975). Fitch and Young (1948) found that the type of fish killed changed when blasting was repeated at the same marine location within 24 hours of previous blasting. They observed that most fish killed on the second day were scavengers, presumably attracted by the victims of the previous day's blasts. However, fishes collected during these types of studies have mostly been recovered floating on the waters surface. Gitschlag *et al.* (2000) collected both floating fish and those that were sinking or lying on the bottom after explosive removal of nine oil platforms in the northern Gulf of Mexico. They found that 3 to 87 percent (46% average) of the specimens killed during a blast might float to the surface. Other impediments to accurately characterizing the magnitude of fish mortality included currents and winds that transported floating fishes out of the sampling area and predation by seabirds or other fishes.

There have been few studies of the impact of underwater explosions on early life stages of fishes (eggs, larvae, juveniles). Fitch and Young (1948) reported the demise of larval anchovies exposed to underwater blasts off California, and Nix and Chapman (1985) found that anchovy and smelt larvae died following the detonation of buried charges. Similar to adult fishes, the presence of a swim bladder contributes to shock wave-induced internal damage in larval and juvenile fishes (Settle *et al.,* 2002). Shock wave trauma to internal organs of larval pinfish and spot from shock waves was documented by Govoni *et al.* (2003). These were laboratory studies, however, and have not been verified in the field.

Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright, 1982). Fish which ascend too quickly, a typical response to fear or to avoid negative stimuli, might experience an increase in the volume of gas-filled organs due to the reduction in ambient pressure. The resulting inflation might render the fish unable to immediately return to its normal habitat depth because the expanded organs make the buoyancy of the fish too great to overcome by swimming downward. Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation.

The variety of environmental parameters and biological features that can modify the impact of underwater explosions complicates the effort to predict lethal effect ranges in the field (Wright, 1982; Keevin and Hempen, 1997). Predictive models have, however, been developed over the past three decades (Wiley *et al.,* 1981; Goertner, 1982; Young, 1991). These are based on measurements of the pressure produced by underwater explosions at increasing distance from the detonation point (O'Keefe and Young, 1984a,b; Wright and Hopky, 1998; Dzwilewski and Fenton, 2003). Different types of explosive materials are normalized in effect range models by establishing an equivalent weight of TNT known as NEW.

Young (1991) provides equations that allow estimation of the potential effect on fish possessing swim bladders using a damage prediction method developed by Goertner (1982). Young's parameters include the size of the fish and its location relative to the explosive source, but are independent of environmental conditions (*e.g.*, depth of fish and explosive shot frequency). An example of such model predictions is shown in Table 3.9-7 which lists estimated explosive-effects ranges using Young's (1991) method for fish possessing swim bladders exposed to explosions that would occur under the No Action Alternative and Alternatives 1 and 2. The 10 percent mortality range is the distance beyond which 90 percent of the fish present would be expected to survive. It is difficult to predict the range of more subtle effects causing injury but not mortality (CSA, 2004).

TABLE 3.9-7
ESTIMATED EXPLOSIVE EFFECTS RANGES FOR FISH WITH SWIM BLADDERS

Training Operation and Type of Ordnance	NEW (lb)	Depth of Explosion (ft)	10% Mortality Range (ft)		
			1-oz Fish	1-lb Fish	30-lb Fish
Mine Neutralization					
MK-103 Charge(1)	0.002	10	40	28	18
AMNS Charge(2)	3.24	20	366	255	164
20-lb NEW UNDET Charge	20	30	666	464	299
Missile Exercise					
Hellfire	8	3.3	317	221	142
Maverick	100	3.3	643	449	288
Firing Exercise with IMPASS					
HE Naval Gun Shell, 5-inch	8	1	244	170	109
Bombing Exercise					
MK-20(3)	109.7	3.3	660	460	296
MK-82(3)	192.2	3.3	772	539	346
MK-83	415.8	3.3	959	668	430
MK-84(3)	945	3.3	1,206	841	541

(1)Alternative 2 only.
(2)Alternatives 1 and 2 only.
(3)No Action Alternative and Alternative 1 only.

Fish located outside the lethal effects range of an underwater explosion could also experience adverse effects from the blast's acoustical signature. Sound is the only form of energy that propagates well underwater and is used by many aquatic animals for imaging, navigations, and communication. Fish have evolved two main sensory organs for detecting sound: the inner ear, located in the skull, and the lateral line system along the flanks and on the head (Ladich and Popper, 2004). The perception of sound pressure is restricted to fish species with gas-filled swim bladders. Due to the higher compressibility of gas than water, the swim bladder responds effectively to sound pressure fluctuations. In some species of fish, a series of modified vertebra connect the inner ear to the swim bladder acting as a transducer that converts sound pressure waves into particle motion which stimulates the otoliths. Species with no swim bladder (for example, mackerel, tuna, sharks) or a much-reduced one (many benthic species, including flatfish) tend to have relatively low auditory sensitivity.

Broadly, fish can be categorized as either hearing specialists or hearing generalists. Fish in the hearing specialist category have a broad frequency range with a low auditory threshold due to a mechanical connection between an air filled cavity, such as a swim bladder, and the inner ear. Specialists detect both the particle motion and pressure components of sound and can hear at levels above 1 kHz. Generalists are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich, 2005). Although hearing capability data only exists for 100 of the 27,000 fish species (Hastings and Popper, 2005), it is thought that most species of fish detect sounds from 0.05 to 1.0 kHz (NRC, 2003). Studies indicate that hearing specializations in marine species are quite rare and that most marine fish are considered hearing generalists (Popper, 2008; Popper, 2003; Amoser and Ladich, 2005). Studies have shown different hearing abilities for species within the same family (Amoser and Ladich, 2005). It has also been shown that susceptibility to the effects of anthropogenic sound can be influenced by developmental and genetic differences in the same species of fish (Popper *et al*., 2007). Therefore, generalizations about fish hearing abilities must be made with caution.

The potential acoustic effects of underwater explosions may be considered in four categories:

- Masking – interference with the ability to hear biologically important sounds.
- Stress – physiological responses including elevated heart rate and release of hormones.
- Behavior – disruption of natural activities like swimming, schooling, feeding, breeding, and migration.
- Hearing – permanent hearing loss from high intensity/long duration sounds or temporary hearing loss from less intense sounds.

If an individual fish were repeatedly exposed to sounds from underwater explosions, the acoustic effects outlined above could lead to long-term consequences such as reduced survival, growth, or reproductive capacity. However, the time scale of individual explosions is very limited, and training exercises involving explosions are dispersed in space and time. Consequently, repeated exposure of individual fish to sounds from underwater explosions is not likely and most acoustic effects are expected to be short-term and localized. Sound from a single explosion could also affect fish recruitment if it occurred in the vicinity of a spawning event. The sound from the explosion could alter the behavior of the fish and disrupt, delay, or prevent the spawning event from occurring. Given the spatial and temporal dispersion of training activities and spawning events, the probability of an explosion disrupting spawning is expected to be low. If a spawning event were disrupted, the effects would be localized and a measureable reduction in fish recruitment would not be expected.

The number of fish affected by an underwater explosion would depend on the population density in the vicinity of the blast, as well as factors discussed above such as NEW, depth of the explosion, and fish size. For example, if an explosion occurred in the middle of a dense school of menhaden, herring, or other schooling fish, a large number of fish could be killed. This would not, however, represent significant mortality in terms of the total population of such fish in the Study Area. Furthermore, the probability of this occurring is low based on the patchy distribution of dense schooling fish. Fish density in a given area is inherently dynamic and varies seasonally, daily, and over shorter time frames. Consequently, fish density data are not available for the Study Area and the number of fish affected by underwater detonations and HE ordnance cannot be accurately quantified.

Fish density is influenced by numerous environmental conditions including habitat and productivity. As discussed above in the analysis of habitat disturbance, live hard bottom habitats are limited in areas where explosions would take place. In addition, Navy mitigation measures reduce the possibility that large numbers of fish would be affected. Nonetheless, the training areas where explosions would take place do contain designated EFH and do support many important species of fish.

To summarize, a limited number of fish would be killed in the immediate proximity of underwater explosions. Additional fish would be injured and could subsequently die or suffer greater rates of predation. Beyond the range of lethal or injurious effects, there could be short-term effects such as masking, stress, behavioral changes, and hearing threshold shifts. However, given the relatively small area that would be affected, and the abundance and distribution of the species concerned, no Fish density is influenced by numerous environmental conditions including habitat and productivity. As discussed above in the analysis of habitat disturbance, live hard bottom habitats are limited in areas where explosions would take place. In addition, Navy mitigation measures reduce the possibility that large numbers of fish would be affected. Nonetheless, the training areas where explosions would take place do contain designated EFH and do support many important species of fish.

population-level effects would be expected. When exercises are completed, the fish stock should repopulate the area. The regional abundance and diversity of fish are unlikely to measurably decrease. While these conclusions are primarily based on qualitative judgments, they are supported by the best scientific information currently available. Quantitative predictions of population-level effects are simply beyond the capacity of contemporary ocean science. In accordance with NEPA, underwater detonations and HE ordnance use in territorial waters under the No Action Alternative would not result in significant impacts to fish populations. In accordance with EO 12114, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to fish populations.

Indirect Effects

In addition to directly affecting fish and fish habitat, underwater explosions could affect other species in the food web including plankton and other prey species. The effects of underwater explosions would differ depending upon the type of prey species in the area of the blast. As previously indicated, fish with swim bladders are more susceptible to blast injuries than fish without swim bladders. Invertebrate species, however, like squid, do not possess air-filled cavities, and therefore are less prone to blast effects (Voss, 1965), although impulsive sound has been implicated in mortality of deep water species (Guerra *et al.,* 2004).

In addition to physical effects of an underwater blast, prey might have behavioral reactions to underwater sound. For instance, squid might exhibit a strong startle reaction to detonations that might include swimming to the surface, jetting away from the source, and releasing ink (McCauley *et al.,* 2000). This startle and flight response is the most common secondary defense among animals (Hanlon and Messenger, 1996). The sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fish and squid if they are within close proximity. The abundances of fish and invertebrate prey species near the detonation point could be diminished for a short period of time before being repopulated by animals from adjacent waters. No lasting effect on prey availability or the pelagic food web would be expected. Indirect effects of underwater detonations and HE ordnance use under the No Action Alternative would not result in a decrease in the quantity or quality of EFH in the Study Area and would have no adverse effects to EFH as defined under the MSFCMA. In accordance with NEPA, indirect effects of underwater detonations and HE ordnance use in territorial waters under the No Action Alternative would not result in significant impacts to fish populations or habitat. In accordance with EO 12114, indirect effects of underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to fish populations or habitat.

Military Expended Materials

Overview

The Navy uses a variety of military expended materials during training exercises conducted in the Study Area. The types and quantities of expended materials used and information regarding fate and transport of these materials within the marine environment are discussed in Section 3.2. The analyses presented in Sections 3.2, 3.3, and 3.6 predict that the majority of the expended materials would rapidly sink to the sea floor, become encrusted by natural processes, and incorporated into the sea floor, with no significant accumulations in any particular area and no significant negative effects to water quality or marine benthic communities. Based on the analyses presented in Sections 3.2, 3.3, and 3.6, impacts associated with military expended materials to EFH would be temporary and/or minimal. Military expended materials under the No Action Alternative would not reduce the quality and/or quantity of EFH in the Study Area. Therefore, the remainder of this section focuses on the effects of military expended materials on fish.

Fish could be exposed to some expended materials via contact and ingestion. Benthic-foraging fish are more likely to encounter and ingest military expended materials than species that forage in the water column. Fish ingest non-food items incidentally to normal feeding, but also commonly expel non-food items before swallowing them. The effects of military expended material ingestion on fish are largely unknown, but would likely vary depending on species and size of the individual, as well as the type and quantity of material ingested. If ingested, some military expended materials could lodge in the digestive system and interfere with food consumption and digestion; resulting in sublethal or lethal effects.

Ordnance-related Materials

Ordnance-related materials include various sizes of NEPM and shrapnel from explosive rounds (Tables 2.2-5 and 2.2-6). The solid metal materials would quickly move through the water column and settle to the sea floor where they could be available for ingestion by benthic-foraging fish. Some materials such as an intact non-explosive practice bomb would be too large to be ingested, but other materials such as small caliber ammunition and shrapnel are small enough to be ingested. These materials could pass through the digestive tract without causing harm, but could also lodge in the digestive system and interfere with food consumption and digestion. Some ordnance-related materials contain lead, copper and other metals, which could be toxic to fish when ingested. While ingestion of ordnance-related materials could result in sublethal or lethal effects, the likelihood of ingestion is low based on the dispersed nature of the materials. Furthermore, a fish might expel the item before swallowing it. Based on these factors, the number of fish potentially affected by ingestion of ordnance-related materials would be low and population-level effects would not occur.

Target-related Materials

Most targets are recovered after use and reused or properly disposed of onshore. Some targets such as 55-gallon metal drums cannot be recovered and sink to the sea floor after use. Unrecoverable floating materials generated by target use are expected to be minimal. Descriptions of targets used in the Study Area and information on fate and transport are provided in Section 3.2. Benthic foraging fish may encounter an expended target on the bottom, but the size of the target would prohibit fish from ingesting it.

Chaff Fibers, End Caps, and Pistons

The background information and general exposure analysis presented in Section 3.7 for marine mammals and chaff is also applicable to fish and is not repeated here. Similar to marine mammals, fish could be exposed to chaff through direct body contact and ingestion. Fish are not expected to respond to direct contact with chaff. In addition, any changes in water quality from chaff use would be negligible and would not be expected to affect fish.

Based on the small size of chaff fibers, fish would not confuse the fibers with prey items or purposefully feed on them. However, fish could occasionally ingest low concentrations of chaff incidentally while feeding on prey items on the surface, in the water column, or on the bottom. The effects of chaff fiber ingestion on fish are expected to be negligible based on the low concentration that could reasonably be ingested, the small size of the chaff fibers, and available data on the toxicity of chaff and aluminum (see Section 3.7).

The potential also exists for fish to ingest chaff end caps and pistons as they sink through the water column or after they have settled to the bottom. If ingested, it is possible the small, (1.3-inch diameter, 0.13-inch thick) round, plastic end cap or piston would pass through the digestive tract of larger fish without causing harm and that a large quantity would need to be ingested to cause harm. Based on the low environmental concentration (0.6 to 2.0 pieces/nm^2/year), it is unlikely that a larger number of fish would ingest an end cap or piston, much less a harmful quantity. Furthermore, a fish might expel the item before swallowing it. Based on these factors, the number of fish potentially affected by ingestion of chaff end cap or pistons would be low and population-level effects would not occur.

Self-protection Flares

Self-protection flares consist of a magnesium/Teflon formulation that, when ignited and released from an aircraft, burn for a short period of time (less than 10 seconds) at very high temperatures. Flares release heat and light to disrupt tracking of Navy aircraft by enemy infrared tracking devices or weapons. Flares are designed to burn completely. Under normal operations, the only material that would enter the water would be a small, round plastic end cap (approximately 1.4 inch diameter). About 465 self-protection flares would be used per year under the No Action Alternative.

An extensive literature review and controlled experiments conducted by the U.S. Air Force revealed that self-protection flare use poses little risk to the environment (USAF, 1997). The light generated by flares would have no effect on fish based on short burn time, relatively high altitudes where they are used, and the wide-spread and infrequent use. The potential exists for fish to ingest self-protection flare end caps as they sink through the water column or after they have settled to the bottom. The number of fish potentially affected by ingestion of self-protection flare end caps would be low based on the low environmental concentration and population-level effects would not occur.

Marine Markers

The MK-25 and MK-58 marine markers produce chemical flames and regions of surface smoke and are used in various training exercises to mark a surface position to simulate divers, ships, and points of contact on the surface of the ocean. The marker is not designed to be recovered after use and would sink to the bottom after burning out. Chemical components of the marker would be consumed during the burning process. Fish in the immediate vicinity could be startled by the light generated by a burning marine marker on the sea surface. However, the effects would be short-term and localized. The tin and aluminum marine mark canisters are cylindrical. The M-25 is 18.5 in long by 2.9 in diameter and the MK-58 is 21.8 in long by 5 in diameter. While marine markers do not present an ingestion risk based on their size, a slight chance exists for a fish to encounter a canister while foraging on the bottom and to become lodged in the canister. Adverse effects from marine markers are not anticipated based on the small number used under the No Action Alternative (300 per year).

In summary, fish could be exposed to a variety of military expended materials under the No Action Alternative, but the analysis presented above indicates that the effects on fish would be negligible to minor. Military expended materials under the No Action Alternative would not result in adverse effects to fish populations. In accordance with NEPA, military expended materials in territorial waters under the No Action Alternative would have no significant impact on fish populations or habitat. Furthermore, military expended materials in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Shortnose Sturgeon

As discussed in Section 3.9.2.3, the shortnose surgeon is not expected to occur in portions of the Study Area located in the Atlantic Ocean (the OPAREA and R-6606) and very rarely occurs in the lower Chesapeake Bay portion of the Study Area. Individuals generally remain within their natal river or estuary, only occasionally moving to marine environments (Dadswell *et al*., 1984). The current Chesapeake Bay system population appears to be centered in the upper Chesapeake Bay (Welsh *et* *al*., 2002). Shortnose sturgeons spawn in freshwater (NMFS, 1998). Consequently, the Study Area does not provide suitable spawning or nursery habitat for the shortnose sturgeon.

Operations occurring in the Atlantic Ocean (OPAREA and R-6606) would have no effect on the shortnose sturgeon because this species is not expected to be present in these areas. Operations in the lower Chesapeake Bay under the No Action Alternative would be limited to helicopter overflights, vessel movements, and the use of towed Mine Warfare devices, which occur in the air and in the water column, respectively. Shortnose sturgeon would not be exposed to aircraft overflights, vessel movements, or towed Mine Warfare devices because they use benthic habitats. Operations in the lower Chesapeake Bay under the No Action Alternative would have no effect on the shortnose sturgeon. The No Action Alternative would have no effect on critical habitat because none has been designated for the shortnose sturgeon.

Smalltooth Sawfish

As discussed in Section 3.9.2.3, the smalltooth sawfish is not expected to occur in the Study Area because its current distribution is limited to peninsular Florida, no recent records exist for the Study Area, and it rarely occurs offshore. The No Action Alternative would have no effect on the smalltooth sawfish. The No Action Alternative would have no effect on critical habitat because none has been designated for the smalltooth sawfish.

Candidate Species

The effects of the No Action Alternative on the Atlantic sturgeon would be the same as those described above for other fish species. The No Action Alternative would not result in significant impacts or significant harm to candidate species.

Species of Concern

The effects of the No Action Alternative on species of concern would be the same as those described above for other fish species. The No Action Alternative would not result in significant impacts or significant harm to species of concern.

3.9.3.2 Alternative 1

Vessel Movements

Vessel movements would increase by about 1.4 percent in the VACAPES Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased potential for vessel collision-related fish mortalities and injuries (primarily eggs and larvae) to occur compared to baseline conditions. However, no measurable effects on fish recruitment would occur because the number of eggs and larvae exposed to vessel movements would continue to be low relative to total ichthyoplankton biomass. Vessel movements would continue to result in short-term and localized disturbances to water column and *Sargassum* habitats, but benthic habitats would not be affected. Navy mitigation measures, which include avoidance of large *Sargassum* mats where some fish species tend to concentrate, further reduce the probability of habitat disturbance and injury or mortality. Impacts to EFH from vessel movements under Alternative 1 would be temporary and minimal. Vessel movements would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, vessel movements in territorial waters under Alternative 1 would have no significant impact on fish populations or habitat. Furthermore, vessel movements in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Aircraft Overflights

Alternative 1 would include a 10 percent increase in fixed-wing aircraft sorties per year and an 88 percent increase in helicopter sorties per year in the VACAPES Study Area (Table 2.2-5). The new fixed-wing sorties would be widely dispersed and a majority of the new helicopter sorties would occur over the lower Chesapeake Bay and W-50. As a result, the potential for fish to be exposed to elevated noise levels would increase compared to baseline conditions, particularly in the lower Chesapeake Bay and W-50. The magnitude of individual exposures would not increase because Alternative 1 does not include use of new aircraft that are louder than current equipment. Peak noise levels generated by the new MH-60R and MH-60S Multi-Mission Combat Support Helicopters would be similar to the noise levels generated by the helicopters they would replace.

Based on the increased operations under Alternative 1 more fish could be exposed to noise and/or the number of times an individual fish is exposed could increase. Similar to the No Action Alternative, the responses would be limited to short-term behavioral or physiological reactions (*e.g.,* swimming away and increased heart rate) and the general health of individual fish would not be compromised. Impacts to EFH from aircraft overflights under Alternative 1 would be temporary and minimal. Aircraft overflights would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, aircraft overflights over territorial waters under Alternative 1 would have no significant impact on fish populations or habitat. Furthermore, aircraft overflights over non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Towed Mine Warfare Devices

The number of towed Mine Warfare device sorties would increase by 75 percent per year in the Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased potential for towed device-related fish mortalities and injuries (primarily eggs and larvae) to occur compared to baseline conditions. However, no measurable effects on fish recruitment would occur because the number of eggs and larvae exposed to towed Mine Warfare devices would continue to be low relative to total ichthyoplankton biomass. Disturbances to water column and *Sargassum* habitats would be short-term and localized. Impacts to EFH from towed Mine Warfare device use under Alternative 1 would be temporary and minimal. Towed Mine Warfare device use would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, the use of towed Mine Warfare devices in territorial waters under Alternative 1 would have no significant impact on fish populations or habitat. Furthermore, the use of towed Mine Warfare devices in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Non-explosive Mine Shape Deployment/Recovery

A Mine Warfare Training Area would be designated in W-50C under Alternative 1 (Figure 2.2-1). This section addresses potential effects associated with establishing and maintaining this training area (*i.e.*, non-explosive mine shape deployment/recovery). The effects of conducting training exercises in this area are the same as those analyzed under aircraft overflights and towed Mine Warfare devices.

As discussed in Chapter 2, the mine shape assembly would include a concrete anchor, mooring line (steel cable or chain), and the mine shape. In some cases the entire assembly (mine shape, mooring line, and anchor) would be deployed concurrently from a boat or aircraft and recovered immediately following the exercise. In other cases concrete anchors would be permanently placed on the sea floor and divers would attach the mooring lines and mine shapes for specific exercises. Mine shapes and mooring lines that would not pose a navigation or fishing hazard could be left in place for up to six months. Up to 20 permanent concrete anchors would be placed in the proposed Mine Warfare Training Area in W-50C (Figure 2.2-2).

The likelihood of a concrete anchor or mine shape directly striking and harming a fish during deployment is extremely low based on the mobility of fish, size of the assembly, and low number of mine shapes. The process of deploying and recovering mine shape assemblies would result in localized disturbances to benthic habitat. Benthic organisms could be crushed, injured, or killed by the impact of the concrete anchor. Approximately 6.25 ft^2 of benthic habitat would be disturbed when a concrete anchor makes contact with the sea floor. A similar size area would be affected when a concrete anchor is recovered. The total area affected per year is not expected to exceed 125 ft^2 based on 20 deployments/recoveries per year. Soft bottom substrates occur in the proposed training area. Mine shapes would not be deployed in areas with live/hard bottom, oyster reefs, SAV, artificial reefs, or shipwrecks. Therefore, disturbed benthic areas would be expected to quickly recover through natural sedimentation processes. The process of divers attaching mooring lines and mines shapes to permanent concrete anchors would not be expected to result in more than minor habitat disturbances.

The permanent concrete anchors would result in minor, long-term changes to benthic habitat. Each permanent anchor would provide about 31.25 ft^2 of exposed hard surface area. Similar to an artificial reef structure, the anchors would be colonized overtime by benthic organisms that prefer hard substrate and would provide structure that could attract some species of fish. Localized increases in species richness and abundance could occur, but significant changes in community structure or function would not be anticipated based on the small surface area provided (625 ft^2 for 20 anchors) and the dispersed nature of the anchors.

The mooring lines would not present an entanglement risk for fish because they would be held taught by the anchor and mine shape. Mooring lines would only be left in place for as long as the mine shape is in the water. Impacts to EFH from mine shape deployment/recovery under Alternative 1 would be minimal based on the small area affected. Mine shape deployment/recovery would not reduce the quality or quantity of EFH in the Study Area. In accordance with NEPA, mine shape deployment/recovery in territorial waters under Alternative 1 would have no significant impact on fish populations or habitat. Mine shape deployment/recovery would not occur in non-territorial waters under Alternative 1 and would have no effect on fish populations or habitat in non-territorial waters in accordance with EO 12114.

Non-Explosive Practice Munitions

The amount of NEPM used in the VACAPES Study Area would increase under Alternative 1 (Tables 2.2-5 and 2.2-6). The number of non-explosive practice bombs dropped in W-72A/B would increase from 295 to 325 per year (Table 3.9-5). These changes would result in increased potential for fish/NEPM strikes and associated fish mortalities and injuries to occur compared to baseline conditions. However, the number of fish affected would continue to be small. Navy mitigation measures, which include avoidance of large *Sargassum* mats where some fish species tend to concentrate, further reduce the probability of NEPM-related injury or mortality.

As discussed for the No Action Alternative, disturbances to water column habitats from NEPM strikes would be short-term and localized. NEPM strikes would cause little or no physical damage to soft bottom benthic habitat, and any damage would be localized. The area affected by non-explosive practice bombs would increase under Alternative 1. The relative non-explosive practice bomb concentration would increase from 2.1 to 2.3 per 100 nm^2/year in W-72A/B. The probability of non-explosive practice bombs striking hard bottom EFH or HAPC, or artificial habitats would increase under Alternative 1. However, the total area of benthic habitat affected would continue to be small. As shown in Table 3.9-6, the maximum area of benthic habitat affected by non-explosive practice bomb strikes would increase from 3,306 ft^2 per year to 3,619 ft^2 per year or 36,190 ft^2 over a ten-year period. Only a percentage of the total area affected (far less than 3,619 ft^2 per year) would be sensitive benthic habitat such as live hard bottom. Non-explosive practice bomb strikes under Alternative 1 could result in long-term, minor effects to benthic EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to benthic EFH would be minimal based on the relatively small area affected by non-explosive practice bombs. Given the small area affected, NEPM use under Alternative 1 would not reduce the quality and/or quantity of EFH in the Study Area.

In accordance with NEPA, NEPM use in territorial waters under Alternative 1 would have no significant impact on fish populations or habitat. Furthermore, NEPM use in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Underwater Detonations and High Explosive Ordnance

The number of MINEX underwater detonations (20-lb charges) would increase from 12 to 24 per year in the VACAPES Study Area under Alternative 1 (Tables 2.2-5 and 2.2-7). These changes would result in increased potential for explosion-related fish injury or mortality compared to baseline conditions. However, explosions under Alternative 1 would not result in significant impacts to fish populations based on the low number of fish that would be affected. The amount of benthic habitat affected by explosions would continue to be small (approximately 302 to 470 ft^2 per year) and the effects would be short-term and localized. Habitat disturbance and fish injury and mortality from explosions are reduced by Navy mitigation measures. Large *Sargassum* mats where some fish species tend to concentrate are avoided and underwater detonation charges are not set within 1,000 m of live/hard bottom, artificial reefs, and shipwrecks. Impacts to EFH from underwater detonations and HE ordnance use under Alternative 1 would be minimal. Underwater detonations and HE ordnance use would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, underwater detonations and HE ordnance use in territorial waters under Alternative 1 would have no significant impact on fish populations or habitat. Furthermore, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Military Expended Materials

The amount of MEM entering the marine environment would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased exposure of fish and EFH to MEM. As discussed above for the No Action Alternative and based on the analyses presented in Sections 3.2, 3.3, and 3.6, impacts associated with MEM to EFH would be temporary and/or minimal. MEM under Alternative 1 would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, MEM in territorial waters under Alternative 1 would have no significant impact on fish populations or habitat. Furthermore, MEM in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Shortnose Sturgeon

Operations occurring in the Atlantic Ocean (OPAREA and R-6606) under Alternative 1 would have no effect on the shortnose sturgeon because this species is not expected to be present in these areas. Operations in the lower Chesapeake Bay under Alternative 1 would be limited to helicopter overflights, vessel movements, and the use of towed Mine Warfare devices, which occur in the air and in the water column, respectively. Shortnose sturgeon would not be exposed to aircraft overflights, vessel movements, and towed Mine Warfare devices because they use benthic habitats. Alternative 1 operations in the lower Chesapeake Bay would have no effect on the shortnose sturgeon. Alternative 1 would have no effect on critical habitat because none has been designated for the shortnose sturgeon.

Smalltooth Sawfish

As discussed in Section 3.9.2.3, the smalltooth sawfish is not expected to occur in the Study Area. Alternative 1 would have no effect on the smalltooth sawfish. Alternative 1 would have no effect on critical habitat because none has been designated for the smalltooth sawfish.

Candidate Species

The effects of Alternative 1 on the Atlantic sturgeon would be the same as those described above for other fish species. Alternative 1 would not result in significant impacts or significant harm to candidate species.

Species of Concern

The effects of Alternative 1 on species of concern would be the same as those described above for other fish species. Alternative 1 would not result in significant impacts or significant harm to species of concern.

3.9.3.3 Alternative 2 (Preferred Alternative)

Vessel Movements

Vessel movements that would occur under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2. Impacts to EFH from vessel movements under Alternative 1 would be temporary and minimal. Vessel movements would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, vessel movements in territorial waters under Alternative 2 would have no significant impact on fish populations or habitat. Furthermore, vessel movements in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Aircraft Overflights

Alternative 2 would include a 4.5 percent increase in fixed-wing aircraft sorties per year and a 92 percent increase in helicopter sorties per year in the VACAPES Study Area (Table 2.2-5). The new fixed-wing sorties would be widely dispersed and a majority of the new helicopter sorties would occur over the lower Chesapeake Bay and W-50. As a result, the potential for fish to be exposed to elevated noise levels would increase compared to baseline conditions, particularly in the lower Chesapeake Bay and W-50. The magnitude of individual exposures would not increase because Alternative 2 does not include use of new aircraft that are louder than current equipment. Peak noise levels generated by the new MH-60R and MH-60S Multi-Mission Combat Support Helicopters would be similar to the noise levels generated by the helicopters they would replace.

Based on the increased operations under Alternative 2 more fish could be exposed to noise and/or the number of times an individual fish is exposed could increase. Similar to the No Action Alternative, the responses would be limited to short-term behavioral or physiological reactions (*e.g.,* swimming away and increased heart rate) and the general health of individual fish would not be compromised. Impacts to EFH from aircraft overflights under Alternative 2 would be temporary and minimal. Aircraft overflights would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, aircraft overflights over territorial waters under Alternative 2 would have no significant impact on fish populations or habitat. Furthermore, aircraft overflights over non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Towed Mine Warfare Devices

The number of towed Mine Warfare device sorties per year would increase by 78 percent in the Study Area under Alternative 2 (Table 2.2-5). These changes would result in increased potential for towed device-related fish mortalities and injuries (primarily eggs and larvae) to occur compared to baseline conditions. However, no measurable effects on fish recruitment would occur because the number of eggs and larvae exposed to towed Mine Warfare devices would continue to be low relative to total ichthyoplankton biomass. Impacts to EFH from towed Mine Warfare device use under Alternative 2 would be temporary and minimal. Towed Mine Warfare device use would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, the use of towed Mine Warfare devices in territorial waters under Alternative 2 would have no significant impact on fish populations or habitat. Furthermore, the use of towed Mine Warfare devices in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Non-explosive Mine Shape Deployment/Recovery

Mine Warfare Training Areas would be designated in W-50C (same as Alternative 1), W-72, W-386, and the lower Chesapeake Bay under Alternative 2 (Figures 2.2-1 through 2.2-4). This section addresses potential effects associated with establishing and maintaining these training areas (*i.e.*, non-explosive mine shape deployment/recovery). The effects of conducting training exercises in these areas are the same as those analyzed under aircraft overflights, towed Mine Warfare devices, and underwater detonations and HE ordnance (for W-50C only). Approximately 20 permanent concrete anchors would be placed in the proposed Mine Warfare Training Area in W-50C and approximately 60 would be placed in the proposed training areas in the lower Chesapeake Bay.

The likelihood of a concrete anchor or mine shape directly striking and harming a fish during deployment is extremely low based on the mobility of fish, size of the assembly, and low number of mine shapes. The process of deploying and recovering mine shape assemblies would result in localized disturbances to benthic habitat. Benthic organisms could be crushed, injured, or killed by the impact of the concrete anchor. Approximately 6.25 ft^2 of benthic habitat would be disturbed when a concrete anchor makes contact with the sea floor. A similar size area would be affected when a concrete anchor is recovered. The total area affected per year is not expected to exceed 1,700 ft^2 based on 270 deployments/recoveries per year. Soft bottom substrates occur in the proposed training areas. Mine shapes would not be deployed in areas with live/hard bottom, oyster reefs, submerged aquatic vegetation, artificial reefs, or shipwrecks. Therefore, disturbed benthic areas would be expected to quickly recover through natural sedimentation processes. The process of divers attaching mooring lines and mines shapes to permanent concrete anchors would not be expected to result in more than minor habitat disturbances.

The permanent concrete anchors would result in minor, long-term changes to benthic habitat. Each permanent anchor would provide about 31.25 ft^2 of exposed hard surface area. Similar to an artificial reef structure, the anchors would be colonized overtime by benthic organisms that prefer hard substrate and would provide structure that could attract some species of fish. Localized increases in species richness and abundance could occur, but significant changes in community structure or function would not be anticipated based on the small surface area provided (625 ft^2 for 20 anchors in W-50C and 1,875 ft^2 for 60 anchors in the lower Chesapeake Bay) and the dispersed nature of the anchors.

The mooring lines would not present an entanglement risk for fish because they would be held taught by the anchor and mine shape. Mooring lines would only be left in place for as long as the mine shape is in the water. Impacts to EFH from temporary mine shape deployment/recovery under Alternative 2 would be minimal based on the small area affected. Mine shape deployment/recovery would not reduce the quality or quantity of EFH in the Study Area. In accordance with NEPA, mine shape deployment/recovery in territorial waters under Alternative 2 would have no significant impact on fish populations or habitat. Furthermore, mine shape deployment/recovery in non-territorial waters would not cause significant harm to fish populations or habitat under Alternative 2.

Non-Explosive Practice Munitions

The amount of NEPM used would increase under Alternative 1 (Tables 2.2-5 and 2.2-6). The number of non-explosive practice bombs dropped in W-72A/B would increase from 295 to 537 per year (Table 3.9-5). These changes would result in increased potential for fish/NEPM strikes and associated fish mortalities and injuries to occur compared to baseline conditions. However, the number of fish affected would continue to be small. Mitigation measures, which include avoidance of large *Sargassum* mats where some fish species tend to concentrate, further reduce the probability of NEPM-related injury or mortality.

As discussed for the No Action Alternative, disturbances to water column habitats from NEPM strikes would be short-term and localized. NEPM strikes would cause little or no physical damage to soft bottom benthic habitat, and any damage would be localized. The area affected by non-explosive practice bombs would increase under Alternative 2. The relative non-explosive practice bomb concentration would increase from 2.1 to 3.8 per 100 nm^2/year in W-72A/B. The probability of non-explosive practice bombs striking hard bottom EFH or HAPC, or artificial habitats would increase under Alternative 2. However, the total area of benthic habitat affected would continue to be small. As shown in Table 3.9-6, the maximum area of benthic habitat affected by non-explosive practice bomb strikes would increase from 3,306 ft^2 per year to 7,384 ft^2 per year or 73,840 ft^2 over a ten-year period. Only a percentage of the total area affected (far less than 7,384 ft^2 per year) would be sensitive benthic habitat such as live hard bottom. Non-explosive practice bomb strikes under Alternative 2 could result in long-term, minor effects to benthic EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to benthic EFH would be minimal based on the relatively small area affected by non-explosive practice bombs. Given the small area affected, NEPM use under Alternative 2 would not reduce the quality and/or quantity of EFH in the Study Area.

In accordance with NEPA, NEPM use in territorial waters under Alternative 2 would have no significant impact on fish populations or habitat. Furthermore, NEPM use in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Underwater Detonations and High Explosive Ordnance

As summarized in Tables 2.2-5 and 2.2-7, underwater detonations and HE ordnance use under Alternative 2 would be the same as Alternative 1, with the following exceptions:

- The number of HE bombs used would decrease from 465 to 20 per year.
- Use of the MK-103 system in W-50C would result in 50 underwater explosions per year (0.002-lbs NEW).
- Use of the Airborne Mine Neutralization System (AMNS) in W-50C would result in 30 underwater explosions (3.24-lbs NEW).

Water column disturbances and potential fish mortality associated with explosions under Alternative 2 would be substantially lower than the No Action Alternative and Alternative 1 based on the reduction in HE bomb use.

Water column disturbances and the potential for fish mortality would increase in W-50C under Alternative 2 based on underwater detonations associated with the MK-103 and AMNS Mine Warfare devices. Fish in the immediate vicinity of explosions could be injured or killed. Prior to detonation, some fish might flee the immediate area in response to water column disturbances associated the Mine Warfare devices being towed through the water. Such evasive responses, the small NEW of the charges, and low number of detonations (total of 80 per year) reduce the likelihood of fish being exposed to impacts from these explosions. Consequently, the number of fish affected by underwater detonations associated with the MK-103 and AMNS is expected to be low.

The effects of explosions associated with FIREX with IMPASS, MISSILEX, and 20-lb NEW underwater detonations under Alternative 2 would be the same as Alternative 1. FIREX with IMPASS and MISSILEX would continue to result in short-term and localized water column disturbances and potential fish mortality. Underwater detonations would continue to impact up to 302 to 470 ft^2 per year of soft bottom benthic habitat, and the effects would be short-term and localized. Overall, the impacts from underwater detonations and HE ordnance use for Alternative 2 would be substantially lower than the No Action Alternative and Alternative 1 based on the reduction in HE bomb use. Impacts to EFH from underwater detonations and HE ordnance use under Alternative 2 would be minimal. Underwater detonations and HE ordnance use would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, underwater detonations and HE ordnance use in territorial waters under Alternative 2 would have no significant impact on fish populations or habitat. Furthermore, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EO 12114.

Military Expended Materials

The amount of MEM entering the marine environment under Alternative 2 would be the same as Alternative 1, with the exception of an increase in non-explosive practice bombs (Table 2.2-5). As discussed above for the No Action Alternative and based on the analyses presented in Sections 3.2, 3.3, and 3.6, impacts associated with MEM to EFH would be temporary and/or minimal. MEM under Alternative 1 would not reduce the quality and/or quantity of EFH in the Study Area. In accordance with NEPA, MEM in territorial waters under Alternative 2 would have no significant impact on fish populations or habitat. Furthermore, MEM in non-territorial waters would not cause significant harm to fish populations or habitat in accordance with EP 12114.

Shortnose Sturgeon

Operations occurring in the Atlantic Ocean (OPAREA and R-6606) under Alternative 2 would have no effect on the shortnose sturgeon because this species is not expected to be present in these areas. Operations in the lower Chesapeake Bay under Alternative 2 would include helicopter overflights, vessel movements, and the use of towed Mine Warfare devices, which occur in the air and in the water column, respectively. Shortnose sturgeon would not be exposed to aircraft overflights, vessel movements, or towed Mine Warfare devices because they use benthic habitats.

Establishment of Mine Warfare Training Areas in the lower Chesapeake Bay under Alternative 2 would involve deployment of non-explosive mine shapes. The likelihood of a concrete anchor or mine shape directly striking and harming a shortnose sturgeon during deployment is extremely low based on the very rare occurrence of this species in the area, the mobility of fish, size of the assembly, and low number of mine shapes. Deployment and recovery of the mine shape assemblies would result in short-term and localized disturbances to benthic habitat, but any effects to the shortnose sturgeon would be insignificant based on the small area affected and the fact that suitable shortnose sturgeon spawning and nursery habitat are not present.

Although exposure to mine shape deployment/recovery would be extremely unlikely and discountable because the shortnose sturgeon rarely occurs in the lower Chesapeake Bay, non-explosive mine shape deployment/recovery operations in the lower Chesapeake Bay under Alternative 2 may affect the shortnose sturgeon. Alternative 2 would have no effect on critical habitat because none has been designated for the shortnose sturgeon.

Smalltooth Sawfish

As discussed in Section 3.9.2.3, the smalltooth sawfish is not expected to occur in the Study Area. Alternative 2 would have no effect on the smalltooth sawfish. Alternative 2 would have no effect on critical habitat because none has been designated for the smalltooth sawfish.

Candidate Species

The effects of Alternative 2 on the Atlantic sturgeon would be the same as those described above for other fish species. Alternative 2 would not result in significant impacts or significant harm to candidate species.

Species of Concern

The effects of Alternative 2 on species of concern would be the same as those described above for other fish species. Alternative 2 would not result in significant impacts or significant harm to species of concern.

3.9.4 Unavoidable Significant Environmental Effects

The analysis presented above indicates that the No Action Alternative, Alternative 1, and Alternative 2 would not result in unavoidable significant adverse effects to fish populations or EFH.

3.9.5 Summary of Environmental Effects

3.9.5.1 Endangered Species Act

Table 3.9-8 provides a summary of the Navy's determination of effect for the No Action Alternative, Alternative 1, and Alternative 2 (the Preferred Alternative) and federally listed fish that potentially occur or historically occurred in the VACAPES Study Area. Operations conducted in the Atlantic Ocean (OPAREA and R-6606) under the No Action Alternative, Alternative 1, and Alternative 2 would have no effect on the shortnose sturgeon. Operations conducted in the lower Chesapeake Bay under the No Action Alternative and Alternative 1 would have no effect on the shortnose sturgeon. Operations conducted in the lower Chesapeake Bay under Alternative 2 may affect the shortnose sturgeon. The No Action Alternative, Alternative 1, and Alternative 2 would have no effect on the smalltooth sawfish. The Study Area does not contain designated critical habitat for any listed species. Consequently, the proposed action would have no effect on critical habitat. The Navy is consulting with NMFS regarding its determination of effect for federally listed fish.

3.9.5.2 Sustainable Fisheries Act – Essential Fish Habitat

As summarized in Table 3.9-9, the No Action Alternative, Alternative 1, and Alternative 2 would not adversely affect EFH. Any impacts would be temporary and/or minimal. The No Action Alternative, Alternative 1, or Alternative 2 would not reduce the quality and/or quantity of EFH in the Study Area.

3.9.5.3 National Environmental Policy Act and Executive Order 12114

As summarized in Table 3.9-9, the No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on fish populations or habitat in territorial waters in accordance with NEPA. Furthermore, in accordance with EO 12114 the No Action Alternative, Alternative 1, and Alternative 2 would not cause significant harm to fish populations or habitat in non-territorial waters.

TABLE 3.9-8
SUMMARY OF THE NAVY'S DETERMINATION OF EFFECT FOR FEDERALLY LISTED FISH POTENTIALLY OCCURRING IN THE VACAPES STUDY AREA FOR ALL ALTERNATIVES

Stressor	Shortnose Sturgeon (Atlantic Ocean)	Shortnose Sturgeon (Lower Chesapeake Bay)	Smalltooth Sawfish
Vessel Movements			
Vessel Disturbance	No Effect	No Effect	No Effect
Vessel Strikes	No Effect	No Effect	No Effect
Aircraft Overflights			
Aircraft Disturbance	No Effect	No Effect	No Effect
Aircraft Strikes	No Effect	No Effect	No Effect
Towed Mine Warfare Devices			
Towed Device Strikes	No Effect	No Effect	No Effect
Mine Warfare Training Area Establishment			
Non-explosive Mine Shape Deployment/Recovery	No Effect	No Effect(1) May Affect(2)	No Effect
Non-explosive Practice Munitions			
Weapons Firing Disturbance	No Effect	No Effect	No Effect
Non-Explosive Practice Munitions Strikes	No Effect	No Effect	No Effect
Underwater Detonations and High Explosive Ordnance			
Underwater Detonations	No Effect	No Effect	No Effect
High Explosive Ordnance	No Effect	No Effect	No Effect
Military Expended Materials			
Ordnance Related Materials	No Effect	No Effect	No Effect
Target Related Materials	No Effect	No Effect	No Effect
Chaff	No Effect	No Effect	No Effect
Self Protection Flares	No Effect	No Effect	No Effect
Marine Markers	No Effect	No Effect	No Effect

(1)No effect determination applies to the No Action Alternative and Alternative 1.
(2)May affect determination applies to Alternative 2.

TABLE 3.9-9
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON FISH AND ESSENTIAL FISH HABITAT IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA and SFA (U.S. Territory)**	**Executive Order 12114 and SFA (Non-Territorial Waters, >12 nm)**
No Action		
Vessel Movements	**EFH –** Vessel movements would result in short-term, localized disturbances to water column and *Sargassum* habitats. Impacts to *Sargassum* habitats would be avoided and minimized by mitigation measures. Vessel movements would not disturb the sea floor and would have no impact on benthic habitats. Impacts to EFH would be temporary and minimal. **Fish/Managed Species –** Vessel movements could elicit behavioral and/or physiological responses in fish, but the effects would be temporary and localized. The probability of vessel strikes with adult and juvenile fish would be low. Injury and mortality to fish eggs and larvae would occur, but the effects would be localized. No population-level impacts would occur.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Aircraft Overflights	**EFH –** Aircraft overflights would result in short-term and localized increases in ambient sound levels in the water column and possibly in shallow water benthic habitats. Impacts to EFH would be temporary and minimal. **Fish/Managed Species –** Aircraft overflights could elicit behavioral and/or physiological responses in some species of fish, but the effects would be temporary and localized. No population-level impacts would occur.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Towed Mine Warfare Devices	**EFH -** Towed MIW devices would result in short-term, localized disturbances to water column and *Sargassum* habitats. Impacts to *Sargassum* habitats would be minimized by avoidance. Towed MIW devices would not disturb the sea floor and would have no impact on benthic habitats. Impacts to EFH would be temporary and minimal. **Fish/Managed Species –** Towed MIW devices could elicit behavioral and/or physiological responses in fish, but the effects would be temporary and localized. The probability of strikes with adult and juvenile fish would be low. Injury and mortality to fish eggs and larvae would occur, but the effects would be localized. No population-level impacts would occur.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.

TABLE 3.9-9
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON FISH AND ESSENTIAL FISH HABITAT IN THE VACAPES STUDY AREA (Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA and SFA (U.S. Territory)**	**Executive Order 12114 and SFA (Non-Territorial Waters, >12 nm)**
Mine Shape Deployment/ Recovery	Not applicable to No Action Alternative	Not applicable No Action Alternative.
Non-explosive Practice Munitions	**EFH –** Similar to non-territorial waters, but lower magnitude because most NEPM is used in non-territorial waters. **Fish/Managed Species -** Similar to non-territorial waters, but lower magnitude because most NEPM is used in non-territorial waters.	**EFH -** Disturbances to water column habitats from NEPM strikes would be temporary and minimal. Impacts to *Sargassum* habitat would be minimal because Navy mitigation measures require avoidance of *Sargassum* mats. Impacts to soft bottom benthic EFH would be temporary and minimal. The total area of benthic habitat affected by non-explosive practice bombs would be small (about 3,309 ft^2 per year) and only a percentage of the total area affected (far less than 3,309 ft^2 per year)would be sensitive benthic habitat such as live hard bottom. Non-explosive practice bombs could result in log-term, minor effects to hard bottom EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to hard bottom EFH would be minimal based on the relatively small area affected. **Fish/Managed Species -** A remote possibility exists that some individual fish at or near the surface may be directly impacted if they are in the target area and at the point of physical impact at the time of NEPM delivery. Navy mitigation measures, which include avoidance of large *Sargassum* mats where some fish species tend to concentrate, reduce the probability of NEPM-related injury or mortality. A limited number of fish might be injured or killed, but NEPM strikes would not result in population-level effects.
Underwater Detonations and High Explosive Ordnance	**EFH –** Underwater explosions in territorial waters would be limited to MINEX UNDETs, which would result in disturbance to water column habitats. However, water column disturbances would be short-term and localized, and associated effects to water column EFH would be temporary and minimal.	**EFH –** Explosions associated with BOMBEX, MISSILEX, and FIREX with IMPASS occur at or near the water's surface in relatively deep waters. Water column disturbances would be short-term and localized, and associated effects to water column EFH would be temporary and minimal. Impacts to *Sargassum*

TABLE 3.9-9
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON FISH AND ESSENTIAL FISH HABITAT IN THE VACAPES STUDY AREA (Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA and SFA (U.S. Territory)**	**Executive Order 12114 and SFA (Non-Territorial Waters, >12 nm)**
	Assuming a worst–case scenario where all 12 MINEX 20-lb charges were detonated directly on the bottom, up to 151 to 235 ft^2 of soft bottom benthic habitat could be disturbed by underwater detonations per year. Crater effects are usually temporary in sand and mud bottoms and repopulation of displaced sediments should be relatively rapid compared to hard bottom areas (NRC, 2002). Impacts to EFH would be temporary and minimal. **Fish/Managed Species –** A limited number of fish would be killed in the proximity of underwater explosions. Additional fish would be injured and could subsequently die or suffer greater rates of predation. Beyond the range of lethal or injurious effects, there could be short-term effects such as masking, stress, behavioral changes, and hearing threshold shifts. However, given the relatively small area that would be affected, and the abundance and distribution of the species concerned, no population-level effects would be expected.	habitat would also be minimal because Navy mitigation measures require avoidance of *Sargassum* mats. Calculations indicate that the maximum radius of the gas bubble produced by these explosions would not extend to the sea floor. Therefore, explosions during these exercises are not expected to result in physical disturbance to benthic habitats. Impacts to EFH would be temporary and minimal. **Fish/Managed Species –** Effects would be similar to those described for territorial waters, but additional fish would be affected because explosions associated with BOMBEX, MISSILEX, and FIREX with IMPASS occur in non-territorial waters. Given the relatively small area that would be affected, and the abundance and distribution of the species concerned, no population-level effects would be expected.
Military Expended Materials	**EFH –** The majority of the expended materials would rapidly sink to the sea floor, become encrusted by natural processes, and incorporated into the sea floor, with no significant accumulations in any particular area and no significant negative effects to water quality or marine benthic communities. Impacts associated with military expended to EFH would be minimal. **Fish/Managed Species –** Some MEM could be ingested by some species of fish and could cause sublethal or lethal effects. However, the number of fish affected would be small and no population-level effects would occur.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Impact Conclusion	**SFA –** Impacts to EFH would be temporary and/or minimal. No reduction in the quality and/or quantity of EFH in the Study Area. **NEPA -** No significant impact to fish populations or habitat.	**SFA –** Impacts to EFH would be temporary and/or minimal. No reduction in the quality and/or quantity of EFH in the Study Area. **Executive Order 12114 -** No significant harm to fish populations or habitat.

TABLE 3.9-9
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON FISH AND ESSENTIAL FISH HABITAT IN THE VACAPES STUDY AREA (Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA and SFA (U.S. Territory)**	**Executive Order 12114 and SFA (Non-Territorial Waters, >12 nm)**
Alternative 1		
Vessel Movements	**EFH -** Slight increase compared to No Action. **Fish/Managed Species -** Slight increase compared to No Action.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Aircraft Overflights	**EFH -** Slight increase compared to No Action. **Fish/Managed Species -** Slight increase compared to No Action.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Towed Mine Warfare Devices	**EFH –** Similar to No Action with increase in sorties. **Fish/Managed Species -** Similar to No Action with increase in sorties.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Mine Shape Deployment/ Recovery	**EFH –** Deployment/recovery of concrete anchors would disturb approximately 125 ft^2 of soft bottom benthic habitat per year. Impacts to benthic EFH would be minimal based on the small area affected. **Fish/Managed Species –** A small number of benthic organisms could be crushed, but no population-level effects would occur.	Not applicable to non-territorial waters.
Non-Explosive Practice Munitions	**EFH –** Similar to non-territorial waters, but lower magnitude because most NEPM is used in non-territorial waters. **Fish/Managed Species -** Similar to non-territorial waters, but lower magnitude because most NEPM is used in non-territorial waters.	**EFH –** Similar to No Action with increase in non-explosive practice bombs. The total area of benthic habitat affected by non-explosive practice bombs would be small (about 3,619 ft^2 per year) and only a percentage of the total area affected (far less than 3,619 ft^2 per year) would be sensitive benthic habitat such as live hard bottom. Non-explosive practice bombs could result in long-term, minor effects to hard bottom EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to hard bottom EFH would be minimal based on the relatively small area affected. **Fish/Managed Species –** Similar to No Action with increased potential for NEPM/fish strikes from increased NEPM use.
Underwater Detonations and High Explosive Ordnance	**EFH –** Similar to No Action, with increase in MINEX UNDETs from 12 to 24 per year. Assuming a worst–case scenario where all 24 MINEX 20-lb charges were detonated directly on the	**EFH -** Similar to No Action, with increase in HE missiles. **Fish/Managed Species -** Similar to No Action, with increase in HE missiles.

TABLE 3.9-9
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON FISH AND ESSENTIAL FISH HABITAT IN THE VACAPES STUDY AREA (Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA and SFA (U.S. Territory)**	**Executive Order 12114 and SFA (Non-Territorial Waters, >12 nm)**
	bottom, up to 302 to 470 ft^2 of soft bottom benthic habitat could be disturbed by underwater detonations per year. Crater effects are usually temporary in sand and mud bottoms and repopulation of displaced sediments should be relatively rapid compared to hard bottom areas (NRC, 2002). Impacts to EFH would be temporary and minimal. **Fish/Managed Species –** Effects would be similar to those described for the No Action, but additional fish would be affected because detonations would increase. Given the relatively small area that would be affected, and the abundance and distribution of the species concerned, no population-level effects would be expected.	
Military Expended Materials	**EFH -** Similar to No Action, with increase in materials. **Fish/Managed Species -** Similar to No Action, with increase in materials.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Impact Conclusion	**SFA –** Impacts to EFH would be temporary and/or minimal. No reduction in the quality and/or quantity of EFH in the Study Area. **NEPA -** No significant impact to fish populations or habitat.	**SFA –** Impacts to EFH would be temporary and/or minimal. No reduction in the quality and/or quantity of EFH in the Study Area. **Executive Order 12114 -** No significant harm to fish populations or habitat.

TABLE 3.9-9 (Continued)
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON FISH AND ESSENTIAL FISH HABITAT IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA and SFA (U.S. Territory)**	**Executive Order 12114 and SFA (Non-Territorial Waters, >12 nm)**
Alternative 2		
Vessel Movements	**EFH -** Slight increase compared to No Action. **Fish/Managed Species -** Slight increase compared to No Action.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Aircraft Overflights	**EFH -** Slight increase compared to No Action. **Fish/Managed Species -** Slight increase compared to No Action.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Towed Mine Warfare Devices	**EFH –** Similar to No Action with increase in sorties. **Fish/Managed Species -** Similar to No Action with increase in sorties.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Mine Shape Deployment/ Recovery	**EFH –** Deployment/recovery of concrete anchors would disturb approximately 1,700 ft^2 of soft bottom benthic habitat per year. Impacts to benthic EFH would be minimal based on the small area affected. **Fish/Managed Species –** A small number of benthic organisms could be crushed, but no population-level effects would occur.	Not applicable to non-territorial waters.
Non-Explosive Practice Munitions	**EFH –** Similar to non-territorial waters, but lower magnitude because most NEPM is used in non-territorial waters. **Fish/Managed Species -** Similar to non-territorial waters, but lower magnitude because most NEPM is used in non-territorial waters.	**EFH –** Similar to No Action with increase in non-explosive practice bombs. The total area of benthic habitat affected by non-explosive practice bombs would be small (about 7,384 ft^2 per year) and only a percentage of the total area affected (far less than 7,384 ft^2 per year) would be sensitive benthic habitat such as live hard bottom. Non-explosive practice bombs could result in long-term, minor effects to hard bottom EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to hard bottom EFH would be minimal based on the relatively small area affected. **Fish/Managed Species –** Similar to No Action with increased potential for NEPM/fish strikes from increased NEPM use.
Underwater Detonations and High Explosive Ordnance	**EFH –** Similar to No Action, with increase in MINEX UNDETs from 12 to 24 per year. Assuming a worst–case scenario where all 24 MINEX 20-lb	**EFH –** Elimination of HE BOMBEX would result in a substantial decrease in water column disturbance compared to

TABLE 3.9-9 (Continued)
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON FISH AND ESSENTIAL FISH HABITAT IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA and SFA (U.S. Territory)**	**Executive Order 12114 and SFA (Non-Territorial Waters, >12 nm)**
	charges were detonated directly on the bottom, up to 302 to 470 ft^2 of soft bottom benthic habitat could be disturbed by underwater detonations per year. Crater effects are usually temporary in sand and mud bottoms and repopulation of displaced sediments should be relatively rapid compared to hard bottom areas (NRC, 2002). Impacts to EFH would be temporary and minimal. **Fish/Managed Species –** Effects would be similar to those described for the No Action, but additional fish would be affected because detonations would increase. Given the relatively small area that would be affected, and the abundance and distribution of the species concerned, no population-level effects would be expected.	No Action. **Fish/Managed Species -** Elimination of HE BOMBEX would result in a substantial decrease in associated effects to fish compared to No Action.
Military Expended Materials	**EFH -** Similar to No Action, with increase in materials. **Fish/Managed Species -** Similar to No Action, with increase in materials.	**EFH –** Same as territorial waters. **Fish/Managed Species –** Same as territorial waters.
Impact Conclusion	**SFA –** Impacts to EFH would be temporary and/or minimal. No reduction in the quality and/or quantity of EFH in the Study Area. **NEPA -** No significant impact to fish populations or habitat.	**SFA –** Impacts to EFH would be temporary and/or minimal. No reduction in the quality and/or quantity of EFH in the Study Area. **Executive Order 12114 -** No significant harm to fish populations or habitat.

3.10 SEABIRDS AND MIGRATORY BIRDS

3.10.1 Introduction and Methods

3.10.1.1 Regulatory Framework

The VACAPES Study Area does not include land areas. Therefore, this section focuses on seabirds and landbirds that could migrate over open-water areas of the VACAPES Study Area seasonally. While the general Study Area for this EIS/OEIS extends up to the shoreline (mean high tide line), none of the proposed activities would take place within 1 mile of the shoreline. Birds using wetlands, mud flats, beaches, and other shoreline habitats would not be exposed to stressors associated with the proposed activities. Therefore, this section does not address shorebirds and wading birds in detail.

Seabirds are birds whose normal habitat and food source is the sea, whether they utilize coastal waters (the nearshore), offshore waters (the continental shelf), or pelagic waters (the open sea) (Harrison, 1983). Migratory birds are any species or family of birds that live, reproduce, or migrate within or across international borders at some point during their annual life cycle. The seabirds addressed in this EIS/OEIS are migratory birds.

The regulatory framework for seabirds and migratory birds is described in detail in Appendix K. The Migratory Bird Treaty Act (MBTA) of 1918 is the primary legislation in the United States established to protect migratory birds. The MBTA prohibits the taking, killing, or possessing of migratory birds unless permitted by regulation. Incidental take of migratory birds during Department of Defense (DoD) military readiness activities is addressed by a regulation promulgated by the Secretary of the Interior and published in the *Federal Register* on February 28, 2007 (50 CFR Part 21).

Two seabird species listed under the federal Endangered Species Act (ESA) potentially occur within the VACAPES Study Area. These include the Bermuda petrel, *Pterodroma cahow*, and roseate tern, *Sterna dougallii*. Therefore, the ESA requirements discussed in Appendix K are applicable to the analysis of these species.

3.10.1.2 Assessment Methods and Data Used

General Approach to Analysis

The general approach to analysis for seabirds and migratory birds is the same as the approach described for marine mammals in Section 3.7.1.2.

Study Area

The study area for seabirds and migratory birds is described in Section 1.5 and is shown in Figure 1.5-1. The study area is analogous to the "action area," for purposes of analysis under Section 7 of the ESA.

Data Sources

A comprehensive, systematic review of relevant literature and data was conducted to complete this analysis for seabirds and migratory birds and to ensure that the best available information was used. Both published and unpublished scientific literature, including the following types of documents, were utilized in the assessment: journals, books, periodicals, bulletins, DoD operations reports, EISs, and other technical reports published by government agencies, private businesses, consulting firms, or non-governmental conservation organizations. The scientific literature was also consulted during the search for geographic location data on the occurrence of resources within the study area. A primary source of information used to describe the affected environment for pelagic seabirds was the *Pelagic Bird Assessment for the Navy's Atlantic Operating Areas* (DoN, 2007), which provides information on the life history and distribution of seabirds occurring along the U.S. Atlantic coast and in the offshore waters of the Navy's Atlantic Operating Areas. Descriptions of literature and data searches conducted during preparation of the pelagic bird assessment report are described in detail in that document.

Factors Used to Assess Effects

This EIS/OEIS analyzed potential effects to seabirds and migratory birds in the context of the MBTA, ESA (listed species only), NEPA, and Executive Order (EO) 12114. The factors used to assess the significance of effects vary under these requirements. Factors considered under the MBTA, NEPA, and EO 12114 include the extent to which an alternative could diminish the capacity of a population of a migratory bird species to maintain genetic diversity, reproduce, and function effectively in its native ecosystem over a reasonable period of time. For purposes of ESA compliance, effects of the action were analyzed to make the Navy's determination of effect for listed species. The definitions used in making the determination of effect under Section 7 of the ESA are based on the USFWS and NMFS *Endangered Species Consultation Handbook* (USFWS and NMFS, 1998) and are provided in Section 3.7.1.1.

3.10.1.3 Warfare Areas and Associated Environmental Stressors

The Navy used a screening process to identify aspects of the proposed action that could act as stressors to seabirds and migratory birds. Navy subject matter experts analyzed the warfare areas and operations included in the proposed action to identify specific activities that could act as stressors. Public and agency scoping comments, previous environmental analyses, previous agency consultations, laws, regulations, executive orders, and resource-specific information also were evaluated. This process was used to focus the information presented and analyzed in the affected environment and environmental consequences sections of this EIS/OEIS.

As summarized in Table 3.10-1, potential stressors to seabirds and migratory birds include:

- Vessel movements (disturbance and strikes);
- Aircraft overflights (disturbance and strikes);
- Towed mine warfare devices (strikes);
- Mine warfare training area establishment (non-explosive mine shape deployment and recovery);
- Non-explosive practice munitions (NEPM) (disturbance and strikes);
- Underwater detonations and high-explosive ordnance; and
- Expended materials such as targets, chaff, self-protection flares, and marine markers (ingestion).

The potential effects of these stressors on seabirds and migratory birds are analyzed in detail in Section 3.10.3.

As discussed in Section 3.3 Water Resources and Section 3.4 Air Quality, some water and air pollutants would be released into the environment as part of the proposed action. The analyses presented in Sections 3.3 and 3.4 indicate that any increases in water or air pollutant concentrations resulting from Navy training in the study area would be negligible and localized, and impacts to water and air quality would not be significant. Based on the analyses presented in Sections 3.3 and 3.4, water quality and air quality changes would have no effects or negligible effects on seabirds and migratory birds. Accordingly, the effects of water quality and air quality changes on seabirds and migratory birds are not addressed further in this EIS/OEIS.

TABLE 3.10-1
SUMMARY OF POTENTIAL STRESSORS TO SEA BIRDS AND MIGRATORY BIRDS [a/]

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Strikes)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment and Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High-explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)										
Mine countermeasures exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓	✓	✓	✓			
Mine countermeasures exercise (MCM)	W-50A/C, W-386, W-72	✓	✓	✓	✓	✓	✓		✓	
Mine neutralization	W-50C	✓	✓	✓	✓	✓	✓	✓	✓	✓
Surface Warfare (SUW)										
Bombing exercise (air-to-surface) (at sea)	W-386 (Air-K), W-72A (Air-3B), W-72A/B			✓	✓			✓	✓	✓
Missile exercise (MISSILEX) (air-to-surface)	W-386 (Air-K), W-72A			✓	✓			✓	✓	✓
Gunnery exercise (GUNEX) (air-to-surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C			✓	✓			✓		✓
GUNEX (surface-to-surface) boat	W-50C, R-6606	✓	✓					✓		✓
GUNEX (surface-to-surface) ship	W-386, W-72	✓	✓					✓		✓
Laser targeting	W-386 (Air-K)			✓	✓					
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA	✓	✓							
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓	✓	✓					
Air Warfare (AW)										
Air combat maneuver (ACM)	W-72A (Air-2A/B, 3A/B)			✓	✓					
GUNEX (air-to-air)	W-72A			✓	✓			✓		✓

TABLE 3.10-1
SUMMARY OF POTENTIAL STRESSORS TO SEABIRDS AND MIGRATORY BIRDS [a/]
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Strikes)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment and Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High-explosive Ordnance	Military Expended Materials
MISSILEX (air-to-air)	W-386 (Air D, G, H, K), W-72A			✓	✓			✓	✓	✓
GUNEX (surface-to-air)	W-386, W-72	✓	✓	✓	✓			✓		✓
MISSILEX (surface-to-air)	W-386 (Air D, G, H, K)	✓	✓	✓	✓			✓		✓
Air intercept control (AIC)	W-386, W-72	✓	✓	✓	✓					
Detect to engage (DTE)	W-386, W-72	✓	✓	✓	✓					
Strike Warfare (STW)										
HARM missile exercise	W-386 (Air E, F, I, J)			✓	✓			✓	✓	✓
Amphibious Warfare (AMW)										
FIREX (surface-to-surface) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓	✓					✓	✓	✓
Electronic Combat (EC)										
Chaff exercise - aircraft	W-386, W-386 (Air-K), W-72			✓	✓					✓

TABLE 3.10-1
SUMMARY OF POTENTIAL STRESSORS TO SEABIRDS AND MIGRATORY BIRDS [a/]
(Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Strikes)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Towed Mine Warfare Devices	Non-explosive Mine Shape Deployment and Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High-explosive Ordnance	Military Expended Materials
Chaff exercise - ship	W-386, W-72	✓	✓							✓
Flare exercise - aircraft	W-386, W-386 (Air-K), W-72			✓	✓					✓
Electronic combat (EC) operations - aircraft	W-386 (Air-K)			✓	✓					
EC operations - ship	VACAPES OPAREA	✓	✓							
Test and Evaluation										
Shipboard Electronic Systems Evaluation Facility (SESEF) utilization	VACAPES OPAREA	✓	✓							

a/ For detailed information on the numbers and types of ordnance, specific weapons platforms, types of targets used, and location of operations, see Table 2.2-4 and Appendix D.

3.10.2 Affected Environment

3.10.2.1 Seabirds and Migratory Birds

Seabird Use of the Study Area

Table 3.10-2 lists seabirds that could potentially occur in the VACAPES Study Area. Seabird distribution and abundance varies considerably by species, with some species primarily occurring in nearshore habitats and others primarily occurring in offshore, pelagic habitats.

TABLE 3.10-2
SEABIRDS POTENTIALLY OCCURRING IN THE VACAPES STUDY AREA [a/]

Family and Scientific Name	Common Name
Alcidae	
Alca torda	Razorbill
Alle alle	Dovekie
Cepphus grylle	Black guillemot
Fratercula arctica	Atlantic puffin
Uria lomvia	Thick-billed murre
Uuria aalge	Common murre
Diomedeidae	
Thalassarche chlororhynchos	Yellow-nosed albatross
Fregatidae	
Fregata magnificens	Magnificent frigatebird
Gaviidae	
Gavia immer	Common loon
Hydrobatidae	
Oceanites oceanicus	Wilson's storm-petrel
Oceanodroma castro	Band-rumped storm-petrel
Oceanodroma leucorhoa	Leach's storm-petrel
Pelagodroma marina	White-faced storm-petrel
Laridae	
Anous stolidus	Brown noddy
Larus argentatus	Herring gull
Larus atricilla	Laughing gull
Larus delawarensis	Ring-billed gull
Larus fuscus	Lesser black-backed gull
Larus glaucoides	Iceland gull
Larus hyperboreous	Glaucous gull
Larus marinus	Great black-backed gull
Larus minutus	Little gull
Larus ridibundus	Black-headed gull
Larus thayeri	Thayer's gull
Larus philadelphia	Bonaparte's gull
Rissa tridactyla	Black-legged kittiwake
Stercorarius maccormicki	South polar skua
Stercorarius skua	Great skua
Onychoprion anaethetus	Bridled tern
Sterna antillarum	Least tern [c/]
Sterna caspia	Caspian tern
Sterna dougallii	Roseate tern [d/]
Sterna forsteri	Forster's tern
Sterna fuscata	Sooty tern
Sterna hirundo	Common tern
Sterna maxima	Royal tern

TABLE 3.10-2
SEABIRDS POTENTIALLY OCCURRING IN THE VACAPES STUDY AREA
(Continued)

Family and Scientific Name	Common Name
Sterna nilotica	Gull-billed tern
Sterna sandvicensis	Sandwich tern
Pelecanidae	
Pelecanus erythroryhyncos	American white pelican
Pelecanus occidentalis	Brown pelican
Phaethontidae	
Phaethon aethereus	Red-billed tropicbird
Phaethon lepturus	White-tailed tropicbird
Phalacrocoracidae	
Phalacrocorax auritus	Double-crested cormorant
Phalacrocorax carbo	Great cormorant
Procellariidae	
Calonectris diomedea	Cory's shearwater
Fulmarus glacialis	Northern fulmar
Pterodroma arminjoniana	Herald petrel
Pterodroma cahow	Bermuda petrel (=cahow) [e/]
Pterodroma feae	Fea's petrel
Pterodroma hasitata	Black-capped petrel
Puffinus gravis	Greater shearwater
Puffinus griseus	Sooty shearwater
Puffinus lherminieri	Audubon's shearwater
Puffinus puffinus	Manx shearwater
Scolopacidae	
Phalaropus fulicarius	Red phalarope
Phalaropus lobatus	Red-necked phalarope
Sulidae	
Sula dactylatra	Masked booby
Sula leucogaster	Brown booby
Stercorariidae	
Stercorarius parasiticus	Parasitic jaeger
Stercorarius longicaudus	Long-tailed jaeger
Stercorarius pomarinus	Pomarine jaeger

a/ Sources: Golder, 2004 and DoN, 2007.
b/ Number in the Outer Continental Shelf IBA, as reported in Golder (2004).
c/ Least tern is federally listed as endangered on U.S. west coast and interior rivers. Birds that might occur in the VACAPES Study Area are not federally listed.
d/ The Northeast breeding population of the roseate tern is federally listed as endangered. This species is listed as threatened in other areas.
e/ The Bermuda petrel is federally listed as endangered throughout its range.

The area from the beach to about 10 nm offshore provides:

- Foraging areas for breeding terns, gulls, skimmers, and pelicans. The beach and very near shore areas provide habitat for the piping plover, Wilson's plover, American oystercatcher, and black skimmer. As noted in Section 3.10.1.1, birds using wetlands, mud flats, beaches, and other shoreline habitats would not be exposed to stressors associated with the proposed activities. Therefore, this section does not address shorebirds and wading birds in detail;
- A migration corridor and winter habitat for terns, gulls, skimmers, pelicans, loons, cormorants, and gannets; and
- Support areas for non-breeding and transient pelagic seabirds.

Offshore pelagic waters support non-breeding and transient pelagic seabirds, loons, gannets, and several tern species (Hunter *et al.*, 2006).

Important Bird Areas

Pelagic seabirds are generally widely distributed, but they tend to congregate in areas along the Gulf Stream, around the continental shelf break, near upwellings, and in areas with large *Sargassum* mats. The most significant congregating site in the southeastern United States is off Cape Hatteras, North Carolina and partially within the VACAPES OPAREA. This area, which was identified as the Outer Continental Shelf Important Bird Area (IBA) by Audubon North Carolina, covers about 716 nm^2 on the western boundary of the Gulf Stream in an area with water depths of 90 meters to 900 meters (Figure 3.10-1). The cool waters from the Labrador Current and the warm waters of the Gulf Stream meet in this area to create one of the richest and most important areas for pelagic birds in the western Atlantic. Large mats of *Sargassum* form in this area, resulting in a high concentration of seabirds and many forms of marine life. The IBA boundary shown in Figure 3.10-1 should be considered a "soft edge," based on the dynamic nature of the physical and biological environment of the Gulf Stream.

The Outer Continental Shelf IBA has the greatest diversity of seabirds in the southeastern United States, and probably has the greatest density of tropical seabirds in the region (Golder, 2004; Hunter *et al.*, 2006). The limited abundance data provided in Golder (2004) for key bird species found in the Outer Continental Shelf IBA are included in Table 3.10-2. However, no current population estimates exist for pelagic seabirds in the southeast region (Hunter *et al*., 2006).

Productive inshore ocean waters and waters of the Chesapeake Bay provide important foraging areas for a great variety of birds during all months of the year. Some of the species that use these waters include pelicans, loons, terns, and gulls.

Inshore ocean waters between Cape Hatteras, North Carolina, and Virginia have been identified as the Outer Banks, Inshore Ocean IBA by Audubon North Carolina (Figure 3.10-1). This IBA, which covers about 235 nm^2 and extends from the surf zone seaward to about 3.1 miles offshore, is important for coastal birds throughout the year. During spring and summer, this IBA is a key foraging area for terns nesting on nearby beaches and islands. During winter months, the IBA supports North Carolina's largest population of northern gannets and red-breasted mergansers. Many species of gulls and terns forage in the area during migration, while loons and sea ducks use it as a migration corridor (Golder, 2004).

Several other IBAs in the general vicinity of the VACAPES Study Area encompass land, marsh, and open inshore waters. Additional IBAs in the area include, but are not limited to the following:

- Cape Hatteras and Pea Island IBAs in North Carolina (Golder, 2004);
- Barrier Island/Lagoon System and Lower Delmarva IBAs in Virginia (National Audubon Society, 2004); and
- Assateague Island IBA in Maryland (National Audubon Society, 2004).

These IBAs provide valuable nesting and foraging habitats, important resting areas, and migration corridors for migratory birds.

The Barrier Island/Lagoon System IBA is located outside the VACAPES Study Area along the western edge of the Delmarva Peninsula from the mouth of Chesapeake Bay to the Maryland border. It covers about 260,000 acres of barrier islands along the Atlantic Coast, maritime forests, extensive salt marshes, inter-tidal mudflats, and open water. This IBA is the most important bird area in Virginia and one of the most important bird areas along the Atlantic Coast of North America. The area has been designated as a United Nations Educational, Scientific, and Cultural Organization Biosphere Reserve and a Western

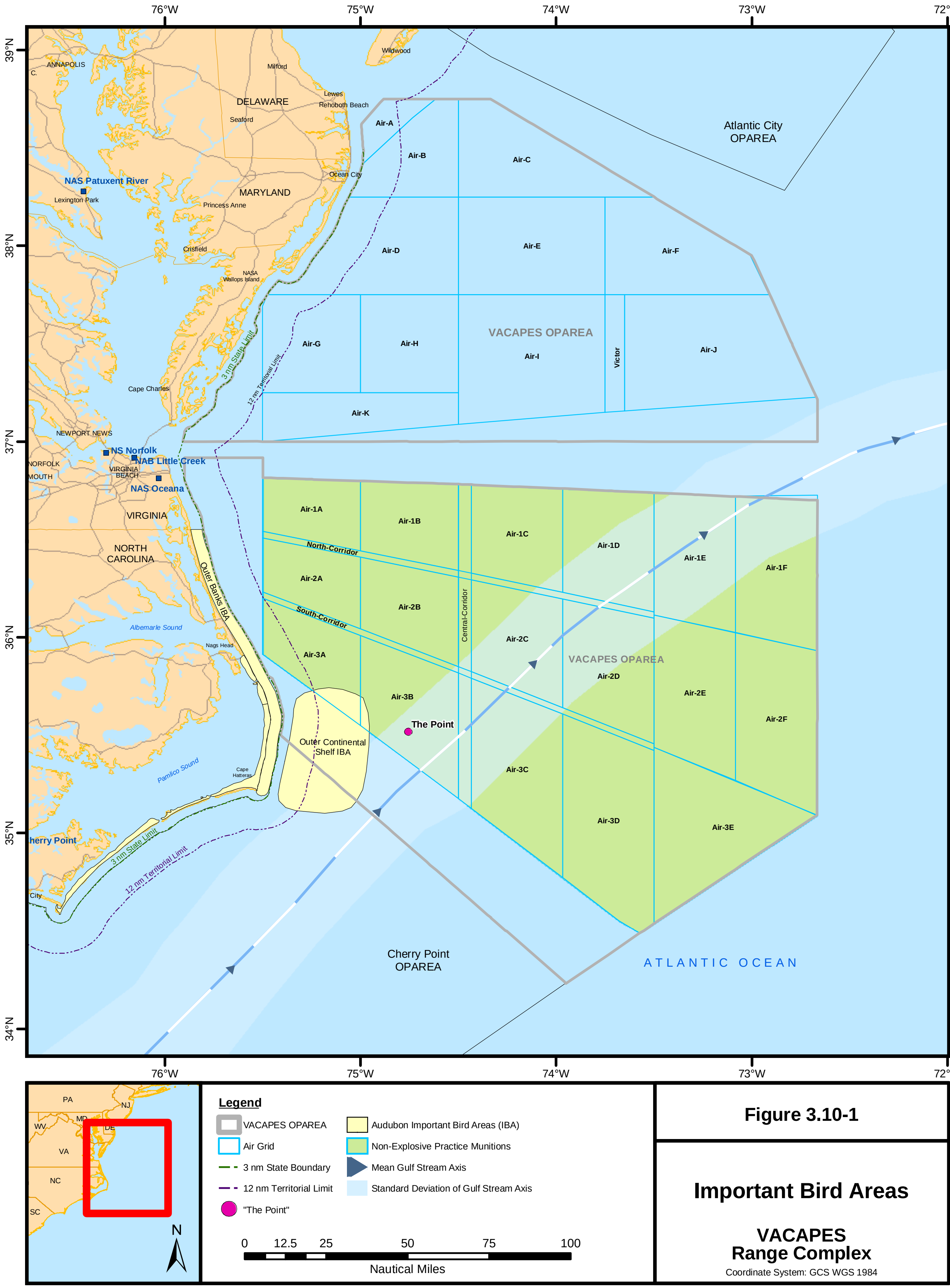


Figure 3.10-1

Important Bird Areas

VACAPES Range Complex

Coordinate System: GCS WGS 1984

Hemisphere Shorebird Reserve Site with international status. It is the site of a National Science Foundation Long-term Ecological Research site, and is the focus of a multi-organizational partnership dedicated to bird conservation (National Audubon Society, 2004).

Birds Using the Lower Chesapeake Bay

The lower Chesapeake Bay region is an important area for both landbirds and waterbirds because it is located in the Atlantic Flyway and provides an abundance of diverse habitat. About 29 species of waterfowl use the Chesapeake Bay for wintering, breeding, or as a stopover during migration. Extensive wintering habitat is of major importance, with about one million waterfowl wintering on the Bay annually (Phillips, 2007; CBP, 1990). Large numbers of pelagic seabirds also winter on the lower Chesapeake Bay and can be observed there during other times of year, particularly after severe storms or hurricanes. The area provides foraging, nesting, and migration stopover habitat to marsh, shore, and wading birds (Phillips, 2007). Many landbirds also cross the lower Chesapeake Bay during biannual migrations. The Delmarva Peninsula channels southbound landbirds towards the mouth of the Bay during the fall migration. Migrants use habitats near the southern tip of the peninsula before crossing the Bay and continuing south along the Atlantic Coast to winter. Annually, between August and December, over 10 million neotropical and temperate passerines (perching birds) and 80 thousand raptors (birds of prey such as hawks) are estimated to migrate through this area (National Audubon Society, 2008). The islands of the Chesapeake Bay Bridge-Tunnel, which spans the mouth of the Bay, are also a popular recreational birding destination, providing birders an opportunity to spot more than 350 species of birds.

The proposed Mine Warfare Training Areas in the lower Chesapeake Bay are located in open waters more than 1 mile from shore. Therefore, species that favor open water habitat such as sea ducks (*e.g.*, scoters, mergansers, goldeneyes, long-tailed ducks, buffleheads, and harlequin ducks) and seabirds (*e.g.*, terns, gulls, Northern Gannets, petrels, storm petrels, and shearwaters) would be expected to occur in these areas, particularly during the winter.

Numerous species of waterbirds and landbirds could also cross the proposed Mine Warfare Training Areas in the lower Chesapeake Bay during biannual (spring and fall) migrations. The vast majority of migrating birds would be expected to cross the lower Bay at night, although some birds migrate in daylight (Kerlinger, 1995; Lincoln, 1998). The altitudes at which migrating birds fly can vary greatly based on the type of bird, where they are flying (over water or over land), and other factors such as weather (Kerlinger, 1995). As seen by radar, some nocturnal migrants (probably shorebirds) fly over the ocean at 15,000 or even 20,000 feet (Lincoln, 1998). Some species such as sea ducks and loons may be commonly seen flying just above the water' surface, but the same species can also be spotted flying so high that they are barely visible through binoculars (Kerlinger, 1995; Lincoln, 1998). While there is considerable variation, the favored altitude for most small birds appears to be between 500 and 1,000 feet. Radar studies have demonstrated that 95 percent of the migratory movements occur at less than 10,000 feet, the bulk of the movements occurring under 3,000 feet (Lincoln, 1998).

3.10.2.2 Birds Listed under the Endangered Species Act

The Bermuda petrel and roseate tern, both of which could potentially occur in the VACAPES Study Area, are listed under the ESA. Additional information about these species is provided below. Critical habitat for these listed birds has not been designated under the ESA within the VACAPES Study Area. The piping plover (*Charadrius melodus*), which is federally listed as threatened, is known to occur adjacent to the VACAPES Study Area. Atlantic coast piping plovers breed on coastal beaches from Newfoundland and southeastern Quebec to North Carolina. They forage along the shoreline and on mud flats. None of the proposed training activities would take place within 1 mile of the shoreline. Therefore, the piping plover would not be exposed to stressors associated with the proposed activities and is not addressed in further detail in this EIS/OEIS. The Navy has completed the ESA Section 7 informal consultation process with USFWS. In a letter dated October 7, 2008, USFWS concurred that Alternative 2 (the Preferred Alternative) would have no effect on the piping plover (Appendix C).

While not listed under the ESA, others species potentially occurring in the study area are of management concern based on relatively low or declining populations. These include the black-capped petrel, masked booby, brown booby, razorbill, sooty shearwater, and northern gannet (Hunter *et al*., 2006).

The black-capped petrel is of particular concern because the worldwide breeding population is currently estimated at 1,000 pairs (BirdLife International, 2007a). Waters in or adjacent to the Gulf Stream between northern Florida and southern Virginia comprise the primary non-breeding range of black-capped petrels. The main foraging area appears to be offshore from Cape Hatteras National Seashore, North Carolina (Hunter *et al*., 2006).

Bermuda Petrel

The Bermuda petrel, also known as cahow, is the rarest of the four gadfly petrels found in the north Atlantic. It was likely abundant on Bermuda until human settlement led to habitat destruction, exploitation of petrels as a food source, and the introduction of predatory mammals such as rats. Bermuda petrels feed at the sea surface primarily on small squid, shrimp, and small fish. They may often feed at night to avoid predators and capture prey that surfaces to feed on plankton (Brinkley and Humann, 2001).

Status and Management - The Bermuda petrel is listed as endangered under the ESA throughout its range. Critical habitat has not been designated for this species.

This species was thought to be extinct for nearly 300 years, until it was rediscovered in the first half of the 20th century. The Bermuda petrel population was estimated at 250 birds in 2005 (BirdLife International, 2007a). A record number of young (40) fledged in 2003, and another 35 fledged in 2005 (BirdLife International, 2007a). While current population numbers are extremely low, the Bermuda petrel population is increasing.

Bermuda petrel breeding habitat is limited to small islets in Castle Harbor, Bermuda. The habitat is protected and intensely managed for this species. Potential threats to Bermuda petrels in the pelagic environment include fisheries interactions; exposure to oil and hazardous materials; debris ingestion and entanglement; and strikes with lighted vessels, platforms, and wind energy turbines (Hunter *et al.*, 2006).

Distribution – From late October through early June, Bermuda petrels can be observed in small breeding colonies on several islets in Castle Harbor, Bermuda. Adult breeding pairs arrive at nesting sites as early as October and begin a courtship period that involves paired nocturnal flights. A single egg is laid, usually in January, and chicks hatch in late February or early March. The chick is ready to fledge in late May to early June; however, it is not uncommon for the parents to abandon the chick two weeks or more before it is able to fly (BirdLife International, 2007a).

When it is not breeding, the Bermuda petrel may be distributed throughout the north Atlantic, but it is primarily found in the warm waters of the Gulf Stream between Bermuda and North Carolina. However, a capture in 2002 on the Azores in the eastern Atlantic indicates the species is capable of a wide distributional range (BirdLife International, 2007a). In recent years, several confirmed sightings have occurred off the coast of North Carolina, where the Gulf Stream separates from the U.S. coast and flows away from shore into the Atlantic (BirdLife International, 2007a). The full range of the Bermuda petrel is difficult to identify, because of its low worldwide population (estimated 250 individuals) and its similar appearance to other species in the same region (BirdLife International, 2007a).

Bermuda Petrel Occurrence in the VACAPES Study Area – Increasing observations and photographic documentation provide evidence that Bermuda petrels regularly forage in the Gulf Stream waters off

North Carolina (Hunter *et al*., 2006). At least one published record (Lee, 1987) exists for the VACAPES Study Area in W-72A(2) (surface grid cell 3B3).

Bermuda petrels would most likely be found in the VACAPES Study Area from May through August, but non-breeding adults and juveniles may also be present in this region at other times of the year (DoN, 2007). For example, the published record noted above is for a sighting in December. Outside the breeding season, Bermuda petrels are most likely to move north of Bermuda and follow the western and northern wall of the Gulf Stream while foraging (BirdLife International, 2007a). This species is not expected to occur in nearshore waters of the VACAPES Study Area or the lower Chesapeake Bay.

Density data for the Bermuda petrel in the VACAPES Study Area or other areas are not available. However, the maximum density would not exceed 0.05 birds per nm^2, assuming that all members of the worldwide population (250 birds) were foraging in the study area simultaneously; and the birds were concentrated in Gulf Stream waters, which make up about 17 percent of the study area, or 4,750 nm^2. Actual density would be much lower because birds are expected to forage in areas outside the study area.

Roseate Tern

Status and Management - The northeastern breeding population of roseate terns is listed as endangered under the ESA. The range of this population extends along the U.S. Atlantic Coast from Canada south to North Carolina (USFWS, 2007a and 2007b). Roseate terns in this population are known to occur in Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, North Carolina, and Virginia as well as in Newfoundland, Nova Scotia, and Quebec. Beyond the northeastern region, the roseate tern is listed as threatened in the Western Hemisphere and adjacent oceans, essentially wherever it is not listed as endangered. Threatened populations are known to occur in Florida, Georgia, North Carolina, South Carolina, Puerto Rico, and the U.S. Virgin islands (USFWS, 2007a).

The global population is estimated to be 40,000 breeding pairs. The northeastern population has been fluctuating at around 3,500 pairs, recording a low of 3,125 pairs in 1992 and a high of 3,775 pairs in 1996 (BirdLife International, 2007b; USFWS, 2007b). In 1993, the Caribbean population was estimated to be between 5,000 and 8,500 pairs, with 350 of those pairs breeding in the Florida Keys (USFWS, 2007b).

Distribution - The roseate tern is widespread in the Atlantic, Indian, and southwestern Pacific Oceans; although local populations are generally small (BirdLife International, 2007b; NatureServe, 2007). In the Atlantic Ocean, the northeastern breeding population is concentrated in isolated colonies mainly between Cape Cod, Massachusetts and Long Island, New York. Additionally, a Caribbean population breeds in the Florida Keys, Bahamas, West Indies, and other locations in central and northern South America. Non-breeding populations are found in and around the Bahamas, Cuba, and the Lesser Antilles (NatureServe, 2007). Roseate terns prey on small, schooling fish by plunge-diving from the air into water (NatureServe, 2007).

The northern population migrates to their Caribbean wintering grounds well off the Atlantic Coast and are only rarely observed during pelagic trips or in coastal areas in the southeastern United States (Hunter *et al*., 2006). Roseate terns are occasional visitors along the Outer Banks, south of Cape Hatteras, particularly at Cape Point within Cape Hatteras National Seashore, during the months of July and August. They may rarely be seen in late spring and early summer (USFWS, 2007c).

Roseate Tern Occurrence in VACAPES Study Area - Roseate terns are not expected to occur in the VACAPES Study Area except as occasional, transient individuals.

3.10.3 Environmental Consequences

3.10.3.1 No Action Alternative

Vessel Movements

As discussed in Section 3.7.3, many of the ongoing and proposed operations within the VACAPES Study Area involve maneuvers by various types of Navy vessels. Birds could be exposed to moving vessels throughout the study area, but few direct encounters would occur based on the infrequency of operations and the low density of vessels within the study area at any time (0 to 10 vessels at any time, which results in a maximum density of fewer than 0.0004 vessels per nm^2; see Section 3.7.3 for overview of vessel movements). The Navy would log about 1,400 total steaming days within the study area during a typical year under the No Action Alternative (Table 2.2-5).

Birds respond to moving vessels in various ways. Some birds commonly follow vessels, including certain species of gulls, storm petrels, and albatrosses (Hamilton, 1958; Hyrenbach, 2001; Hyrenbach, 2006). Other species such as frigatebirds and sooty terns seem to avoid vessels (Borberg *et al*., 2005; Hyrenbach, 2006).

Vessel movements could elicit short-term behavioral or physiological responses, such as alert response, startle response, fleeing the immediate area, or temporary increase in heart rate. However, the general health of individual birds would not be compromised. An additional discussion of these responses is provided below under aircraft overflights.

Direct strikes with vessels or interactions with a vessel's rigging (such as fishing gear, wires, poles, or masts) can result in bird injury or mortality. The possibility of encounters could increase at night, especially during inclement weather. Birds can become disoriented at night in the presence of artificial light (Bruderer *et al*., 1999; Black, 2005), and lighting on vessels may attract some seabirds (Hunter *et al*., 2006), increasing the potential for harmful encounters. Harmful seabird/vessel interactions are commonly associated with commercial fishing vessels because birds are attracted to concentrated food sources around these vessels (Melvin *et al*., 2001; Dietrich and Melvin, 2004).

Based on the low Navy vessel density and patchy distribution of seabirds in the study area, the probability of bird/vessel strikes is extremely low. Navy training activities attempt to simulate warlike conditions; therefore, in an attempt to remain visually disguised, vessels do not typically use large deck lights or strobes. This reduces the potential attraction of nocturnal foraging seabirds. Furthermore, the concentrated food sources that attract seabirds to commercial fishing vessels are absent around Navy vessels. Navy mitigation measures (see Chapter 5), which include avoidance of large *Sargassum* mats where seabirds tend to concentrate, further reduce the probability of vessel disturbance and strikes.

If a bird were to collide with a vessel, individual injury or mortality could occur. However, vessel movements under the No Action Alternative would not have a significant, adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, vessel movements in territorial waters would have no significant impact on birds. In accordance with EO 12114, vessel movements in non-territorial waters would not cause significant harm to birds. Effects of the No Action Alternative on the federally listed Bermuda petrel and roseate tern are analyzed below.

Aircraft Overflights

Aircraft Disturbance

Various types of fixed-wing aircraft and helicopters are used in training exercises throughout the VACAPES Study Area (see Chapter 2 and Appendix D). Seabirds and other migratory birds could be exposed to airborne noise associated with subsonic and supersonic, fixed-wing aircraft overflights and helicopter operations. See Section 3.5 Airborne Noise Environment for a description of the existing noise environment and Appendix H for an overview of airborne acoustics. Birds could be exposed to elevated noise levels while foraging or migrating in open water environments within the Atlantic Ocean or the lower Chesapeake Bay. With the exception of an occasional high-altitude (greater than 3,000 feet) fixed-wing aircraft overflight, none of the proposed aircraft training would take place within 1 mile of the shoreline. Therefore, exposure of birds to aircraft noise while they are using wetlands, mud flats, beaches, and other shoreline habitats would be negligible.

Numerous studies have documented that birds and other wild animals respond to human-made noise, including aircraft overflights, weapons firing, and explosions (National Park Service, 1994; Larkin, 1996; Plumpton, 2006). The manner in which birds respond to noise depends on several factors, including life-history characteristics of the species, characteristics of the noise source, loudness, onset rate, distance from the noise source, presence or absence of associated visual stimuli, and previous exposure. Researchers have documented a range of bird behavioral responses to noise, including no response, alert behavior, startle response, flying or swimming away, diving into the water, and increased vocalizations (National Park Service, 1994; Larkin, 1996; Plumpton, 2006). While they are difficult to measure in the field, some of these behavioral responses are likely accompanied by physiological responses, such as increased heart rate or stress.

Chronic stress can compromise the general health of birds, but stress is not necessarily indicative of negative consequences to individual birds or to populations (National Park Service, 1994; Larkin, 1996; Bowles *et al*., 1990 in Larkin, 1996). For example, the reported behavioral and physiological responses of birds to noise exposure are within the range of normal adaptive responses to external stimuli, such as predation, that birds face on a regular basis. Unless repeatedly exposed to loud noises or simultaneously exposed to synergistic stressors, it is possible that individuals would return to normal almost immediately after exposure and the individual's metabolism and energy budgets would not be affected. Studies have also shown that birds can become habituated to noise following frequent exposure and cease to respond behaviorally to the noise (National Park Service, 1994; Larkin, 1996; Plumpton, 2006). Little is known about physiological responses of birds that have habituated to noise.

Approximately 5,966 fixed-wing sorties would occur in the VACAPES Study Area annually under the No Action Alternative and approximately 98 percent of the sorties would be above 3,000 feet. Bird exposure to fixed-wing aircraft noise would be brief (seconds) as an aircraft quickly passed overhead. Exposures would be infrequent, based on the transitory, dispersed nature of the overflights, and repeated exposure of individual birds over a short period of time (hours or days) would be extremely unlikely.

While fixed-wing aircraft operations could occur in SUA throughout the VACAPES Study Area under the No Action Alternative, most sorties would be associated with air combat maneuver (ACM) training, which takes place in W-72A (Air-2A/B and Air-3A/B) (Figure 2.1-2). Under the No Action Alternative, approximately 5,264 ACM sorties (F/A-18 aircraft) would occur annually (average of 14 sorties per day). Altitudes would range from 5,000 to 30,000 feet and typical airspeeds would range from very low (less than 100 knots) to high subsonic (less than 600 knots). Sound exposure levels at the sea surface from most ACM overflights are expected to be less than 85 decibels on an A-weighted scale (dBA), based on an F/A-18 aircraft flying at an altitude of 5,000 feet and at a subsonic airspeed of 400 knots. Some ACM training would involve supersonic flight, which would produce sonic booms, but such airspeeds would be infrequent.

A portion of the Outer Continental Shelf IBA, which supports a high concentration of seabirds, is located under Air-3A/B where ACM overflights occur. However, seabirds at or near the sea surface in this area may not respond to overflight noise, based on the relatively high flight altitudes (5,000 to 30,000 feet). Most documented responses of birds have been to low-level aircraft overflights occurring below

3,000 feet (National Park Service, 1994). The duration of exposure would be very short (seconds) and exposures would be infrequent. Unlike the situation at a busy commercial airport or military landing field, repeated exposure of individual birds or groups of birds would be unlikely based on the dispersed nature of the overflights. If birds were to respond to an overflight, the responses would be limited to short-term behavioral or physiological reactions, such as alert response, startle response, or temporary increase in heart rate, and the general health of individual birds would not be compromised.

Approximately 1,743 helicopter sorties would occur in the VACAPES Study Area annually under the No Action Alternative. Helicopter overflights would occur throughout the VACAPES Study Area, with most occurring in W-50 and the lower Chesapeake Bay. The W-50 area is south of the mouth of the Chesapeake Bay and from about 3 to 12 nm offshore. This area is also located east of the Atlantic Flyway, which generally follows the shoreline. Helicopter use in the lower Chesapeake Bay occurs north and west of the Chesapeake Bay Bridge-Tunnel. A variety of seabirds, including large rafts of sea ducks in the lower Chesapeake Bay, could be exposed to helicopter noise in the areas beneath helicopter sorties. However, Navy pilots are trained to avoid large flocks of birds to protect aircrews and equipment. Such measures would also minimize bird exposure to helicopter noise. In addition, landbirds could be exposed in the lower Chesapeake Bay area during seasonal migrations. However, exposure during migration is expected to be minimal because most helicopter sorties would occur during daylight hours and most migrating birds would cross the lower Bay at night (Kerlinger, 1995; Lincoln, 1998).

Unlike fixed-wing aircraft, helicopter training operations occur mostly at low altitudes: approximately 90 percent are below 3,000 feet above ground level (AGL) and 10 percent are below 200 feet AGL. This increases the likelihood that birds would respond to helicopter overflights. In addition, some studies have suggested that birds respond more to noise from helicopters than from fixed-wing aircraft (Larkin, 1996; Plumpton, 2006). Noise from low-altitude helicopter overflights may elicit short-term behavioral or physiological responses, such as alert response, startle response, and/or temporary increase in heart rate, in exposed birds. Repeated exposure of individual birds or groups of birds is unlikely, based on the dispersed nature of the overflights. The general health of individual birds would not be compromised.

In summary, aircraft noise under the No Action Alternative could elicit short-term behavioral or physiological responses in exposed birds. Helicopter overflights would be more likely to elicit responses than fixed-wing aircraft, but the general health of individual birds would not be compromised. Aircraft noise under the No Action Alternative would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, aircraft noise over territorial waters would have no significant impact on birds. In accordance with EO 12114, aircraft noise over non-territorial waters would not cause significant harm to birds.

Aircraft Strikes

Wildlife/aircraft strikes are a major concern for the Navy because they can cause harm to aircrews, damage to equipment, and injury or mortality to wildlife. From 2002 through 2004, an annual average of 596 known wildlife/aircraft strike events occurred Navy-wide, and most of these events involved birds (Navy Safety Center, 2004). While all wildlife/aircraft strikes are serious and potentially dangerous events, the number of animals injured or killed annually is small, considering the number of Navy-wide aircraft operations.

While bird strikes can occur anywhere aircraft are operated, Navy data indicate they occur most often over land or close to shore. The potential for bird strikes to occur in offshore areas is relatively low because operations are widely dispersed at relatively high altitudes (above 3,000 feet for fixed-wing aircraft) and bird densities are generally low. For example, from 2002 through 2004, only five known bird strikes involving vessel-based aircraft occurred Navy-wide.

Of the 1,789 Navy-wide, wildlife-strike events reported for 2002 through 2004, only 19 (1%) involved seabirds. Nine (47%) of the seabird strike events involved gulls (Navy Safety Center, 2004), which commonly occur in terrestrial environments or over nearshore waters.

In addition, Navy pilots are trained to avoid large flocks of birds to protect aircrews and equipment. For example, Navy pilots would avoid large rafts of sea ducks or large aggregations of other seabirds during low-altitude helicopter operations in the lower Chesapeake Bay to ensure safety.

Few, if any, bird/aircraft strikes and associated bird mortalities or injuries are expected to occur in the study area under the No Action Alternative. Aircraft strikes under the No Action Alternative would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, aircraft strikes over territorial waters would have no significant impact on bird populations. In accordance with EO 12114, aircraft strikes over non-territorial waters would not cause significant harm to bird populations.

Towed Mine Warfare Devices

As described in Chapter 2 and Appendix D, mine warfare exercises conducted in the study area include the use of various underwater mine detection and countermeasures systems that are towed through the water by helicopters flying approximately 75 feet above the water at low airspeeds. This training would occur in the lower Chesapeake Bay (a minimum of 1 mile from the shoreline) and portions of the OPAREA within 45 nm of NS Norfolk (see Figures 2.2-1, 2.2-2, 2.2-3, and 2.2-4). Effects on birds from this training could include the following:

- Birds could be injured or killed if they were struck on the water by the towed device or the tow line connecting the helicopter to the device.
- The noise, downdraft, and visual cues from the nearby helicopter would cause birds in the immediate area to flee. Such birds could be struck by the tow line during an evasive response because the tow line might be difficult to see.

However, these effects are unlikely, because birds typically would evade the helicopter long before the tow lines presented a strike risk.

Similar to aircraft strikes discussed above, few if any bird/towed device strikes and associated bird mortalities or injuries are expected to occur in the study area under the No Action Alternative. Towed mine warfare device use under the No Action Alternative would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, towed mine warfare device use in territorial waters would have no significant impact on birds. In accordance with EO 12114, the use of towed mine warfare devices in non-territorial waters would not cause significant harm to birds.

Mine Warfare Training Area Establishment (Non-explosive Mine Shape Deployment and Recovery)

The No Action Alternative does not include establishment of mine warfare training areas where non-explosive mine shapes would be deployed.

Non-Explosive Practice Munitions

Weapons-Firing Disturbance

Current Navy operations in the study area include firing a variety of weapons and employing a variety of non-explosive practice munitions (NEPM), including bombs, missiles, naval gun shells, cannon shells, and small-caliber ammunition. NEPM use occurs in several training areas, but its use in state waters (0 to 3 nm from shore) is limited to R-6606. (See Table 2.2-6 for a summary of ordnance use by training area.)

Ordnance use is not authorized in W-110, W-387, or the lower Chesapeake Bay. Disturbance associated with weapons-firing noise and direct NEPM strikes are potential stressors to birds.

Bird responses to weapons-firing noise are expected to be similar to those discussed above for fixed-wing aircraft and helicopter operations, including short-term behavioral or physiological responses such as alert response, startle response, and/or temporary increase in heart rate. These operations are often preceded by other activity in the general area, such a vessel movement or target setting, which might disperse birds away from the area in which weapons-firing noise would occur. Therefore, birds might not be exposed to the loudest noise levels associated with weapons firing.

The general health of individual birds would not be compromised and weapons-firing noise would not result in significant impacts to migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, weapons-firing noise in territorial waters would have no significant impact on birds. In accordance with EO 12114, weapons-firing noise in non-territorial waters would not cause significant harm to birds.

Non-Explosive Practice Munitions Strikes

Fired NEPM has the potential to directly strike birds as it travels through the air to its intended target. As discussed in Sections 3.7.3 and 3.8.3, statistical modeling conducted for the VACAPES Study Area indicates that the probability of NEPM striking marine mammals and sea turtles is extremely low. Statistical modeling could not be conducted to estimate the probability of seabird/NEPM strikes because seabird density data are not available. Nonetheless, several factors discussed below indicate that the probability of NEPM directly striking a seabird is also expected to be extremely low under the No Action Alternative.

The highest concentrations of seabirds within the VACAPES Study Area are expected to occur in the area of the Outer Continental Shelf IBA, much of which is located in W-110. Ordnance use is not authorized in W-110, which would reduce the probability of bird strikes in this area.

The small number of bombs and missiles that would be expended in the study area annually (Table 2.2-5), coupled with the often patchy distribution of seabirds (Schneider and Duffy, 1985; Haney, 1986; Fauchald *et al*., 2002), suggest that the probability of these types of NEPM striking a seabird would be extremely low. The number of cannon shells, gun shells, and small-arms rounds that would be expended annually during gunnery exercises is much higher (Table 2.2-5). However, the total number of rounds expended is not a good indicator of strike probability during gunnery exercises, because multiple rounds are fired at individual targets.

Navy mitigation measures include, but are not limited to, maintaining a dedicated lookout to monitor the target area for marine life, and clearing an area of bird concentrations before firing occurred. Exercises also avoid large *Sargassum* mats where seabirds tend to concentrate. These standard procedures further reduce the probability of NEPM strikes. See Chapter 5 for a detailed description of mitigation measures.

Human activity such as vessel or boat movement, aircraft overflights, and target setting could cause birds to flee a target area prior to the onset of firing, thus avoiding harm. If birds were in the target area, they would likely flee the area after the initial rounds struck the target area (assuming the birds were not struck by the initial rounds).

There would be a very small possibility that some individual seabirds may be directly impacted if they were in the target area and at the point of physical impact at the time of ordnance delivery. However, NEPM strikes under the No Action Alternative would not result in significant impacts to populations of migratory birds as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, NEPM strikes in territorial waters would have no significant impact on birds. In accordance with EO 12114, NEPM strikes in non-territorial waters would not cause significant harm to birds.

Underwater Detonations and High-explosive Ordnance

Explosions that occur in the OPAREA are associated with training exercises that use high-explosive (HE) ordnance, including bombs (BOMBEX), missiles (MISSILEX), naval gun shells (FIREX with IMPASS, 5-inch HE rounds), and underwater detonations associated with mine neutralization training (MINEX). Underwater detonation and HE ordnance use is limited to specific training areas (see Table 2.2-7 for a summary of explosions by training area) and does not occur in the lower Chesapeake Bay or in state waters of the Atlantic Ocean (0 to 3 nm from shore).

The potential for seabirds to be exposed to explosions is difficult to quantify, and depends on several factors including the following:

- The geographic location of the explosions within the study area and whether birds are present at the time of the explosion. Most explosions occur in Air-K and Air-3B (Table 2.2-7). While seabirds could be exposed in any of the areas where explosions occurred, the potential for exposure of pelagic seabirds would appear to be highest in Air-3B. Although seabird density data are not available for the study area, Air-3B is expected to support relatively high concentrations of pelagic seabirds based on its proximity to the Outer Continental Shelf IBA and Gulf Stream. Most of the Outer Continental Shelf IBA and the Gulf Stream are located in areas where explosions do not occur.
- Position of the explosion in relationship to the sea surface, such as altitude above the surface, at the surface, or depth below the surface. Explosions associated with bombs, missiles, and naval gunshells occur at or immediately below the sea surface, while underwater detonations occur on the bottom and at depths below the surface.
- Position of the bird in the environment at the time of explosion, such as in the air, on the surface, or diving below the surface. Studies have shown that birds are more susceptible to underwater explosions when they are submerged versus on the surface (Yelverton *et al.*, 1973). Similarly, birds in flight are expected to be less susceptible to underwater explosions than those on the surface.
- Magnitude of the explosion, expressed as net explosive weight (NEW) and the zone of influence (ZOI) associated with the explosion. While ZOIs cannot be calculated for seabirds based on available data, higher NEWs would produce larger ZOIs. Of the explosions that would occur in the study area, HE bombs would have the largest ZOIs (see Table 2.2-7 for NEW values).

In general, the effects of explosions would correspond to the distance of the bird from the explosion, and would range from lethal injury in the immediate vicinity of an explosion to short-term behavioral effects on the outer edges of the ZOI. Yelverton *et al.* (1973) found that ducks submerged 2 feet below the surface experienced 100 percent mortality when exposed to 1-lb underwater charges at slant ranges of 28 feet or less. Mortality decreased to 33 percent at slant ranges of 31 to 33 feet, and no mortality was observed at a slant range of 36 feet. However, most birds at 36 feet experienced extensive lung hemorrhage and some experienced liver ruptures, hemorrhagic kidneys, and eardrum ruptures. No internal injuries were found at a slant range of 110 feet for submerged ducks.

Ducks exposed while on the water surface were less susceptible to injury and death than the submerged ducks. Death occurred at slant ranges of 13 to 14 feet for ducks on the surface when exposed to 8-lb charges. Ducks exposed to 8-lb charges while on the surface survived at slant ranges of 15 to 21 feet, but they experienced internal injuries. No mortality was observed in ducks on the surface when exposed to 1-lb changes at slant ranges of 10 to 18 feet, but internal injuries were observed in all birds except at 18 feet (Yelverton *et al.*, 1973).

While the effects of explosions in the study area on seabirds cannot be quantified, lethal injury to some seabird individuals could occur from the 1,413 explosions that would take place each year (Table 2.2-7) under the No Action Alternative. Many of these explosions would be associated with bombs (465), which have relatively large NEWs and ZOIs. Approximately 26 percent (121) of the bomb explosions would occur in Air-3B, which is expected to have relatively high seabird concentrations.

Navy mitigation measures are expected to reduce, but not eliminate, the potential for seabird mortality from explosions. As discussed in Chapter 5, Navy mitigation measures include, but are not limited to, avoidance of large *Sargassum* mats where seabirds tend to concentrate. Human activity such as vessel movement, aircraft overflights, and target setting could cause birds to flee a target area prior to the onset of an explosion, thus avoiding harm. In addition, birds that are in flight during an explosion would be less susceptible to harm than birds that are on the sea surface or diving underwater during an explosion.

On the other hand, seabirds could be attracted to an area to forage if an explosion resulted in a fish kill. This would only be a concern for events that involved multiple explosions in the same area over a relatively long period, such as FIREX with IMPASS events, which involve firing 39 HE 5-inch rounds per event.

While some seabird mortality could occur, only a small number of birds would be affected and population-level effects would not be expected. Underwater detonations and HE ordnance use under the No Action Alternative would not result in significant impacts to populations of migratory birds as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, underwater detonations and HE ordnance use in territorial waters would have no significant impact on birds. In accordance with EO 12114, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to birds.

Military Expended Materials

The Navy uses a variety of military expended materials (MEM) during training exercises conducted in the VACAPES Study Area. The types and quantities of MEM and information regarding fate and transport of these materials in the marine environment are discussed in Section 3.2. Most MEM currently used by the Navy rapidly sinks to the sea floor, and seabirds would not be exposed to these materials. Seabirds could ingest or inhale some types of MEM if the materials floated in the air or on the sea surface, or became entrained in *Sargassum* mats at the surface. Specifically:

- Ordnance-related materials would sink in relatively deep waters, would not present an ingestion risk to seabirds, and would have no effect on birds.
- Most targets would be recovered after use, while targets such as metal drums rapidly sink after use. Marine markers are non-recoverable pyrotechnic devices used in training to mark a surface position on the ocean. Targets and marine markers would have no effect on birds.
- Seabirds could be exposed to some materials such as chaff fibers in the air or at the sea surface through direct contact or inhalation.

Based on the dispersion characteristics of chaff, large areas of air space and open water within the VACAPES Study Area would be exposed to chaff, but the chaff concentrations would be very low. As described in Sections 3.2.3.1 and 3.7.3.3, chaff concentrations would be about 5.4 grams per square nautical mile, or fewer than 179,000 fibers per square nautical mile or 0.005 fibers per square foot.

Seabirds would be exposed to chaff fibers because chaff is used in much of the OPAREA. Several literature reviews and controlled experiments have indicated that chaff poses little environmental risk except at concentrations substantially higher than those that could reasonably occur from military training use (USAF, 1997; Hullar *et al*., 1999; Arfsten *et al*., 2002). Birds would occasionally come in direct contact with chaff fibers, but such contact would be inconsequential.

Chaff is similar in form to fine human hair (USAF, 1997). Because of its flexible nature and softness, external contact with chaff would not adversely affect most wildlife (USAF, 1997), and the fibers would quickly blow off or wash off shortly after contact. Inhalation of chaff fibers is not expected to have any adverse effects on birds because the fibers are too large to be inhaled into the lung. If inhaled, the fibers would deposit in the nose, mouth, or trachea and either be swallowed or expelled (Hullar *et al*., 1999).

While chaff clouds are undetectable to the human eye (Arfsten *et al*., 2002), the ability of a bird to see a chaff cloud and possibly become disoriented is unknown. Normally, chaff exercises occur above 10,000 ft altitude and most are during the day. Birds normally are below 1,000 ft except during migration and then they primarily migrate at night. There are exceptions to both of these generalizations, but any overlap of occurrence of birds and high concentrations of chaff would be rare. Therefore, chaff would not be expected to disorient birds or effect bird migration.

After falling from the air, chaff fibers float on the sea surface for variable periods of time, depending on wave and wind action. Seabirds could unintentionally ingest low concentrations of floating chaff fibers, which consist of about 60 percent silica and 40 percent aluminum by weight.

Some fibers would likely become entrained in *Sargassum* mats and remain at or near the surface for longer periods of time. The presence of chaff use, large *Sargassum* mats in the Outer Continental Shelf IBA, and high concentrations of seabirds in the IBA suggest that chaff fiber concentrations and ingestion rates in this area might be relatively higher than in other portions of the VACAPES Study Area.

Ingestion of chaff fibers is not expected to cause physical damage to a bird's digestive tract, based on the small size (ranging in lengths of 0.25 to 3 inches with diameters of about 40 micrometers) and flexible nature of the fibers and the small quantity that could reasonably be ingested. In addition, concentrations of chaff fibers that could reasonably be ingested are not expected to be toxic to birds. Scheuhammer (1987) reviewed the metabolism and toxicology of aluminum in birds and mammals. Intestinal adsorption of orally ingested aluminum salts was very poor, and the small amount adsorbed was almost completely removed from the body by excretion.

Dietary aluminum normally has small effects on healthy birds and mammals, and concentrations greater than 1,000 mg/kg are needed to induce effects such as impaired bone development, reduced growth, and anemia (Nybo, 1996). A bird weighing approximately 1 kg would need to ingest more than 83,000 chaff fibers per day to receive a daily aluminum dose equal to 1,000 mg/kg (based on chaff consisting of 40% aluminum by weight and a 5-ounce chaff canister containing 5 million fibers). As an example, an adult herring gull weighs about 0.8 to 1.2 kg (Cornell Lab of Ornithology, 2008). It is highly unlikely that a bird would ingest a toxic dose of chaff, based on the anticipated environmental concentration of chaff of 0.005 fibers per square foot (or 1.8 fibers per square foot for an unrealistic, worst-case scenario of 360 chaff cartridges simultaneously released at a single drop point).

Other MEM that could be ingested by seabirds includes small, plastic end-caps and pistons associated with chaff and self-protection flares (see Section 3.2). The chaff end-cap and piston are round and are 1.3 inches in diameter and 0.13 inches thick (Spargo, 2007). This MEM typically sinks in saltwater (Spargo, 2007), which reduces the likelihood of ingestion. However, some of the material could remain at or near the surface if it were to fall directly on a dense *Sargassum* mat.

About 40,300 end-caps and pistons would be released into the marine environment in the VACAPES Study Area annually, resulting in a low environmental concentration of 0.6 to 2.0 pieces per nm^2 per year. The number of end-caps and pistons that would remain at the surface in *Sargassum* mats and would potentially be available to seabirds would be an extremely small percentage of the total.

Many species of seabirds are known to ingest plastic debris. For example, 21 of 38 seabird species (55%) collected off the coast of North Carolina from 1975 to 1989 contained plastic particles in their digestive tract (Moser and Lee, 1992). Plastic is often mistaken for prey and the incidence of plastic ingestion appears to be related to a species' feeding mode and diet. Seabirds that feed by pursuit-diving, surface-seizing, and dipping tend to ingest plastic, while those that feed by plunging or piracy typically do not ingest plastic. Birds of the order Procellariiformes, which include petrels and shearwaters, tend to accumulate more plastic than do other species. Some seabirds, including gulls and terns, regularly regurgitate indigestible parts of their food, such as shell and fish bones. However, most procellariiforms have small gizzards and an anatomical constriction between the gizzard and proventriculus that make it difficult to regurgitate solid material such as plastic (Azzarello and Van Vleet, 1987; Moser and Lee, 1992; Pierce *et al*., 2004).

Moser and Lee (1992) found no evidence that seabird health was affected by the presence of plastic, but other studies have documented adverse consequences of plastic ingestion. As summarized by Azzarello and Van Vleet (1987) and Pierce *et al*. (2004), documented consequences of plastic ingestion by seabirds include blockage of the intestines and ulceration of the stomach; reduction in the functional volume of the gizzard, leading to reduced digestive capability; and distention of the gizzard, leading to reduced hunger. Studies have found negative correlations between body weight and plastic load, as well as body fat, a measure of energy reserves, and the number of pieces of plastic in a seabird's stomach. Other possible concerns that have been identified include toxicity from plastic additives and toxic contaminants that could be adsorbed to the plastic from ambient seawater.

Pierce *et al*. (2004) described two cases where plastic ingestion caused seabird mortality from starvation. A necropsy of an adult northern gannet revealed that a 1.5-inch-diameter plastic bottle cap lodged in the gizzard, obstructed passage of food into the small intestine, and resulted in death from starvation. Dissection of an adult greater shearwater gizzard revealed that a 1.5-inch by 0.5-inch fragment of plastic blocked the pylorus, obstructed the passage of food, and resulted in death from starvation.

If a seabird were to ingest a plastic end-cap or piston, the response would vary based on the species and individual bird. The responses could range from none, to sublethal (reduced energy reserves), to lethal (digestive tract blockage leading to starvation). Ingestion of end-caps and pistons by species that regularly regurgitate indigestible items would likely have no adverse effects. However, end-caps and pistons are similar in size to the plastic pieces described above that caused digestive tract blockages and eventual starvation. Therefore, ingestion of plastic end-caps and pistons could be lethal to some individuals of some species of seabirds, such as procellariiforms that have small gizzards and anatomical constrictions that make it difficult to regurgitate solid material.

Based on available information, it is not possible to accurately estimate actual ingestion rates or responses of individual birds. However, the number of end-caps or piston ingested by seabirds is expected to be very low, based on the low concentration (0.6 to 2.0 pieces per nm^2 per year) and the fact that an extremely small percentage of the total would be potentially available to seabirds (that is, those that landed on *Sargassum* mats and remained at the sea surface). Plastic ingestion under the No Action Alternative would not result in a significant adverse effect on migratory bird populations because sublethal and lethal effects, if they occurred, would be limited to a few individual birds.

In summary, MEM would not result in a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, MEM in territorial waters would have no significant impact on birds. In accordance with EO 12114, MEM in non-territorial waters would not cause significant harm to birds.

Bermuda Petrel

While the Bermuda petrel is very rare (worldwide population estimate of 250 birds in 2005), available information suggests that low numbers of foraging birds are likely to occur with some regularity in portions of the VACAPES Study Area. The highest potential for this species to occur exists in portions of W-72 and W-110 along Gulf Stream frontal boundaries. As discussed above for other seabirds, it is possible that Bermuda petrels would be exposed to various stressors associated with the No Action Alternative, including vessel movements, aircraft overflights, NEPM, underwater detonations and HE ordnance, and MEM.

Bermuda Petrel - Vessel Movements

Bermuda petrels may often feed at night to avoid predators and capture prey that surfaces to feed on plankton (Brinkley and Humann, 2001). Consequently, this species could be susceptible to interactions with lighted vessels at night. However, Navy training activities attempt to simulate warlike conditions and, in an attempt to remain visually disguised, vessels typically do not use large deck lights or strobes. This reduces the potential for attraction and disorientation of nocturnal foraging seabirds. Furthermore, the concentrated food sources that attract seabirds to commercial fishing vessels are not present around Navy vessels.

The probability of a Bermuda petrel colliding with a Navy vessel is extremely low, based on the low density of birds (a maximum density of much less than 0.05 birds per nm^2) and low density of Navy vessels in the study area. Navy mitigation measures (see Chapter 5), which include avoidance of large *Sargassum* mats where seabirds tend to concentrate, further would reduce the probability of vessel strikes. Vessel movements may affect the Bermuda petrel under the No Action Alternative, but the effects would be discountable because they are extremely unlikely to occur.

Bermuda Petrel - Aircraft Overflights

Despite their low density, Bermuda petrels would occasionally be exposed to elevated noise levels associated with aircraft overflights for short durations (seconds). Most of the exposures would be from relatively high-altitude, fixed-wing aircraft overflights. Exposure to helicopter noise would be less likely because most helicopter operations would occur in W-50 and the lower Chesapeake Bay, where Bermuda petrels are not expected to occur.

As discussed above for other seabirds, if a Bermuda petrel were to respond to a noise exposure, the responses would be limited to short-term behavioral or physiological reactions, such as alert response, startle response, and/or temporary increase in heart rate and the general health of individual birds would not be compromised. Noise associated with aircraft overflights may affect the Bermuda petrel, but any effects would be insignificant.

Bermuda petrels are not expected to be exposed to aircraft strikes, based on the low Bermuda petrel density and widely dispersed and infrequent nature of training operations. Most fixed-wing aircraft overflights in the study area occur at altitudes above 5,000 feet, while Bermuda petrels spend most of their time near the sea surface. Therefore, the probability of a fixed-wing aircraft striking a Bermuda petrel is extremely low. Most helicopter operations take place in W-50 and the lower Chesapeake Bay, where Bermuda petrels are not expected to occur. Aircraft strikes under the No Action Alternative would have no effect on the Bermuda petrel.

Bermuda Petrel - Towed Mine Warfare Devices

Towed mine warfare devices would have no effect on Bermuda petrels under the No Action Alternative because use of these systems would be limited to the lower Chesapeake Bay and areas of the Atlantic Ocean relatively close to shore where Bermuda petrels are not expected to occur.

Bermuda Petrel – Mine Warfare Training Area Establishment (Non-explosive Mine Shape Deployment and Recovery)

The No Action Alternative does not include establishment of mine warfare training areas where non-explosive mine shapes would be deployed. Therefore, no effect on Bermuda petrels would occur.

Bermuda Petrel - Non-Explosive Practice Munitions

As discussed above for other seabirds, Bermuda petrels could be exposed to noise associated with weapons firing. However, only short-term behavioral or physiological responses, such as alert response, startle response, and/or temporary increases in heart rate would be expected and the general health of individual birds would not be compromised. Weapons-firing noise may affect the Bermuda petrel under the No Action Alternative, but the effects would be insignificant.

Bermuda petrels are not expected to be exposed to direct NEPM strikes, based on the low density of birds present and the locations of these operations. Some of the prime foraging areas for Bermuda petrels are located in W-110 and possibly in W-387, where ordnance use is not authorized. Most NEPM would be expended in R-6606, W-50, Air-1A, and Air-K (Table 2.2-6), where Bermuda petrels are not expected to occur. Navy mitigation measures (see Chapter 5), which include avoidance of large *Sargassum* mats where seabirds tend to concentrate, would further reduce the probability of NEPM strikes. NEPM strikes under the No Action Alternative would have no effect on the Bermuda petrel.

Bermuda Petrel – Underwater Detonations and High-explosive Ordnance

Of the training areas where explosions occur (Table 2.2-7), Bermuda petrels are most likely to be present in Air-3B, 1C1/2, and portions of W-72, based on proximity to the western frontal boundary of the Gulf Stream. Bermuda petrels are less likely to occur in the areas where explosions take place (W-50, Air-K, 7C/D, and 8C/D).

Under the No Action Alternative, 121 HE bomb explosions would occur annually in Air-3B. About five or six FIREX with IMPASS events would occur annually in 1C1 and 1C2. While sufficient data are not available to calculate ZOIs for seabirds, the ZOIs for HE bomb explosions are expected to be the largest. While the effects of explosions on Bermuda petrels cannot be quantified, the likelihood of an exposure to cause injury appears to be remote, based on the very low density of birds. Other factors that would reduce the likelihood of harmful exposure include the Bermuda petrel's foraging habits (that is, feeding on the surface versus diving for food) and mitigation measures the Navy implements during BOMBEX and FIREX with IMPASS (see Chapter 5).

An exposure resulting in a short-term behavioral response would be more likely to occur than an exposure that caused injury because the ZOI for behavioral effects would be much larger than the ZOI for injury. If exposures were to occur, they would most likely be in Air-3B, based on the number of HE bomb explosions, the relatively large ZOIs associated with HE bomb explosions, and the quality of foraging habitat. Underwater detonations associated with Mine Warfare training would have no effect on the Bermuda petrel under Alternative 2 because these exercises would take place in areas where the Bermuda petrel is not expected to occur. The effects of HE ordnance use under Alternative 2 would be discountable. HE ordnance use under Alternative 2 may affect the Bermuda petrel.

Bermuda Petrel – Military Expended Materials

As discussed for other seabirds, ordnance-related materials and marine markers would sink in relatively deep waters and would not present an ingestion risk. Target-related materials would be recovered after use or would rapidly sink after use. Therefore, ordnance-related materials, target-related materials, and marine markers would have no effect on the Bermuda petrel.

Bermuda petrels could be exposed to chaff fibers, chaff plastic end-caps or pistons, and self-protection flare end-caps. As discussed above for other seabirds, the effects of direct contact with chaff fibers, and inhalation and ingestion of chaff fibers, would be insignificant.

Bermuda petrels feed at the sea surface and could mistake plastic end-caps or pistons entrained in *Sargassum* as prey. This species is a member of the Procellariidae family, which appears to be more susceptible than other seabird families to digestive tract blockages from plastic. However, the probability of a Bermuda petrel ingesting a plastic end-cap or piston is extremely low, based on the low density of birds, low concentration of end-caps and pistons (0.6 to 2.0 pieces per nm^2 per year), and fact that an extremely small percentage of the total (that is, only those that landed on *Sargassum* mats and remained at the sea surface) would be potentially available for ingestion. Chaff fibers, end-caps, and pistons may affect the Bermuda petrel, but the effects would be insignificant or discountable.

The No Action Alternative would have no effect on critical habitat because none has been designated for the Bermuda petrel.

Roseate Tern

Roseate terns are not expected to occur in the VACAPES Study Area except as occasional transient individuals. Roseate terns would most likely not be exposed to any of the stressors associated with the No Action Alternative. Consequently, the No Action Alternative would have no effect on the roseate tern. The No Action Alternative would have no effect on roseate tern critical habitat because none has been designated for this species.

3.10.3.2 Alternative 1

Vessel Movements

Vessel movements would increase by approximately 1.4 percent in the VACAPES Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased potential for bird strikes and associated bird mortalities and injuries to occur compared to No Action Alternative conditions. Even though vessel movements would increase about 1.4 percent under Alternative 1, seabirds are not expected to be harmed by collisions with vessels for the same reasons discussed under the No Action Alternative. If birds were affected by vessel movements under Alternative 1, the number of individuals affected would be small. Navy mitigation measures, which include avoidance of large *Sargassum* mats where seabirds tend to concentrate, would further reduce the probability of vessel strikes.

Vessel movements under Alternative 1 would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, vessel movements in territorial waters would have no significant impact on birds. In accordance with EO 12114, vessel movements in non-territorial waters would not cause significant harm to birds. Effects of Alternative 1 on the federally listed Bermuda petrel and roseate tern are analyzed below.

Aircraft Overflights

Alternative 1 would include a 4.5 percent increase in fixed-wing aircraft sorties per year and a 94 percent increase in helicopter sorties per year in the VACAPES Study Area (Table 2.2-5). Most new helicopter sorties would occur over the lower Chesapeake Bay and W-50. The potential for birds to be exposed to elevated noise levels would increase compared to No Action Alternative conditions, particularly in the lower Chesapeake Bay and W-50. The magnitude of individual exposures would not increase, because Alternative 1 does not include use of new aircraft that are louder than current equipment. Peak noise levels generated by the new MH-60R and MH-60S Multi-Mission Helicopters would be similar to the noise levels generated by the helicopters that they would replace.

Based on the increased operations under Alternative 1, more birds could be exposed to noise and/or the number of times an individual bird is exposed could increase. Similar to the No Action Alternative, the responses would be limited to short-term, behavioral or physiological reactions, such as alert response, startle response, and/or temporary increase in heart rate, and the general health of individual birds would not be compromised. As discussed for the No Action Alternative, the presence of dense aggregations of sea ducks, other seabirds, and migrating landbirds is a potential concern during low-attitude helicopter operations over the lower Chesapeake Bay. Navy helicopter pilots would avoid large flocks of birds to protect aircrews and equipment. Exposure during migration is expected to be minimal because most helicopter sorties would occur during daylight hours and most migrating birds would cross the lower Bay at night.

Birds repeatedly exposed to aircraft noise often become habituated to the noise and do not respond behaviorally (National Park Service, 1994; Larkin, 1996; Plumpton, 2006). However, habituation seems unlikely in the study area because of the widely dispersed nature and relative infrequency of Alternative 1 operations.

Aircraft noise exposures under Alternative 1 would result in negligible effects to individual birds and would not result in significant adverse effects to migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, aircraft noise over territorial waters would have no significant impact on birds. In accordance with EO 12114, aircraft noise over non-territorial waters would not cause significant harm to birds.

The changes in aircraft overflights would increase the likelihood of bird/aircraft strikes and associated bird mortalities and injuries. However, as discussed above for the No Action Alternative, bird/aircraft strikes are rare in offshore areas and the numbers of bird mortalities that occur Navy-wide are insignificant from a bird population standpoint. Despite the increases in overflights, negligible changes in bird/aircraft strikes would occur, and the number of birds affected would be small.

Aircraft strikes under Alternative 1 would have no significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, aircraft strikes over territorial waters would have no significant impact on birds. In accordance with EO 12114, aircraft strikes over non-territorial waters would not cause significant harm to birds.

Towed Mine Warfare Devices

Towed mine warfare device sorties would increase by 75 percent per year under Alternative 1. Similar to the No Action Alternative, the potential for a towed mine warfare device to strike a bird under Alternative 1 would be extremely low because birds would likely see and hear the oncoming helicopter and flee the immediate area.

Use of towed mine warfare devices under Alternative 1 would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, towed mine warfare device use in territorial waters would have no significant impact on birds. In accordance with EO 12114, towed mine warfare device use in non-territorial waters would not cause significant harm to birds.

Mine Warfare Training Area Establishment (Non-explosive Mine Shape Deployment and Recovery)

A mine warfare training area would be designated in W-50 under Alternative 1 (Figure 2.2-1). This section addresses potential effects associated with establishing and maintaining this training area, including non-explosive mine shape deployment and recovery. The effects of conducting training exercises in this area would be the same as those analyzed under aircraft overflights and towed mine warfare devices.

As discussed in Chapter 2, the mine shape assembly would include a concrete anchor, mooring line (steel cable or chain), and the mine shape. If seabirds were present at the time of mine shape deployment or recovery, they could be startled by the process and flee the immediate area. However, the effects would be negligible, short-term, and localized.

Mine warfare training area establishment would have no significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, mine warfare training area establishment in territorial waters would have no significant impact on birds. Mine warfare training area establishment would not occur in non-territorial waters under Alternative 1 and, therefore, there would be no harm in accordance with an EO 12114 evaluation.

Non-Explosive Practice Munitions

The amount of NEPM used would increase in the VACAPES Study Area under Alternative 1 (Tables 2.2-5 and 2.2-6). These changes would result in increased potential for birds to be exposed to weapons-firing noise. The potential for bird/NEPM strikes and associated bird mortalities and injuries would also increase. However, the number of birds affected would continue to be small. Navy mitigation measures, which include avoidance of large *Sargassum* mats where seabirds tend to concentrate, would further reduce the probability of ordnance strikes.

While a remote possibility would exist that some individuals of some bird species may be directly impacted if they were in the target area and at the point of physical impact at the time of ordnance delivery, NEPM strikes under Alternative 1 would not result in significant impacts to populations of migratory birds as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, NEPM strikes in territorial waters would have no significant impact on birds. In accordance with EO 12114, NEPM strikes in non-territorial waters would not cause significant harm to birds.

Underwater Detonations and High-explosive Ordnance

The numbers and locations of explosions that would occur under Alternative 1 would be the same as the No Action Alternative, except for increases in Hellfire missile and 20-lbs NEW underwater detonations (Tables 2.2-5 and 2.2-7).

- The number of explosions associated with Hellfire missile use would increase from 30 to 60 per year under Alternative 1. These explosions would continue to occur at or near the water's surface in Air-K and W-72A.
- The number of explosions associated with 20-lbs NEW underwater detonations would increase from 12 to 24 in W-50 under Alternative 1 (Table 2.2-7).

Consequently, the potential for birds to be exposed to impacts from explosions would increase under Alternative 1. While some seabird mortality could occur, mitigation measures and factors discussed for the No Action Alternative indicate that a small number of birds would be affected and population-level effects would not be expected.

Underwater detonations and HE ordnance use under Alternative 1 would not result in significant impacts to populations of migratory birds as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, underwater detonations and HE ordnance use in territorial waters would have no significant impact on birds. In accordance with EO 12114, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to birds.

Military Expended Materials

The amount of chaff fibers and plastic end-caps and pistons entering the marine environment would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased potential for birds to ingest chaff and plastic end-caps and pistons. As discussed for the No Action Alternative, several literature reviews and controlled experiments have indicated that chaff poses little environmental risk except at concentrations substantially higher than those that could reasonably occur from military training use (USAF, 1997; Hullar *et al*., 1999; Arfsten *et al*., 2002). It is highly unlikely that a bird would ingest a toxic dose of chaff, based on the anticipated environmental concentration of chaff that would occur with Alternative 1.

As discussed for the No Action Alternative, if a seabird were to ingest a plastic end-cap or piston, the response would vary, based on the species and individual bird. The responses could range from none, to sublethal (reduced energy reserves), to lethal (digestive tract blockage leading to starvation). Based on available information, it is not possible to accurately estimate actual ingestion rates or responses of individual birds. However, the change in the number of end-caps or pistons ingested by seabirds would be very low, based on the small change in the low concentration (0.7 to 2.2 pieces per nm^2 per year for Alternative 1 compared to 0.6 to 2.0 pieces per nm^2 per year for the No Action Alternative) and the fact that an extremely small percentage of the total would be potentially available to seabirds (that is, those that landed on *Sargassum* mats and remained at the sea surface). Plastic ingestion under Alternative 1 would not result in a significant adverse effect on migratory bird populations because sublethal and lethal effects, if they occurred, would be limited to a few birds.

MEM would not result in a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, MEM in territorial waters would have no significant impact on birds. In accordance with EO 12114, MEM in non-territorial waters would not cause significant harm to birds.

Bermuda Petrel

As discussed above for other seabirds, increases in training operations under Alternative 1 (Table 2.2-5) would increase the potential for Bermuda petrels to be exposed to associated stressors. The probability of a Bermuda petrel being exposed to a vessel collision would continue to be extremely low, based on the small increase in vessel operations (1.4% increase in vessel steaming days per year) and the low Bermuda petrel density. Navy protective measures, which include avoidance of large *Sargassum* mats where seabirds tend to concentrate, would further reduce the probability of vessel interactions. Vessel movements may affect the Bermuda petrel under Alternative 1, but the effects would be insignificant or discountable.

The effects of aircraft overflights under Alternative 1 are expected to be similar to the No Action Alternative. Fixed-wing aircraft sorties would increase by 10 percent, but the aircraft would continue to operate at relatively high altitudes. Helicopter sorties would increase by 88 percent, but most helicopter operations would continue to occur in W-50 and the lower Chesapeake Bay, where Bermuda petrels are not expected to occur. Aircraft noise under Alternative 1 may affect the Bermuda petrel, but the effects would be insignificant, such as short-term behavioral responses. Aircraft strikes under Alternative 1 would have no effect on the Bermuda petrel because most fixed-wing flights would be at high altitudes and most helicopter operations would take place in areas where this species is not expected to occur.

The proposed increase in towed mine warfare device sorties under Alternative 1 would have no effect on the Bermuda petrel because the sorties would occur in the lower Chesapeake Bay, W-50, and portions of W-72 and W-386, where this species is not expected to occur.

Establishing the proposed mine warfare training area in W-50 under Alternative 1 would have no effect on the Bermuda petrel because this species is not expected to occur in W-50.

The increases in NEPM use under Alternative 1 (Tables 2.2-5 and 2.2-6) would not appreciably increase Bermuda petrel exposure to weapons-firing noise or NEPM strikes. Most NEPM would continue to be expended in R-6606, W-50, Air-1A, and Air-K, where Bermuda petrels are not expected to occur. Navy mitigation measures (see Chapter 5), which include avoidance of large *Sargassum* mats where seabirds tend to concentrate, would further reduce the probability of NEPM strikes. Weapons-firing noise under Alternative 1 may affect the Bermuda petrel, but the effects would be insignificant, such as short-term behavioral responses. NEPM strikes under Alternative 1 would have no effect on the Bermuda petrel because Bermuda petrel density is very low and most NEPM use would be in areas where this species is not expected to occur.

The numbers and locations of explosions that would occur under Alternative 1 would be the same as the No Action Alternative, except for increases in Hellfire missiles and 20-lbs NEW underwater detonations (Tables 2.2-5 and 2.2-7). Twelve additional 20-lbs NEW underwater detonations would take place per year in W-50, and 23 additional Hellfire missile explosions would take place per year in Air-K. Bermuda petrels are not expected to occur in W-50 or Air-K, and would not be affected by these changes.

Seven additional Hellfire missile explosions would occur per year in W-72A(2). Bermuda petrels may occur in portions of W-72A(2) along the western frontal boundary of the Gulf Stream. While the potential for Bermuda petrels to be exposed to impacts from explosions would increase under Alternative 1, the probability of exposure would continue to be low, based on the low density of birds. Underwater detonations associated with Mine Warfare training would have no effect on the Bermuda petrel under Alternative 1 because these exercises would take place in areas where the Bermuda petrel is not expected to occur. The effects of HE ordnance use under Alternative 1 would be discountable. HE ordnance use under Alternative 1 may affect the Bermuda petrel.

As described for the No Action Alternative, there would be no effect from ordnance-related materials, target-related materials, or marine markers. The amount of chaff fibers and plastic end-caps and pistons entering the marine environment would increase in the VACAPES Study Area under Alternative 1 (Table 2.2-5). These changes would result in increased potential for Bermuda petrels to ingest chaff, plastic end-caps, and pistons. As discussed for the No Action Alternative, several literature reviews and controlled experiments have indicated that chaff would poses little environmental risk except at concentrations substantially higher than those that could reasonably occur from military training use (USAF, 1997; Hullar *et al*., 1999; Arfsten *et al*., 2002). It is highly unlikely that a Bermuda petrel would ingest a toxic dose of chaff, based on the anticipated environmental concentration of chaff for Alternative 1. The probability of a Bermuda petrel ingesting a chaff or flare plastic end-cap or piston would continue to be extremely low, based on the low density of birds, the low concentration of end-caps and pistons (about 0.7 to 2.2 pieces per nm^2 per year), and the fact that an extremely small percentage of the total would be potentially available for ingestion (that is, those that landed on *Sargassum* mats and remained at the sea surface). Chaff fibers, end-caps, and pistons may affect the Bermuda petrel under Alternative 1, but the effects would be insignificant or discountable.

Alternative 1 would have no effect on critical habitat because none has been designated for the Bermuda petrel.

Roseate Tern

Roseate terns are not expected to occur in the VACAPES Study Area except as occasional, transient individuals. Roseate terns would most likely not be exposed to any of the stressors associated with

Alternative 1. Consequently, Alternative 1 would have no effect on the roseate tern. Alternative 1 would have no effect on roseate tern critical habitat because none has been designated for this species.

3.10.3.3 Alternative 2 (Preferred Alternative)

Vessel Movements

Vessel movements that would occur under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2.

Vessel movements under Alternative 2 would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, vessel movements in territorial waters would have no significant impact on birds. In accordance with EO 12114, vessel movements in non-territorial waters would not cause significant harm to birds. Effects of Alternative 2 on the federally listed Bermuda petrel and roseate tern are analyzed below.

Aircraft Overflights

Alternative 2 would include a 4.5 percent increase in fixed-wing aircraft sorties per year and a 92 percent increase in helicopter sorties per year in the VACAPES Study Area (Table 2.2-5). Most new helicopter sorties would occur over the lower Chesapeake Bay and in W-50. As a result, the potential for birds to be exposed to elevated noise levels would increase compared to No Action Alternative conditions, particularly in the lower Chesapeake Bay and W-50. The magnitude of individual exposures would not increase, because Alternative 2 does not include the use of new aircraft that are louder than current equipment. Peak noise levels generated by the new MH-60R and MH-60S Multi-Mission Helicopters would be similar to the noise levels generated by the helicopters that they would replace.

Based on the increased number of operations under Alternative 2, more birds could be exposed to noise and/or the number of times an individual bird was exposed could increase. Similar to the No Action Alternative, the responses would be limited to short-term behavioral or physiological reactions, such as alert response, startle response, and/or temporary increase in heart rate, and the general health of individual birds would not be compromised. As discussed for the No Action Alternative, the presence of dense aggregations of sea ducks, other seabirds, and migrating landbirds is a potential concern during low-attitude helicopter operations over the lower Chesapeake Bay. Navy helicopter pilots would avoid large flocks of birds to protect aircrews and equipment. Exposure during migration is expected to be minimal because most helicopter sorties would occur during daylight hours and most migrating birds would cross the lower Bay at night.

Birds repeatedly exposed to aircraft noise often become habituated to the noise and do not respond behaviorally (National Park Service, 1994; Larkin, 1996; Plumpton, 2006). However, habituation seems unlikely in the study area because of the widely dispersed nature of the operations and the relative infrequency of the operations.

Aircraft noise exposures under Alternative 2 would result in negligible effects to individual birds and would not result in significant adverse effects to migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, aircraft noise over territorial waters would have no significant impact on birds. In accordance with EO 12114, aircraft noise over non-territorial waters would not cause significant harm to birds.

The changes in aircraft overflights would increase the likelihood of bird/aircraft strikes and associated bird mortalities and injuries. However, as discussed above for the No Action Alternative, bird/aircraft strikes are rare in offshore areas and the numbers of bird mortalities that occur Navy-wide are insignificant from a bird population standpoint. Despite the increases in overflights, negligible changes in bird/aircraft strikes would occur, and the number of birds affected would be small.

Aircraft strikes under Alternative 2 would have no significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, aircraft strikes over territorial waters would have no significant impact on birds. In accordance with EO 12114, aircraft strikes over non-territorial waters would not cause significant harm to birds.

Towed Mine Warfare Devices

Towed mine warfare device sorties would increase by 78 percent per year under Alternative 2. Similar to the No Action Alternative, the potential for a towed mine warfare device to strike a bird under Alternative 2 would be extremely low because birds would likely see and hear the oncoming helicopter and flee the immediate area.

Use of towed mine warfare devices under Alternative 2 would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, towed mine warfare device use in territorial waters would have no significant impact on birds. In accordance with EO 12114, towed mine warfare device use in non-territorial waters would not cause significant harm to birds.

Mine Warfare Training Area Establishment (Non-explosive Mine Shape Deployment and Recovery)

As discussed in Chapter 2, mine warfare training areas would be designated in W-50 (same as Alternative 1), W-72, W-386, and the lower Chesapeake Bay under Alternative 2 (Figures 2.2-1 through 2.2-4). This section addresses potential effects associated with establishing and maintaining these training areas, including non-explosive mine shape deployment and recovery. The effects of conducting training exercises in these areas would be the same as those analyzed under aircraft overflights, towed mine warfare devices, and underwater detonations and HE ordnance (for W-50 only).

As discussed in Chapter 2, the mine shape assembly would include a concrete anchor, mooring line (steel cable or chain), and the mine shape. If seabirds were present at the time of mine shape deployment and recovery, they could be startled by the process and flee the immediate area. However, the effects would be negligible, short-term, and localized.

Mine warfare training area establishment under Alternative 2 would have no significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, mine warfare training area establishment in territorial waters would have no significant impact on birds. In accordance with EO 12114, establishment of mine warfare training areas in non-territorial waters would not cause significant harm to birds.

Non-explosive Practice Munitions

The amount of NEPM used in the VACAPES Study Area under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2.

NEPM use under Alternative 2 would not result in significant impacts to populations of migratory birds as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, NEPM use in territorial waters would have no significant impact on birds. In accordance with EO 12114, NEPM use in non-territorial waters would not cause significant harm to birds.

Underwater Detonations and High-explosive Ordnance

As summarized in Tables 2.2-5 and 2.2-7, underwater detonations and HE ordnance use under Alternative 2 would be the same as Alternative 1, with the following exceptions:

- The number of HE bombs used would decrease from 465 to 20 per year.
- Use of the MK-103 system in W-50 would result in 50 underwater explosions per year (0.002-lbs NEW).
- Use of the Airborne Mine Neutralization System (AMNS) in W-50 would result in 30 underwater explosions per year (3.24-lbs NEW).

As discussed for the No Action Alternative, HE bombs have higher NEWs and ZOIs compared to other HE ordnance used in the VACAPES OPAREA. Consequently, the potential for birds to be exposed to impacts from explosions under Alternative 2 would be substantially lower than in the No Action Alternative, based on the reduction in HE bomb use. Under Alternative 2, HE bombs would no longer be used in Air-3B, which supports relatively high numbers of pelagic seabirds, based on its proximity to the western frontal boundary of the Gulf Stream and Outer Continental Shelf IBA.

The probability of birds being exposed to impacts from explosions associated with the MK-103 and AMNS Mine Warfare devices in W-50 would be extremely low. Prior to detonation, birds would likely flee the immediate area in response to disturbances associated the mine warfare devices being towed through the water by helicopters. The small NEW of the charges, the fact that these explosions would occur in the water column, and the low numbers of detonations (total of 80 per year) would further reduce the likelihood of birds being exposed to impacts from these explosions.

While some seabird mortality could occur under Alternative 2, the above analysis indicates that a small number of birds would be affected and that population level effects would not be expected. Overall, the impacts from underwater detonations and HE ordnance use for Alternative 2 would be substantially lower than the No Action Alternative and Alternative 1 based on the reduction in HE bomb use. Underwater detonations and HE ordnance use under Alternative 2 would not result in significant impacts to populations of migratory birds as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, underwater detonations and HE ordnance use in territorial waters would have no significant impact on birds. In accordance with EO 12114, underwater detonations and HE ordnance use in non-territorial waters would not cause significant harm to birds.

Military Expended Materials

The amount of MEM entering the marine environment under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2.

MEM under Alternative 2 would not result in a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. In accordance with NEPA, MEM in territorial waters would have no significant impact on birds. In accordance with EO 12114, MEM in non-territorial waters would not cause significant harm to birds.

Bermuda Petrel

Vessel movements that would occur under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2. Vessel movements may affect the Bermuda petrel under Alternative 2, but the effects would be insignificant or discountable.

The effects of aircraft overflights under Alternative 2 are expected to be similar to the No Action Alternative. Fixed-wing aircraft sorties would increase by 4.5 percent, but the aircraft would continue to operate at relatively high altitudes. Helicopter sorties would increase by 92 percent, but most helicopter operations would continue to occur in W-50 and the lower Chesapeake Bay, where Bermuda petrels are not expected to occur. Aircraft noise under Alternative 2 may affect the Bermuda petrel, but the effects would be insignificant, such as short-term behavioral responses. Aircraft strikes under Alternative 2 would have no effect on the Bermuda petrel because most fixed-wing flights would be at high altitudes and most helicopter operations would take place in areas where this species is not expected to occur.

The proposed increase in towed mine warfare device sorties under Alternative 2 would have no effect on the Bermuda petrel because the sorties would occur in the lower Chesapeake Bay, W-50, and portions of W-72 and W-386 where this species is not expected to occur.

The Bermuda petrel is not expected to occur in areas where the proposed mine warfare training areas would be established under Alternative 2 (lower Chesapeake Bay, W-50, and portions of W-72 and W-386). Therefore, establishing the mine warfare training areas under Alternative 2 would have no effect on the Bermuda petrel.

The amount of NEPM used in the VACAPES Study Area under Alternative 2 would be the same as Alternative 1 (Table 2.2-5). Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2.

Weapons-firing noise under Alternative 2 may affect the Bermuda petrel, but the effects would be insignificant, primarily consisting of short-term behavioral responses. NEPM strikes under Alternative 2 would have no effect on the Bermuda petrel because Bermuda petrel density is very low and most NEPM use would be in areas where this species is not expected to occur.

The number of HE bombs used in the study area would decrease under Alternative 2 (Tables 2.2-5 and 2.2-7). HE bombs would no longer be used in Air-3B, an area where the Bermuda petrel is expected to occur. Explosions associated with MK-103 and AMNS operations under Alternative 2 would take place in W-50, where the Bermuda petrel is not expected to occur. The probability of Bermuda petrels being exposed to impacts from explosions would be extremely low under Alternative 2 and would decrease relative to the No Action Alternative. Underwater detonations associated with Mine Warfare training would have no effect on the Bermuda petrel under Alternative 2 because these exercises would take place in areas where the Bermuda petrel is not expected to occur. The effects of HE ordnance use under Alternative 2 would be discountable. HE ordnance use under Alternative 2 may affect the Bermuda petrel.

The amount of MEM entering the marine environment under Alternative 2 would be the same as Alternative 1. Therefore, the analysis presented above for Alternative 1 is applicable to Alternative 2. Chaff fibers, end-caps, and pistons may affect the Bermuda petrel under Alternative 2, but the effects would be insignificant or discountable.

Alternative 2 would have no effect on critical habitat because none has been designated for the Bermuda petrel.

Roseate Tern

Roseate terns are not expected to occur in the VACAPES Study Area except as occasional transient individuals. Roseate terns would most likely not be exposed to any associated with Alternative 2. Consequently, Alternative 2 would have no effect on the roseate tern. Alternative 2 would have no effect on roseate tern critical habitat, because none has been designated for this species.

3.10.4 Unavoidable Significant Environmental Effects

The analysis presented above indicates that the No Action Alternative, Alternative 1, and Alternative 2 would not result in unavoidable significant adverse effects to seabirds or migratory birds.

3.10.5 Summary of Environmental Effects

3.10.5.1 Endangered Species Act

Table 3.10-3 summarizes the Navy's determinations of effect for the No Action Alternative, Alternative 1, and Alternative 2 (the Preferred Alternative) for federally listed birds that potentially occur in the VACAPES Study Area. The alternatives may affect the Bermuda petrel and would have no effect on the roseate tern. The study area does not contain designated critical habitat for any listed species. Consequently, the alternatives would have no effect on critical habitat. The Navy has completed informal consultation with the USFWS in accordance with Section 7 of the ESA. In a letter dated October 7, 2008 (Appendix C), the USFWS concurred with the Navy's determination that Alternative 2 (the Preferred Alternative) may affect, but is not likely to adversely affect the Bermuda petrel and would have no effect on the roseate tern.

3.10.5.2 Migratory Bird Treaty Act

As discussed in the analyses presented throughout Section 3.10.3 and summarized in Table 3.10-4, the No Action Alternative, Alternative 1, and Alternative 2 would not diminish the capacity of a population of any migratory bird species to maintain genetic diversity, reproduce, or function effectively in its native ecosystem. The proposed action would not have a significant adverse effect on migratory bird populations. As a result and in accordance with 50 CFR Part 21, the Navy is not required confer with the USFWS on the development and implementation of conservation measures to minimize or mitigate adverse effects to migratory birds that are not listed under the ESA.

3.10.5.3 National Environmental Policy Act and Executive Order 12114

As summarized in Table 3.10-4, the No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on seabirds and migratory birds in territorial waters. Furthermore, the No Action Alternative, Alternative 1, and Alternative 2 would not cause significant harm to seabirds and migratory birds in non-territorial waters.

TABLE 3.10-3
SUMMARY OF THE NAVY'S DETERMINATION OF EFFECT FOR FEDERALLY LISTED BIRDS POTENTIALLY OCCURRING IN THE VACAPES STUDY AREA FOR ALL ALTERNATIVES

Stressor	Bermuda Petrel	Roseate Tern
Vessel movements		
Vessel disturbance	May affect	No effect
Vessel strikes	May affect	No effect
Aircraft overflights		
Aircraft disturbance	May affect	No effect
Aircraft strikes	No effect	No effect
Towed mine warfare devices		
Towed device strikes	No effect	No effect
Mine warfare training area establishment		
Non-explosive mine shape deployment and recovery	No effect	No effect
Non-explosive practice munitions		
Weapons-firing disturbance	May affect	No effect
Non-explosive practice munitions strikes	No effect	No effect
Underwater detonations and high-explosive ordnance		
Underwater detonations	No effect	No effect
High-explosive ordnance	May affect	No effect
Military expended materials		
Ordnance-related materials	No effect	No effect
Target-related materials	No effect	No effect
Chaff	May affect	No effect
Self-protection flares	May affect	No effect
Marine markers	No effect	No effect
Critical habitat		
Critical habitat	No effect	No effect

TABLE 3.10-4
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON SEABIRDS AND MIGRATORY BIRDS IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
No Action		
Vessel movements	Short-term behavioral responses to vessels and extremely low potential for injury or mortality from strikes. No long-term population-level effects.	Short-term behavioral responses to vessels and extremely low potential for injury or mortality from strikes. No long-term population-level effects.
Aircraft overflights	Short-term behavioral responses to overflights, primarily involving helicopters. Extremely low potential for injury or mortality from strikes. No long-term population-level effects.	Short-term behavioral responses to overflights. Extremely low potential for injury or mortality from strikes. No long-term population-level effects.
Towed mine warfare devices	Extremely low potential for towed device strikes. No long-term population-level effects.	Extremely low potential for towed device strikes. No long-term population-level effects.
Non-Explosive Mine Shape Deployment/ Recovery	No effect.	No effect.
Non-explosive practice munitions	Short-term behavioral responses to firing noise. Extremely low potential for injury or mortality from strikes. No long-term population-level effects.	Short-term behavioral responses to firing noise. Extremely low potential for injury or mortality from strikes. No long-term population-level effects.
Underwater detonations and high-explosive ordnance	Short-term behavioral responses to explosion noise. Potential for a small number of injuries or mortalities in the immediate vicinity of an explosion. No long-term population-level effects.	Short-term behavioral responses to explosion noise. Potential for a small number of injuries or mortalities in the immediate vicinity of an explosion. No long-term population-level effects.
Military expended materials	No effects associated with ordnance related materials, targets, or marine markers. Extremely low potential for sublethal or lethal effects from ingestion of chaff or flare end-caps or pistons. No long-term population-level effects.	No effects associated with ordnance related materials, targets, or marine markers. Extremely low potential for sublethal or lethal effects from ingestion of chaff or flare end-caps or pistons. No long-term population-level effects.
Impact conclusion	No significant impact to seabirds and migratory birds.	No significant harm to seabirds and migratory birds.
Alternative 1		
Vessel movements	Short-term behavioral responses to vessels and extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to vessels and extremely low potential for injury or mortality from strikes. Slight increase compared to No Action alternative. No long-term population-level effects.

TABLE 3.10-4
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON SEABIRDS AND MIGRATORY BIRDS IN THE VACAPES STUDY AREA
(Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Aircraft overflights	Short-term behavioral responses to overflights, primarily involving helicopters. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to overflights. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.
Towed mine warfare devices	Extremely low potential for towed device strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Extremely low potential for towed device strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.
Non-Explosive Mine Shape Deployment/ Recovery	Minor, short-term, localized disturbances associated with non-explosive mine shape deployment and recovery. No long-term population-level effects.	No effect.
Non-explosive practice munitions	Short-term behavioral responses to firing noise. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to firing noise. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.
Underwater detonations and high-explosive ordnance	Short-term behavioral responses to explosion noise. Potential for a small number of injuries or mortalities in the immediate vicinity of an explosion. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to explosion noise. Potential for a small number of injuries or mortalities in the immediate vicinity of an explosion. Slight increase compared to No Action Alternative. No long-term population-level effects.
Military expended materials	No effects associated with ordnance-related materials, targets, or marine markers. Extremely low potential for sublethal or lethal effects from ingestion of chaff or flare end-caps or pistons. Slight increase compared to No Action Alternative. No long-term population-level effects.	No effects associated with ordnance-related materials, targets, or marine markers. Extremely low potential for sublethal or lethal effects from ingestion of chaff or flare end-caps or pistons. Slight increase compared to No Action Alternative. No long-term population-level effects.
Impact conclusion	No significant impact to seabirds and migratory birds.	No significant harm to seabirds and migratory birds.
Alternative 2		
Vessel movements	Short-term behavioral responses to vessels and extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to vessels and extremely low potential for injury or mortality from collisions. Slight increase compared to No Action Alternative. No long-term population-level effects.

TABLE 3.10-4
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON SEABIRDS AND MIGRATORY BIRDS IN THE VACAPES STUDY AREA
(Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Aircraft overflights	Short-term behavioral responses to overflights, primarily involving helicopters. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to overflights. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.
Towed mine warfare devices	Extremely low potential for towed device strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Extremely low potential for towed device strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.
Non-Explosive Mine Shape Deployment/ Recovery	Minor, short-term, localized disturbances associated with non-explosive mine shape deployment and recovery. No long-term population-level effects.	Minor, short-term, localized disturbances associated with non-explosive mine shape deployment and recovery. No long-term population-level effects.
Non-explosive practice munitions	Short-term behavioral responses to firing noise. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to firing noise. Extremely low potential for injury or mortality from strikes. Slight increase compared to No Action Alternative. No long-term population-level effects.
Underwater detonations and high-explosive ordnance	Short-term behavioral responses to explosion noise. Potential for a small number of injuries or mortalities in the immediate vicinity of an explosion. Slight increase compared to No Action Alternative. No long-term population-level effects.	Short-term behavioral responses to explosion noise. Potential for a small number of injuries or mortalities in the immediate vicinity of an explosion. Substantial decrease in impacts associated with HE bomb use compared to No Action Alternative. No long-term population-level effects.
Military expended materials	No effects associated with ordnance-related materials, targets, or marine markers. Extremely low potential for sublethal or lethal effects from ingestion of chaff or flare end-caps or pistons. Slight increase compared to No Action Alternative. No long-term population-level effects.	No effects associated with ordnance-related materials, targets, or marine markers. Extremely low potential for sublethal or lethal effects from ingestion of chaff or flare end-caps or pistons. Slight increase compared to No Action Alternative. No long-term population-level effects.
Impact conclusion	No significant impact to seabirds and migratory birds.	No significant harm to seabirds and migratory birds.

3.11 LAND USE

3.11.1 Introduction and Methods

Land use is the classification of either natural or human-modified activities occurring at a given location. As detailed in Section 1.3.1, no inland ranges or associated airspace will be analyzed in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). In offshore settings, land use is typically limited to public access and safety issues, including potential hazards inherent in flight operations, weapons firing, mine laying, and underwater demolition. It is the policy of the Navy to observe every possible precaution in the planning and execution of all operations that occur onshore or offshore to prevent injury to people or damage to property (DoN, 2006).

3.11.1.1 Assessment Methods and Data Used

Bathymetry data for classification of offshore areas were obtained from the National Oceanic and Atmospheric Administration (NOAA). Historical naval training and environmental studies contributed to the development of the land use section.

3.11.1.2 Warfare Areas and Associated Environmental Stressors

No potential stressors from the proposed activities on land use have been identified. Land-based installations and ranges are managed by Commander Naval Installations Command (CNIC). CNIC is responsible for preparing National Environmental Policy Act (NEPA) documentation for its installations when necessary. Therefore, installations are not included in the analysis for this EIS/OEIS. Other Service land ranges are responsible for environmental compliance and analysis of their own ranges and, therefore, are not included in this EIS/OEIS.

As described in Section 1.5, the study area for this EIS/OEIS is the Virginia Capes (VACAPES) operating area (OPAREA), lower Chesapeake Bay, associated special use airspace (SUA), and area extending 3 nautical miles (nm) from mean high tide seaward. Because the VACAPES OPAREA begins 3 nm off the coast, Navy training would not impact lands that would be affected by the Submerged Lands Act (SLA)[13].

3.11.2 Affected Environment

Navy training activities occur both nearshore and offshore. Offshore areas, defined by NOAA, include all range activities that occur outside the 20-fathom[14] (equal to 120 feet or 37 meters) curve on the Atlantic coast. This area is shown in Figure 3.11-1 (NOAA, 2000).

Offshore activities are military, commercial, and recreational. Although the Federal Aviation Administration (FAA) has established warning areas for military operations, virtually all airspace and seaspace is available for co-use most of the time. Only potentially dangerous activities are exclusive use. Exclusive-use times are scheduled and broadcast through notices-to-mariners (NOTMAR), issued by the U.S. Coast Guard (USCG), and notices-to-airmen (NOTAM), issued by the FAA (DoN, 2006).

[13] The Submerged Lands Act (43 U.S.C. §§1301-1315[2002]) was developed by Congress in an attempt to return the title of submerged lands to the state and promote the exploration and development of petroleum deposits in coastal waters. It effectively grants title to the natural resources located within the first 3 miles of a state's coastal submerged lands.

[14] "A fathom is a unit of length equal to 6 feet (1.83 meters). It is used principally in the measurement and specification of marine depths" (www.thefreedictionary.com/fathom).

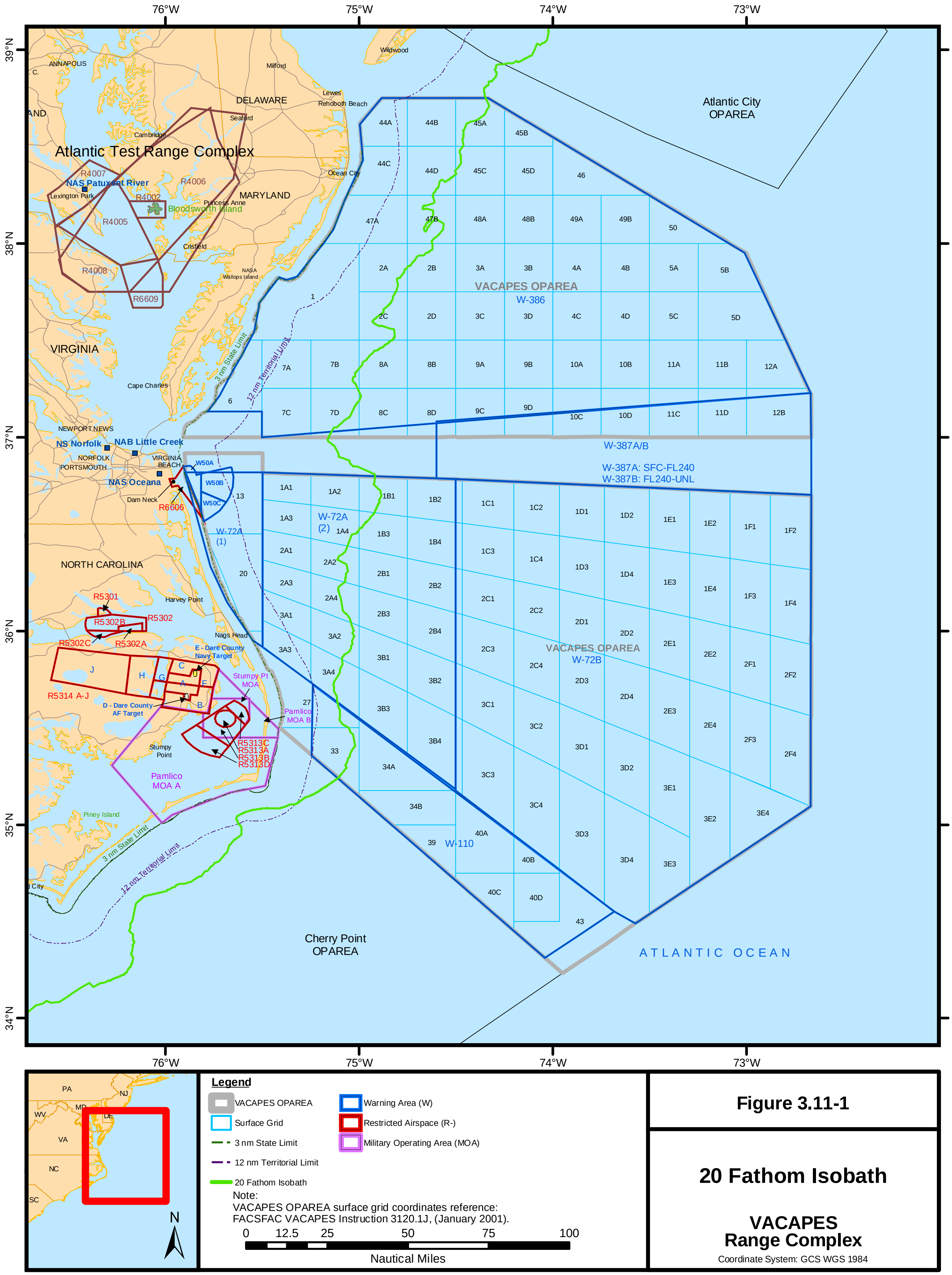


Figure 3.11-1

20 Fathom Isobath

VACAPES Range Complex

Coordinate System: GCS WGS 1984

The Regional Shore Installation Management Program (RSIP) for the Mid-Atlantic Region presents an overview of shore infrastructure and assesses present facility needs. It also identifies future needs that arise from Navy operational or homeporting changes. The current RSIP does not identify any anticipated changes in shore installation requirements that would be reflected in the use of the VACAPES Range Complex.

3.11.2.1 Real Estate Use and Agreements

Palmetto Point. The Navy and state of North Carolina (1965) signed a special use agreement in March 1965 that assigned the "…right to use, construct, operate, maintain, replace, and remove an aircraft target facility with three appurtenant markers, such facility and markers to be constructed within the confines of four (4) certain areas of submerged lands in Albemarle Sound, Tyrrell County, North Carolina." This special use agreement provides for the target areas only. The corresponding surface danger zone is authorized by the Army in 33 CFR 334.410 (DoN, 2006).

In August 1965, the Navy and Socony Mobil Oil Company entered into a subordination agreement that subordinates the company's interests in the rights to the submerged lands granted to the Navy by the state of North Carolina. The company did, however, "…reserve the right and privilege of mining, exploring, operating, and producing minerals there by slant drilling or other means but without entering upon the said submerged lands or installing thereon any equipment or other facilities" (DoN, 2006).

Stumpy Point. The Navy and State of North Carolina (1959) entered into a use agreement in January 1959 that granted the Navy "…the right, license, and permission to use those certain areas of submerged lands [in Pamlico Sound] … for the construction, maintenance, and operation of a target facility together with its components." This use agreement provides for the target areas only. The corresponding surface danger zone is authorized by the Army in 33 CFR 334.410 (DoN, 2006).

Palmetto and Stumpy Point. In October 1997, the Navy received a letter from the North Carolina Department of Natural Resources (1997) regarding four active water-based targets. The letter called into question the validity of the existing use agreements, stating that "…the two existing agreements apparently do not encompass all the submerged lands being utilized and/or contain provisions of questionable legal value." The letter further states that "…the State [of North Carolina] is interested in revisiting these three-decade old agreements…," and "…insuring the proper management of its submerged lands and clarifying the rights and responsibilities of both parties."

In response to this letter, Navy personnel attended several meetings with the state regarding the water-based targets. However, no formal response has been filed by the Navy. State interest in this issue has subsided in recent years (DoN, 2006). These water targets are not included in the VACAPES Study Area or included in this EIS/OEIS.

3.11.3 Environmental Consequences

3.11.3.1 No Action Alternative

None of the No Action Alternative offshore events would be associated with land encroachment, land forms, or soil. Land-based modes of transportation and utility systems would not be associated with offshore events. Additionally, the scenic quality of the offshore area would not be affected by No Action Alternative activities. No changes to existing real estate use or agreements would result from implementation of the No Action Alternative. Therefore, the No Action Alternative would have no impact under NEPA on land use and would cause no harm on land use under EO 12114.

3.11.3.2 Alternative 1

Alternative 1 would increase operational training, expand warfare missions, accommodate force structure changes, and enhance range complex capabilities. Proposed increases to commercial air services (CAS), the introduction of maritime security surface strike group (SSG) training, MH-60R/S training, and organic mine countermeasures (OMCM) to the mine countermeasures mission (MCM) would not be associated with land encroachment, land forms, or soil. Land-based modes of transportation and utility systems would not be associated with offshore events. Additionally, the scenic quality of the offshore area would not be affected by proposed activities. No changes to existing real estate use or agreements would result from the implementation of Alternative 1. Therefore, the proposed activities associated with Alternative 1 would have no impact on land use and would cause no harm on land use under EO 12114 and would cause no harm on land use under EO 12114.

3.11.3.3 Alternative 2 (Preferred Alternative)

Alternative 2 would increase operational training, expand warfare missions, accommodate force structure changes, and enhance range complex capabilities beyond that proposed for Alternative 1. Proposed increases to CAS, the introduction of maritime security SSG training, MH-60R/S training, and OMCM would not be associated with land encroachment, land forms, or soil. The decrease in HE explosive bomb use in the VACAPES Study Area would not have any effect on land use compared to the No Action Alternative or Alternative 1. Land-based modes of transportation and utility systems would not be associated with offshore events. Additionally, the scenic quality of the offshore area would not be affected by proposed activities. No changes to existing real estate use or agreements would result from the implementation of Alternative 2. Therefore, the proposed activities associated with Alternative 2 would have no impact on land use and would cause no harm on land use under EO 12114.

Coastal Zone Management Consistency. In accordance with the Coastal Zone Management Act, the Navy will be submitting a statement and supporting documentation to Delaware, Maryland, Virginia, and North Carolina indicating that the proposed action is consistent to the maximum extent practicable with the state's coastal zone enforceable policies. In the Final EIS/OEIS,Appendix G will include federal consistency determinations to each relevant state agency.

3.11.4 Unavoidable Significant Environmental Effects

There would not be any unavoidable significant environmental effects as a result of implementation of the No Action Alternative, Alternative 1, or Alternative 2.

3.11.5 Summary of Environmental Effects (NEPA and EO 12114)

Table 3.11-1 summarizes the environmental effects of the alternatives on land use in the VACAPES Range Complex study area. There are no aspects of the proposed actions that are likely to act as stressors to land use; thus there would not be any NEPA or EO 12114 effects on land use. Proposed actions would have no effect on land use in territorial waters. In non-territorial waters, there would be no harm to land use under the No Action Alternative, Alternative 1, or Alternative 2.

TABLE 3.11-1
SUMMARY OF ENVIRONMENTAL EFFECTS
OF THE ALTERNATIVES ON LAND USE IN THE VACAPES STUDY AREA

Alternative and Stressor	NEPA (Territorial Waters, 0 to 12 nm)	Executive Order 12114 (Non-Territorial Waters, >12 nm)
No Action Alternative		
No stressors were identified for land use.	No effects on land encroachment, land forms, or soil; transportation or utility systems; scenic quality of the offshore area; or real estate use or agreements.	In non-territorial waters, there would be no harm to land use.
Impact conclusion	Implementation of the No Action Alternative would have no impact on land use on U.S. territory.	In non-territorial waters, there would be no harm to land use.
Alternative 1		
No stressors were identified for land use.	No effects on land encroachment, land forms, or soil; transportation or utility systems; scenic quality of the offshore area; or real estate use or agreements.	In non-territorial waters, there would be no harm to land use.
Impact conclusion	Implementation of Alternative 1 would have no impact on land use on U.S. territory.	In non-territorial waters, there would be no harm to land use.
Alternative 2		
No stressors were identified for land use.	No effects on land encroachment, land forms, or soil; transportation or utility systems; scenic quality of the offshore area; or real estate use or agreements.	In non-territorial waters, there would be no harm to land use.
Impact conclusion	Implementation of Alternative 2 would have no impact on land use on U.S. territory.	In non-territorial waters, there would be no harm to land use.

3.12 Cultural Resources

3.12.1 Introduction and Methods

Cultural resources include prehistoric and historic sites, structures, objects, landscapes, ethnographic resources, and other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Cultural resources are typically discussed in terms of archaeological sites, including both prehistoric and historical occupations, architectural resources, and locations of concern to Native American groups, including Traditional Cultural Properties. There is a potential for prehistoric and historic cultural resources to occur within the VACAPES Study Area, which was defined in Section 1.5. Underwater prehistoric archeological sites may be present at depths of less than 300 feet from Paleo-Indian habitation during the last ice age. However, such sites probably would be buried under accumulated sediments. As a result, the only cultural resources likely to occur in the entirely offshore study area would be historic shipwrecks, which are classified as archeological resources. Because of mechanical, chemical, and biological erosion and decay, older shipwrecks probably are represented only by non-organic materials, such as metal and ballast stones, and are likely covered by sediments. No architectural resources occur in the Study Area and no sites associated with federally recognized American Indian tribes were identified for this project. For purposes of this document, shipwrecks are the only cultural resources considered in this assessment.

Procedures for the identification, evaluation, and treatment of cultural resources are contained in a series of federal and state laws and regulations and agency guidelines. Archaeological, architectural, and Native American resources are protected by a variety of laws and their implementing regulations: the National Historic Preservation Act (NHPA) of 1966 as amended in 2000; the Archeological and Historic Preservation Act of 1974; the Archaeological Resources Protection Act of 1979; the American Indian Religious Freedom Act of 1978; the Native American Graves Protection and Repatriation Act of 1990; the Submerged Lands Act of 1953; the Abandoned Shipwreck Act of 1987; the Sunken Military Craft Act; and OPNAVINST 5090.1B. The Advisory Council on Historic Preservation further guides treatment of archaeological and architectural resources through the regulations, Protection of Historic Properties (36 CFR 800). Historic properties, as defined by the NHPA, represent the subset of cultural resources listed on, or are eligible for, inclusion on the National Register of Historic Places (NRHP). Additional regulations and guidelines for shipwrecks include 10 USC 113, Title XIV for the Sunken Military Craft Act; the Abandoned Shipwreck Guidelines prepared by the National Park Service (NPS, 2007); and the Guidelines for Archaeological Research Permit Applications on Ship and Aircraft Wrecks under the Jurisdiction of the Department of the Navy (36 CFR 4, Part 767) overseen by the Naval Historical Center.

Consultation with the Delaware, Maryland, North Carolina and Virginia State Historic Preservation Offices (SHPO); American Indian tribes; and with the public and state and federal agencies as required by Section 106 of the NHPA and by government-to-government consultation required by EO 13007, will be accomplished as part of the NEPA process for this EIS/OEIS.

3.12.1.1 Assessment Methods and Data Used

Assessment Methods

This draft EIS/OEIS evaluates effects of the alternatives on significant cultural resources, which are historic properties listed in or eligible for inclusion in the National Register of Historic Places (NRHP). (The term "historic properties" is used for NRHP-eligible or -listed prehistoric, historic, or traditional cultural resources.) Cultural resources that have not been formally evaluated are considered potentially eligible (*i.e.* a Consensus Determination in consultation with the SHPO) and are afforded the same regulatory consideration as listed properties.

Historic properties must meet one or more of the NRHP criteria defined at 36 CFR 60.4. That is, properties must:

- Be associated with events that have made a significant contribution to the broad patterns of American history;
- Be associated with the lives of persons significant in the American past;
- Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or
- Have yielded, or may be likely to yield, information important in prehistory or history.

A historic property also must possess integrity of location, design, setting, materials, workmanship, feeling, and association to qualify for the NRHP.

Very few of the shipwrecks within the VACAPES Study Area have been fully documented or evaluated for their NRHP significance. Therefore, in this EIS/OEIS, all unevaluated shipwrecks are considered potentially eligible for the NRHP.

Data Used

Information on the area's historic shipwrecks was obtained from:

- The states of Delaware, Maryland, Virginia, and North Carolina;
- Maps and data that are available on the Internet;
- The National Oceanic and Atmospheric Administration's (NOAA) Internet-based Automated Wreck and Obstruction Information System ; and
- Published sources, as cited.

Information on underwater archaeological resources obtained from the respective SHPOs is substantially refined and locations have been verified. This information is specifically excluded from the Freedom of Information Act in accordance with Section 304 of the NHPA. Numbers of shipwrecks used in this EIS/OEIS are estimates compiled from information obtained from these sources. No comprehensive underwater surveys have been completed for the area of potential impact, and data changes are made yearly as additional discoveries are made. When the Navy conducts analysis of these resources in relation to Navy operations and potential mitigation measures, public disclosure of these sites will not occur unless permission is expressly given. Locations of identified shipwrecks are shown in Figures 3.12-1 and 3.12-2 for the VACAPES Range Complex and Chesapeake Bay area, respectively.

3.12.1.2 Warfare Areas and Associated Environmental Stressors

Aspects of the alternatives that are likely to act as stressors to cultural resources were identified by analyzing the warfare areas, operations, and specific activities included in the alternatives. Table 3.12-1 identifies the operations that could affect cultural resources. These will be carried forward for detailed analysis in this EIS/OEIS.

3.12.2 Affected Environment

Thousands of submerged cultural resources, primarily shipwrecks, are located along the south Atlantic continental shelf. Early history of the coastal areas of the individual states (Delaware, Maryland, Virginia, and North Carolina) is closely linked to maritime activities because colonial settlement and commerce in these states were made possible by shipping. Shipwrecks occurred in these areas throughout the historic period, which began with European exploration of the area during the early 16th century and continued until 1960. (Unless they are of extraordinary significance, resources are not eligible for listing in the NRHP until they are at least 50 years old.)

Most of the approximately 525 shipwrecks within the VACAPES Study Area are along the North Carolina coast. Over the past four centuries, thousands of ships were wrecked along these coasts, earning these waters the nickname "The Graveyard of the Atlantic." Shipwrecks are not randomly located, but often are associated with prominent capes such as Cape Hatteras, Cape Lookout, and Cape Fear, and the attendant shoals such as Diamond, Lookout, and Frying Pan. Numerous wrecks are concentrated in the Cape Hatteras area, where the intersection of cold northern currents and the northbound Gulf Stream forms shoals and submerged, shifting sandbars that, in combination with powerful currents, treacherous seas, and wind, create hazards for mariners.

Delaware

Shipwrecks have been occurring off the Delaware coast since shortly after Italian mariners first voyaged along the eastern coast of North America in 1524. However, there is limited information on shipwrecks off this state because of the difficulty in correlating individual, historically documented shipping losses with known shipwreck locations. Fewer than 1 percent of the shipwrecks that occurred in the state's waters have been positively identified (Koski-Karell, 1995). Many of the shipwrecks recorded by divers were caused by collisions between vessels. In the colonial period, the mouth of Delaware Bay was known as the most treacherous entry into the colonies because of the many, rapidly shifting shoals, and about half the known shipwrecks occur in this vicinity. Other wrecks are spread along the Atlantic Coast of Delaware.

TABLE 3.12-1
SUMMARY OF POTENTIAL STRESSORS TO CULTURAL RESOURCES [a/]

Warfare Area and Operation	Training Areas	Mine Warfare Deployment and Recovery	Towed Mine Warfare Devices	Non-explosive Practice Munitions	Underwater Detonations and High-explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)						
Mine countermeasures exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓		
Mine countermeasures exercise (MCM)	W-50A/C, W-386, W-72	✓	✓	✓		
Mine neutralization	W-50C	✓		✓	✓	✓
Surface Warfare (SUW)						
Bombing exercise (air-to-surface) (at sea)	W-386 (Air-K), W-72A (Air-3B), W-72A/B			✓	✓	✓
Missile exercise (MISSILEX) (air-to-surface)	W-386 (Air-K), W-72A			✓	✓	✓
Gunnery exercise (GUNEX) (air-to-surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C			✓		✓

TABLE 3.12-1
SUMMARY OF POTENTIAL STRESSORS TO CULTURAL RESOURCES [a/] (Continued)

Warfare Area and Operation	Training Areas	Mine Warfare Deployment and Recovery	Towed Mine Warfare Devices	Non-explosive Practice Munitions	Underwater Detonations and High-explosive Ordnance	Military Expended Materials
GUNEX (surface-to-surface) boat	W-50C, R-6606			✓		✓
GUNEX (surface-to-surface) ship	W-386, W-72			✓		✓
Laser targeting	W-386 (Air-K)					
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- Ship	VACAPES OPAREA					
VBSS/MIO- Helo	VACAPES OPAREA					
Air Warfare (AW)						
Air combat maneuver (ACM)	W-72A, (Air-2A/B, 3A/B)					
GUNEX (air-to-air)	W-72A					✓
MISSILEX (air-to-air)	W-386 (Air D, G, H, K), W-72A			✓	✓	✓
GUNEX (surface-to-air)	W-386, W-72			✓		✓
MISSILEX (surface-to-air)	W-386 (Air D, G, H, K)			✓		✓
Air intercept control (AIC)	W-386, W-72					
Detect to engage (DTE)	W-386, W-72					
Strike Warfare (STW)						
HARM missile exercise	W-386 (Air E, F, I, J)			✓	✓	✓
Amphibious Warfare (AMW)						
Firing exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)			✓	✓	✓
Electronic Combat (EC)						
Chaff exercise- aircraft	W-386, W-386 (Air-K), W-72					✓
Chaff exercise- ship	W-386, W-72					✓
Flare exercise- aircraft	W-386, W-386 (Air-K), W-72					✓

TABLE 3.12-1
SUMMARY OF POTENTIAL STRESSORS TO CULTURAL RESOURCES [a/] (Continued)

Warfare Area and Operation	Training Areas	Mine Warfare Deployment and Recovery	Towed Mine Warfare Devices	Non-explosive Practice Munitions	Underwater Detonations and High-explosive Ordnance	Military Expended Materials
Electronic combat (EC) operations- aircraft	W-386 (Air-K)					
EC operations- ship	VACAPES OPAREA					
Test and Evaluation						
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA					

a/ For detailed information on the numbers and types of ordnance, specific weapons platforms, types of targets used, and location of operations, see Table 2.2-4 and Appendix D.

Maryland

The U.S. Navy Shipwreck Inventory Project in Maryland identified 105 shipwrecks (naval vessel remains) of 21 vessel types in Maryland waters or relevant contiguous areas. Some of these include 36 U.S. Navy vessels, two state navy vessels, one foreign navy vessel, three privateers, and 56 vessels in service to the Confederacy (http://www.history.navy.mil/branches/org). Records of the Maryland State Historic Trust indicate that about 166 wrecks are located along the Maryland coast, and another 100 or so are possible or potential. About half the documented wrecks are schooners, with warships, steamers, and frigates, constituting the other half.

Virginia

The Association of Underwater Explorers lists 50 known shipwrecks along the Virginia coast, as well as hundreds of unidentified wrecks (AUE, 2007). These wrecks represent a wide variety of vessels, from tugs and submarines to tankers and barges. Along with collisions and storm events, a number of the ships were sunk by German submarines during World War II. Others, including German vessels, were commandeered and used for target practice. Some, such as Liberty ships, were stripped and sunk to form artificial reefs. The Virginia Department of Historic Resources indicates that numerous wrecked vessels are known or suspected to exist within Virginia's coastal waters. Of the 352 wrecks identified in Chesapeake Bay, only a few can be identified by name or vessel type.

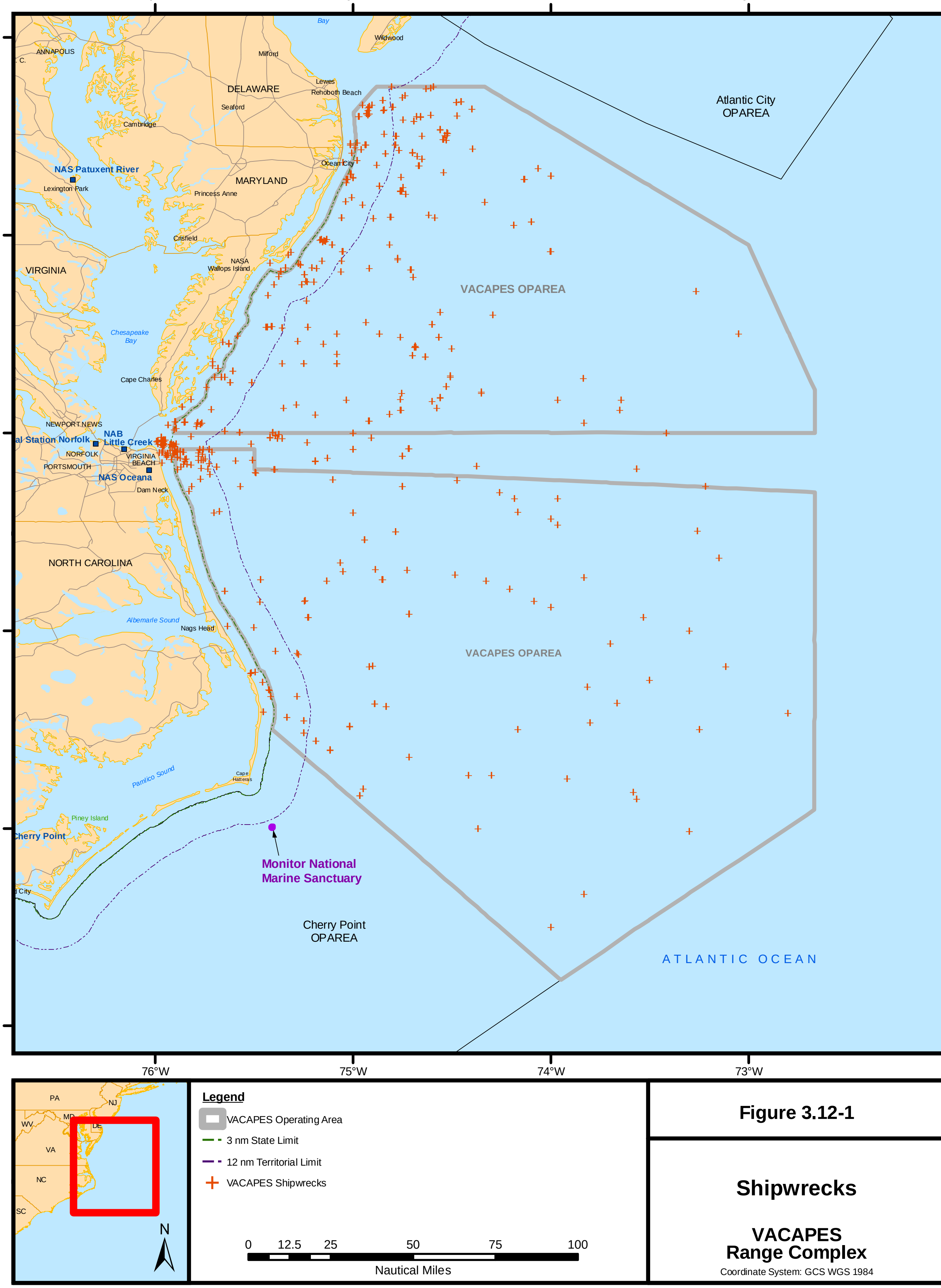


Figure 3.12-1

Shipwrecks

VACAPES Range Complex

Coordinate System: GCS WGS 1984

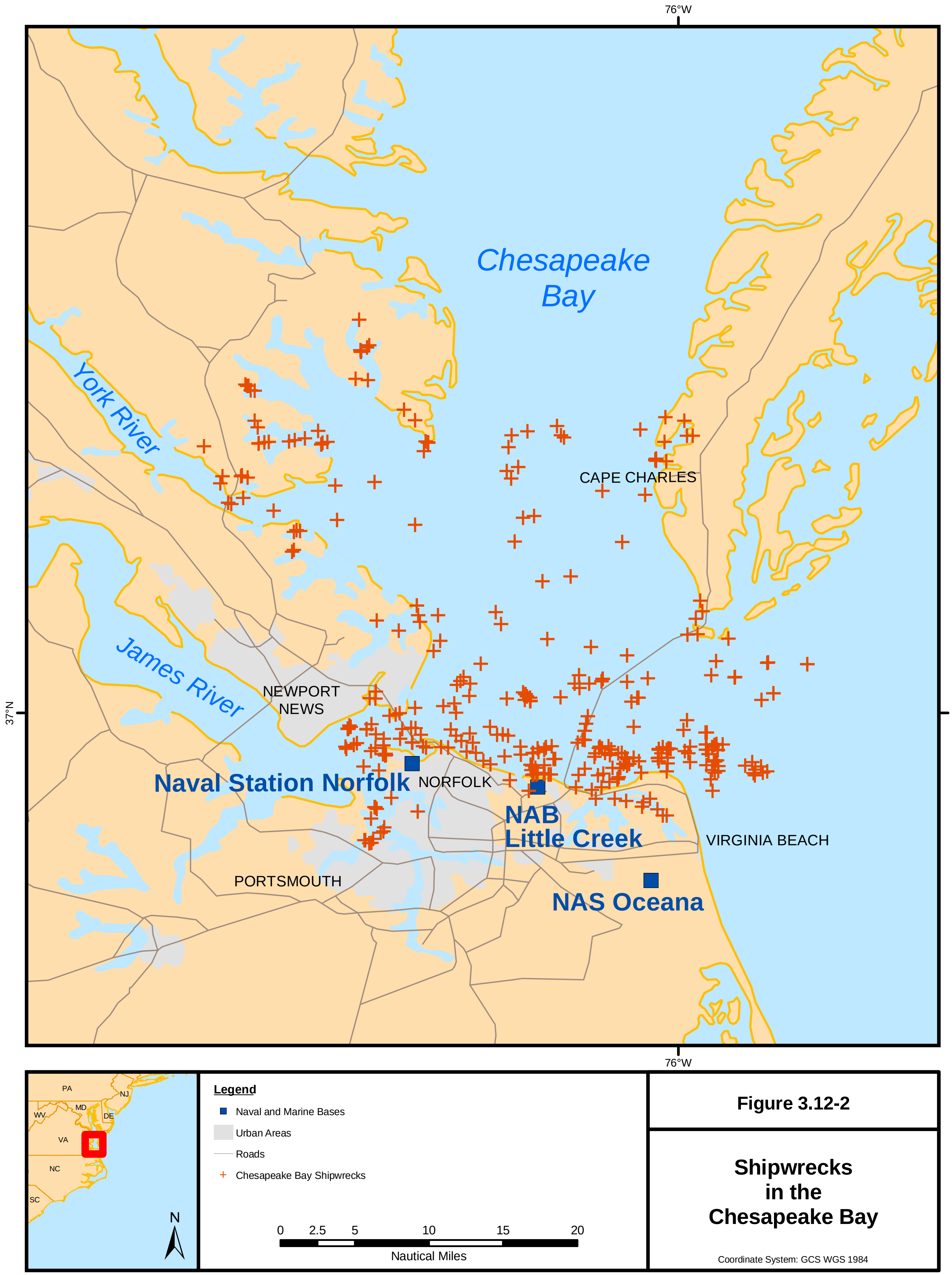


Figure 3.12-2

Shipwrecks in the Chesapeake Bay

North Carolina

Warfare, especially during World War II, contributed substantially to the wrecked vessels off North Carolina. Records of the North Carolina Underwater Archaeology Branch indicate that almost 3,000 wrecks occurred from the northern Outer Banks area to New Inlet. Only 87 of these can be identified by name, affiliation, or vessel type. Thirty-six of these vessels, including freighters, tankers, and three German submarines, were lost during World War II. Other shipwrecks along the North Carolina coast involved a wide variety of watercraft, including early 19th century Spanish merchant sailing ships, wood- and iron-sided steamers dating to the 1900s, freighters, whalers, gunboats, a steam battleship, and trawlers lost during World War II. The *USS Monitor*, *USS Huron*, and the 15 Civil War shipwrecks in southeastern North Carolina are listed on the NRHP.

VACAPES Study Area

The Global Maritime Wrecks Database (Veridian, 2001) was used to identify the potential for shipwrecks to exist within the VACAPES Study Area. Approximately 525 locations indicating the presence of metal obstructions and/or submerged wrecks were identified in the VACAPES Study Area; of these, 160 can be identified by name and vessel type (Veridian, 2001). Most identified vessels are from the United States, Norway, and Great Britain. Of the wrecks off the Virginia coast, the *Florida* and *USS Cumberland* are listed on the NRHP.

As a result of German submarine activity during WW II, many ships were torpedoed and sunk in the VACAPES Study Area. Some of these ships (e.g., the *Kingston Celonite*) are associated with loss of life. As these shipwrecks may contain human remains, they are considered war grave sites.

A literature review was undertaken for the five potential Bottom Impact areas (Instrumented Training Area North, Instrumented Training Area South, and Warning Areas (W) 50A, 50B, and 50C) in the VACAPES OPAREA (Southeastern Archaeological Research, Inc. [SEARCH], 2008). Review of available databases identified one known wreck site (*Texaco*) and at least 30 obstructions, navigational aids or unidentified soundings within the Instrumented Training Area North. Two known wreck sites (*Atkinson* and *Margaret*) and at least 88 obstructions, navigational aids, objects or unidentified soundings have been recorded in the Instrumented Training Area South (SEARCH, 2008). One wreck site (*Kingston Celonite*), and at least two unidentified soundings are located in W-50A (SEARCH, 2008). Two wreck sites (*Salty Sea II* and *Tiger*), and at least six obstructions or unidentified soundings have been recorded in W-50B (SEARCH, 2008). No wreck sites or obstructions occur in W-50C (SEARCH, 2008). Application of the predictive model indicates that four Potential Bottom Impact Areas have a high or moderate potential to contain submerged cultural resources (SEARCH, 2008). Of the five areas, only W-50C is considered to have the lowest probability to contain submerged cultural resources (SEARCH, 2008:35).

Because no comprehensive survey or evaluation of submerged resources has occurred in the Study Area and the area is considered high to moderate probability for shipwrecks, additional shipwrecks are likely to occur, and some existing and new shipwrecks could be considered eligible for the NRHP.

The locations of known shipwrecks as identified in the literature review prepared by SEARCH, Inc. will be provided to Navy operators so these resources may be avoided during training activities. As previously discussed, exact locations of these resources are considered sensitive information and specifically excluded from public dissemination under Section 304 of the NHPA.

3.12.3 Environmental Consequences

An undertaking is considered to have an effect on a historic property when the undertaking may alter characteristics of the property that may qualify it for inclusion in the NRHP. An effect is considered adverse when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

Adverse effects as defined by Section 106 of the NHPA include, but are not limited to:

- Physical destruction, damage, or alteration of all or part of the property;
- Isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the National Register;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;
- Neglect of a property resulting in its deterioration or destruction; and
- Transfer, lease, or sale of the property (36 CFR 800.5 (a)(2)).

For the purposes of this EIS/OEIS, a significant impact under NEPA is defined as an unresolvable "adverse effect" under Section 106 of the NHPA. Section 106 criteria of adverse effect were applied to cultural resources that could be affected by the project, and ways were considered to avoid, minimize, or mitigate adverse effects as described below.

Note that adverse effects under the National Historic Preservation Act (NHPA) also include reasonably foreseeable effects caused by the alternatives, and those that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5(a)(1)). Because cultural resources are nonrenewable, all adverse effects on NRHP-eligible cultural resources in the VACAPES Study Area, as addressed in this draft EIS/OEIS, would be long term.

Impacts to archaeological sites, specifically shipwrecks, may include, but not be limited to, physical disturbance through collision impacts from underwater equipment, vibration from HE detonations, and removal of shipwreck features and artifacts Any physical disturbance in the area of an NRHP-eligible or potentially eligible archaeological site, or modification to such a site, can affect the physical integrity of that cultural resource, resulting in alteration or destruction of those characteristics or qualities which make it potentially eligible for inclusion in the NRHP and thus, would be an adverse effect under Section 106 of the NHPA.

3.12.3.1 No Action Alternative

The training activities with the greatest potential to affect shipwrecks include mine countermeasures (MCM) exercise and mine neutralization. MCM events generally involve a helicopter with minesweeping and mine-hunting gear. Typically, the helicopter flies within 75 feet of the water while towing the appropriate system on the surface and/or down to a depth of 150 feet. The towed device may include one or more systems as sonar, laser, mechanical, acoustic, magnetic, or sweeping. Except for the MK-105, MCM systems are deployed and recovered from the helicopter once the aircraft arrives are the training area. The MK-105 must be towed from NS Norfolk to the training area.

MCM systems include AN/AQS-20 and AN/AQS-24A, which are helicopter-towed sonar devices. Other minesweeping systems include the MK-103 (mechanical minesweeping system), MK-104 (used to counter acoustic-influencing mines), MK-105 (used to counter magnetic-influencing mines), and MK-106 (a combined system, the MK-104 attached to an MK-105). Other systems such as the MK-104/MK-105 and MOP (SPU-1W) cause mines to self-detonate (although no explosive mines are used for training).

Under the No Action Alternative, a total of 1,358 Mine Warfare (MIW) sorties (see Table 2.2-5) would occur yearly in areas W-50, W-72, and W-386 of the VACAPES OPAREA and lower Chesapeake Bay. These training areas have shipwrecks throughout that could be affected by minesweeping systems. For example, if operators were unaware of the locations of shipwrecks in the sortie area, the towed MIW devices or attachment cable could inadvertently encounter, snag, and/or damage a shipwreck situated in relatively shallow water, particularly during at low tide. MIW device operators are required to tow equipment without encountering the bottom or obstructions, because such strikes could damage expensive equipment or put the aircraft in jeopardy. Therefore, aircraft crews are knowledgeable of the bottom depths, existing reefs, shipwrecks, and other potential obstructions underwater. This knowledge makes the likelihood of snagging the equipment, and damaging shipwrecks, very low (*no historic properties affected* under Section 106).

Mine neutralization activities in W-50 area could have an adverse effect on shipwrecks. Typically, 12 mine neutralization events would occur yearly. Explosive Ordnance Disposal (EOD) units use underwater explosive charges to destroy or neutralize simulated mines with the detonation of explosive charges equivalent to up to 20 pounds of TNT. Because water rapidly transmits shock waves, demolition of mines could damage cultural sites in the general vicinity. The amount of damage would depend on factors such as size of the charge, distance from the wreck, and topography of the ocean bottom(*possible adverse effect* under Section 106).

Bombing exercises and surface-to-surface gunnery exercises would have a lower potential to affect shipwrecks. These activities can deposit military expended material (MEM) on the ocean bottom in the vicinity of shipwrecks. However, even if bomb fragments sank to the ocean bottom, it is unlikely that they would come into contact with a wreck. Even if they should sink in the vicinity of a wreck, the MEM would not affect the historic characteristics of the shipwreck, and eventually all would be covered by sediments. Thus, these operations would not have an adverse effect on shipwrecks (*no adverse effect* under Section 106).

Under the No Action Alternative, where training operations and major range events would continue at current levels, but because avoidance of known shipwreck locations is conducted during current training, no significant impacts (only negligible to minor impacts) to cultural resources within the VACAPES Study Area would be expected (*no adverse effects* under Section 106). On-going MIW operations and EOD activities would have the advantage of past experience with known locations of shipwrecks, so operators should be able to avoid damage to cultural resources in these areas. Required planning and implementation of described mitigation measures, especially avoidance, (see Chapter 5) would help reduce the potential for impacts.

3.12.3.2 Alternative 1

Under Alternative 1, MCM activities would increase from 1,358 sorties per year to 2,060 per year. These exercises would include use of the:

- MK-103, MK-104, MK-105, MK-106, OASIS, and SPU-1W systems in the lower Chesapeake Bay (see Figure 2.2-2 and 2.2-3); and
- AN/AQS-20 and AN/AQS-24 systems in the shallow areas (40 to 150 feet) of W-386 and W-72 (Figure 2.2-4).

No simulated mines or Versatile Exercise Mine (VEM) units would be deployed in this alternative.

If helicopter operators were unaware of the locations of shipwrecks in the study area, the towed MIW devices and attachment cables could inadvertently encounter, snag, and damage a shipwreck situated in relatively shallow water, particularly during low tide. However, as discussed in the No Action Alternative, this occurrence would be highly unlikely (*no historic properties affected* under Section 106).

Mine neutralization activities, including EOD, RAMICS, and AMNS, would increase from 12 events per year to 334. As described in Section 2.2.4, bottom and moored mine shapes would be deployed in W-50C under Alternative 1. Mine shapes would be anchored with concrete blocks 8 to 16 cubic feet in size. Anchors would be dropped from a boat, and mooring lines would be attached with the shapes.

Because there are no known shipwrecks in W-50C, there is no possibility of dropping an anchor on a known cultural resource (*no historic properties affected* under Section 106).

Mine neutralization activities used in AMNS and RAMICS systems use non-explosive practice munitions to cause the mine shape to surface or be destroyed. With AMNS, the target location is determined, and then an expendable, self-propelled neutralizer device locates the target and renders it inoperable. RAMICS is a targeting, fire control, and gun system that fires a supercavitating projectile at a near-surface moored mine shape. These mine neutralization systems would be used in W-50C, where no known shipwrecks occur (*no historic properties affected* under Section 106).

As described under the No Action Alternative, EOD units that use underwater explosive charges to neutralize simulated mines have the potential to damage cultural sites in the general vicinity. Damage would vary, based on sea bottom topography and proximity to the shipwreck. All EOD training with explosive charges would be performed in W-50C, which previously has been approved for detonations. There are no known shipwrecks located in W-50C (*no historic properties affected* under Section 106).

MEM such as shells and mine fragments expended during the proposed operations would sink to the ocean bottom. It is unlikely these materials would come into contact with a shipwreck. However, if MEM were to sink onto a shipwreck, or in the near vicinity, it would not affect the historic characteristics of the shipwreck. Eventually, the MEM would provide a substrate for benthic colonization and would likely be covered by shifting sediments. Thus, these operations would not have an adverse effect on shipwrecks (*no adverse effect* under Section 106).

Through planning and implementation of mitigation measures, including avoidance, (see Chapter 5) Alternative 1 would result in no significant impacts (negligible to minor impacts) for shipwrecks in the Chesapeake Bay or the VACAPES Study Area (*no adverse effect* under Section 106).

3.12.3.3 Alternative 2 (Preferred Alternative)

The same types of MIW activities described for Alternative 1 would be employed for Alternative 2, except that training areas for the MCM systems would be identified. Under the preferred alternative, the number of training events would be about the same as in Alternative 1 (an increase in 50 sorties; see Table 2.2-4), and the following mine warfare training areas would be designated within the VACAPES Study Area:

- Training areas in W-50C would be established for explosive/non-explosive MK-103, AMNS, and RAMICS training (Figure 2.2-1).
- For RAMICS and AMNS training, up to 20 moored mines would be deployed in a one nm by four nm area in W-50C.
- MK-103 training area would be located in W-50A and C. The training area would include up to 20 moored mines held in place with anchors.

Mooring cables would be attached to 8- to 16-cubic-foot concrete blocks set on the ocean bottom. There are no shipwrecks in this area, so there would be no effects for this MIW activity (*no historic properties affected* under Section 106).

Sixty shipwrecks are located within the general area of the proposed MK-105 and SPU-1W training area (Figures 3.12-2 and 2.2-2). However, most of the wrecks are close to the shores of the cities of Norfolk and Virginia Beach, outside the vicinity of the proposed training area.

Exercises in each of these mine warfare training areas would involve helicopter-towed systems. All these towed MIW devices would have the potential to snag or damage submerged shipwrecks. However, as stated in the No Action Alternative, the likelihood of an aircrew dragging the device on the ocean or bay bottom or hitting a submerged structure is low (*no historic properties affected* under Section 106).

Each one nm by four nm area would be populated with 20 VEM units (see Section 2.2.5 for description). VEM units would be placed on the lower Chesapeake Bay bottom in areas that would avoid shipping lanes, shipwrecks, artificial reefs, and hard bottom areas. Because VEM units are instrumented simulated mine shapes, no detonations or explosions would occur.

There is one potential shipwreck in the proposed OASIS training area (Figure 2.2-3). As with other minesweeping systems, there is a potential to snag or damage this submerged shipwreck. However, the potential is very small because of the depth of the water (40 feet) and the operators' knowledge of the location of the only wreck in the area. The OASIS mine field would be one nm by four nm and populated with 20 VEM units that would electronically record acoustical and magnetic sweep systems. No explosive devices would be used in these ranges. By knowing the location of the shipwreck and planning mine locations, installing a mine on a shipwreck would be highly unlikely (*no historic properties affected* under Section 106).

There are a few shipwrecks in the areas where the proposed AN/AQS-20 and AN/AQS-24A mine training area would be located (Figure 2.2-4). As in the other mine training areas, by knowing the location of shipwrecks and planning mine locations, installing a mine on a shipwreck would be highly unlikely.

The 96 percent decreased use of High Explosive (HE) bombs in Alternative 2 compared to the No Action Alternative or Alternative 1 would not affect any cultural resources. BOMBEXs would only occur in W-386 (Air-K) under this alternative which has water depths ranging between 90 – 120-ft. HE bombs will normally explode at or near the surface of the water. MEM resulting from exploded ordnance would drop through the water column and rest on the ocean floor. According to the shipwreck database, very few shipwrecks occur in the Air-K grid of W-386. As stated previously, in the unlikely event that MEM falls on a shipwreck, the expended material would not cause any additional harm to the resource (*no adverse effect* under Section 106).

Through planning and implementation of described mitigation measures, especially avoidance, (see Chapter 5) Alternative 2 would cause no significant adverse impacts (negligible to minor impacts) for shipwrecks in the Chesapeake Bay or the VACAPES Study Area (*no adverse effect* under Section 106).

3.12.4 Unavoidable Significant Environmental Effects

The analysis presented above indicates that the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant effects to historic properties.

3.12.5 Summary of Environmental Effects (NEPA and EO 12114)

Less than significant impacts to cultural resources would result from the No Action Alternative, Alternative 1, or Alternative 2 (the Preferred Alternative). MEM would be deposited in offshore areas, and most would become buried in the sea floor sediment and have no substantial cultural resource effects. Even if MEM sank in the vicinity of a wreck, it would not affect the historic characteristics of the shipwreck. Although the volume of MEM would increase in Alternative 1 and Alternative 2 in correlation to changes in operations, the effects on cultural resources would be no greater than under the No Action Alternative. In all alternatives, mine warfare activities would be limited to the identified areas in the lower Chesapeake Bay, W-50A/C, W-386, and W-72 and would not affect cultural resources. Table 3.12-2 summarizes stressors by alternative and the impacts that would occur under NEPA within the U.S. territory or under EO 12114 outside U.S. waters in the global commons.

TABLE 3.12-2
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON CULTURAL RESOURCES IN THE VACAPES STUDY AREA

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
No Action		
Mine warfare deployment and recovery	Localized disturbance to sea bottom; limited potential of installing concrete anchor on shipwreck.	Localized disturbance to sea bottom; limited potential of installing concrete anchor on shipwreck.
Towed mine warfare devices	Limited potential for a towed MIW device to disturb a shipwreck.	Limited potential for a towed MIW device to disturb a shipwreck.
Non-explosive practice munitions	Localized disturbance to sea bottom; limited potential to strike a shipwreck.	Localized disturbance to sea bottom; limited potential to strike a shipwreck.
Underwater detonations and high-explosive ordnance	Localized disturbance to sea bottom; limited potential for explosions to occur at the location of a shipwreck.	Localized disturbance to sea bottom; limited potential for explosions to occur at the location of a shipwreck.
Military expended materials	Localized accumulation of MEM on sea bottom; limited potential for MEM to accumulate at the location of a shipwreck.	Localized accumulation of MEM on sea bottom; limited potential for MEM to accumulate at the location of a shipwreck.
Impact conclusion	Less than significant impacts to cultural resources with implementation of mitigation measures (avoidance of known shipwreck locations).	Less than significant harm to cultural resources with implementation of mitigation measures (avoidance of known shipwreck locations).
Alternative 1		
Mine warfare deployment and recovery	Localized disturbance to sea bottom; limited potential of installing concrete anchor on shipwreck.	Localized disturbance to sea bottom; limited potential of installing concrete anchor on shipwreck.
Towed mine warfare devices	Limited potential for a towed MIW device to disturb a shipwreck.	Limited potential for a towed MIW device to disturb a shipwreck.
Non-explosive practice munitions	Localized disturbance to sea bottom; limited potential to strike a shipwreck.	Localized disturbance to sea bottom; limited potential to strike a shipwreck.
Underwater detonations and high-explosive ordnance	Localized disturbance to sea bottom; limited potential for explosions to occur at the location of a shipwreck.	Localized disturbance to sea bottom; limited potential for explosions to occur at the location of a shipwreck.
Military expended materials	Localized accumulation of MEM on sea bottom; limited potential for MEM to accumulate at the location of a shipwreck.	Localized accumulation of MEM on sea bottom; limited potential for MEM to accumulate at the location of a shipwreck.
Impact conclusion	Less than significant impacts to cultural resources with implementation of mitigation measures (avoidance of known shipwreck locations).	Less than significant harm to cultural resources with implementation of mitigation measures (avoidance of known shipwreck locations).

TABLE 3.12-2
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON CULTURAL RESOURCES IN THE VACAPES STUDY AREA (Continued)

	Summary of Effects and Impact Conclusion	
Alternative and Stressor	**NEPA (Territorial Waters, 0 to 12 nm)**	**Executive Order 12114 (Non-Territorial Waters, >12 nm)**
Alternative 2		
Mine warfare deployment and recovery	Localized disturbance to sea bottom; limited potential of installing concrete anchor on shipwreck.	Localized disturbance to sea bottom; limited potential of installing concrete anchor on shipwreck.
Towed mine warfare devices	Limited potential for a towed MIW device to disturb a shipwreck.	Limited potential for a towed MIW device to disturb a shipwreck.
Non-explosive practice munitions	Localized disturbance to sea bottom; limited potential to strike a shipwreck.	Localized disturbance to sea bottom; limited potential to strike a shipwreck.
Underwater detonations and high explosive ordnance	Localized disturbance to sea bottom; limited potential for explosions to occur at the location of a shipwreck.	Localized disturbance to sea bottom; limited potential for explosions to occur at the location of a shipwreck.
Military expended materials	Localized accumulation of MEM on sea bottom; limited potential for MEM to accumulate at the location of a shipwreck.	Localized accumulation of MEM on sea bottom; limited potential for MEM to accumulate at the location of a shipwreck.
Impact conclusion	Less than significant impacts to cultural resources with implementation of mitigation measures (avoidance of known shipwreck locations).	Less than significant harm to cultural resources with implementation of mitigation measures (avoidance of known shipwreck locations).

3.13 TRANSPORTATION

3.13.1 Introduction and Methods

Traffic issues refer to transportation and circulation of vehicles within an organized framework. This discussion addresses the marine and air traffic within the vicinity of the VACAPES Range Complex. Military and civilian use of the offshore sea and air areas is compatible, with Navy ships accounting for three percent of the total ship presence out to 200 nautical miles (nm) (Center for Naval Analysis (CNA), 2001). Where naval vessels and aircraft conduct operations that are not compatible with commercial or recreational transportation (*e.g.,* hazardous weapons firing), they are confined to Operating Areas (OPAREA) away from commercially used waterways and inside Special Use Airspace (SUA). Hazardous operations are communicated to all vessels and operators by use of Notice-to-Mariners (NOTMAR), issued by the U.S. Coast Guard (USCG), and Notice-to-Airmen (NOTAM), issued by the Federal Aviation Administration (FAA).

Ocean Traffic. Ocean traffic is the transit of commercial, private, or military vessels at-sea, including submarines. Ocean traffic flow in congested waters, especially near coastlines, is controlled by the use of directional commercially used waterways for large vessels (cargo, container ships, and tankers). Traffic flow controls are also implemented to ensure that harbors and ports-of-entry remain as uncongested as possible. There is less control on ocean traffic involving recreational boating, sport fishing, commercial fishing, and activity by naval vessels. In most cases, the factors that govern commercially used waterways or boating traffic include the following: adequate depth of water, weather conditions (primarily affecting recreational vessels), the availability of fish of recreational or commercial value, and water temperature (higher water temperatures increase recreational boat traffic and diving activities).

Exclusive Economic Zones (EEZs) are seazones that were established by the Third United Nations Convention on the Law of the Sea in 1982. Part V, Article 55 of the Convention establishes that the EEZ is "an area beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part, under which the rights and jurisdiction of the coastal State and the rights and freedom of other States are governed by the relevant provisions of this Convention." (UN, 1982). The EEZs extend 200 nautical miles from the coastal baseline (the baseline usually follows the low-water line). Within the EEZ, the coastal nation has sole exploitation rights over all natural resources; however, foreign nations have the freedom of navigation and over-flight, subject to the regulation of the reigning coastal state (NOAA, 2007). The EEZ was established by Presidential Proclamation in 1983 (NOAA, 2007).

Internal waters are those waters and waterways on the landward side of the baseline. Territorial waters extend from the baseline to 12 nautical miles. These areas were defined by the 1982 Law of the Sea Convention and established the coastal state's right to establish laws, regulate use and have use of any resource in internal and territorial waters (NOAA, 2007).

Air Traffic. Air traffic refers to movements of aircraft through airspace. Safety and security factors dictate that use of airspace and control of air traffic be closely regulated. Accordingly, regulations applicable to all aircraft are promulgated by the Federal Aviation Administration (FAA) to define permissible uses of designated airspace, and to control that use. These regulations are intended to accommodate the various categories of aviation, whether military, commercial, or general aviation. The regulatory scheme for airspace and air traffic control varies from highly controlled to uncontrolled. Less controlled situations include flight under Visual Flight Rules (VFR) or flight outside of U.S. controlled airspace (*e.g.,* flight over international waters off the east coast). Examples of highly controlled air traffic situations are flights in the vicinity of airports where aircraft are in critical phases of flight, either take-off or landing and flight under Instrument Flight Rules (IFR), particularly flights on high or low altitude airways.

The FAA owns and operates the air traffic control system. The system of airspace designation makes use of various definitions and classifications of airspace to facilitate control. "Controlled Airspace" is a generic term that covers different classes of airspace. The controlling agency of any airspace is the FAA Air Traffic Control (ATC) facility that exercises control of the airspace when Special Use Airspace has is not active. Special Use Airspace is specially designated airspace that is used for a specific purpose and is controlled by the military unit or other organization whose activity established the requirement for the Special Use Airspace (FAA, 2006). Special Use Airspace includes restricted areas, military operations areas, as well as warning, prohibited, alert, and controlled firing areas.

- Airways are established routes used by commercial aircraft, general aviation, and military aircraft. There are two types of airway route structures: low altitude routes (those below 18,000 feet mean sea level [MSL]) and high altitude routes (those above 18,000 feet MSL).
- "Victor Routes" are the network of airways serving commercial aviation operations up to 18,000 MSL.
- Class A extends from 18,000 MSL up to and including 60,000 MSL and includes designated airways for commercial aviation operations at those altitudes.
- Class B airspace extends from the ground to 10,000 MSL surrounding the nation's busiest airports.
- Class C and D airspace are defined areas around certain airports, tailored to the specific airport.
- Class E is controlled airspace not included in Class A, B, C, or D.
- Class G is uncontrolled airspace (*i.e.,* not designated as Class A-E).

Special Use Airspace refers to areas with defined dimensions where flight activities are confined due to their nature and the need to restrict or limit non-participating aircraft. SUA is established under procedures outlined in 14 CFR Part 73. The majority of SUA is established for military activities, and may be used for commercial or general aviation when not reserved for military activities. There are multiple types of SUA. A Restricted Area is a type of SUA within which non-military flight activities are closely restricted. Other types of SUA include Military Operating Areas (MOA), alert areas, and controlled firing areas; each SUA designation carries varying restrictions on the types of military and non-military activities that may be conducted. One type of SUA of particular relevance to the VACAPES Envrionmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) Study Area is a Warning Area, which is defined in 14 CFR Part 1 as follows:

> "A warning area is airspace of defined dimensions, extending from 3 nautical miles outward from the coast of the United States that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating pilots of potential danger. A warning area may be located over domestic or international waters or both."

Warning areas are established to contain a variety of aircraft and non-aircraft activities, such as aerial gunnery, air and surface missile firings, bombing, aircraft carrier operations, surface and subsurface operations, and naval gunfire. Warning areas contain hazardous activities; where these activities are conducted mainly in international airspace, the FAA regulations may warn against, but do not have the authority to prohibit, flight by nonparticipating aircraft.

3.13.1.1 Assessment Methods and Data Used

The CNA (2001, 2004, 2006) studies were used to look at non-Navy ship traffic in the vicinity of the VACAPES Range Complex. In 2001 the Chief of Naval Operations (CNO-N45) initiated a study that, amongst other things, sought to determine the contribution of the Navy to coastal ship traffic. This study utilized the Historical Temporal Shipping database[15] and daily listings of Navy ship traffic. Regarding "traffic" issues, the 2001 CNA study concluded that the Navy ships were a small fraction of the coastal ship presence (1/30th) and comparisons of naval and commercial traffic is difficult due to naval traffic being "patchy" in both time and space while commercial traffic is more uniform.

The 2004 CNA study concentrated more on the Navy Operating Areas (OPAREAs) and, due to the difficulties in estimating small commercial vessels and recreational boats, the CNA was asked to establish a methodology for estimating the small boat and craft traffic in a given ocean area. Additionally, the HITS data used in the 2001 study had been developed in 1993 and had not been updated so, using sporadic vessel position data, the 2004 study developed a tool for comparing relative densities of large vessels, by vessel type, region, and time to compare Navy and non-Navy traffic levels (CNA, 2004).

The 2006 CNA study concentrated more on information concerning Navy and non-Navy vessel traffic and speed patterns due to increasing concerns regarding proposed speed restrictions. The study concluded that estimates of vessel speed could be calculated from positional data and that, while Navy ships were capable of transiting at higher speeds than most large commercial vessels, they generally do not do so (CNA, 2006).

Information regarding personal watercraft was obtained in part from the USCG. In addition to its national defense role as one of the five U.S. Armed Services, the USCG is charged with a broad scope of regulatory, law-enforcement, humanitarian, and emergency-response duties. In addition to ensuring maritime safety and security, the USCG focuses on personal watercraft and boating. State tourism and parks and recreation divisions also provided sources for state-specific personal watercraft and recreational boating data.

Sport diving industry statistics are not maintained for numbers of individuals participating in specific regions of the country or for sites that are commonly used (Davison, 2007; DEMA, 2006). Dive locations identified in this document were established through the use of the National Oceanic and Atmospheric Administration Office of Coast Survey's Automated Wreck and Obstruction Information System, a survey of state dive charter company websites, Veridian Corporation's 2001 Global Maritime Wrecks Database, and state tourism and parks and recreation information.

3.13.1.2 Warfare Areas and Associated Environmental Stressors

Impacts to transportation are assessed in terms of anticipated levels of disruption or improvement of current transportation patterns and systems; deterioration or improvement of existing levels of service; and changes in existing levels of transportation safety. Impacts may arise from physical changes to circulation (*i.e.,* closing, rerouting, or creation of new traffic patterns), or changes in daily or peak-hour traffic volumes created either by direct or indirect changes to transportation activities. Stressors that would likely impact transportation activities are identified in Table 3.13-1. These stressors were

[15]The Historical Temporal Shipping (HITS) data is a 1993 database, developed by the Naval Oceanographic Office, which describes the number of ships expected in each region of the ocean for five types of ships: fishing, merchant, tanker, large tanker, and supertanker. While ship types other than those included in the HITS data also may transit the site, the selected ship types are expected to be representative of major commercial shipping in the region. Traffic density was determined for this study by isolating 1-degree latitude by 1-degree longitude boxes. For each box, ship-hour estimates were divided by box area. This calculation is useful comparing relative densities between East Coast Navy OPAREAs and ship types (CNA, 2001).

identified by conducting a detailed analysis of the warfare areas, operations, and specific activities included in the Alternatives.

TABLE 3.13-1
SUMMARY OF POTENTIAL STRESSORS TO TRANSPORTATION RESOURCES

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Aircraft Overflights (Disturbance)	Military Expended Materials
Mine Warfare (MIW)				
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓
Mine Countermeasures Exercise (MCM)	W-50A/C W-386, W-72	✓	✓	✓
Mine Neutralization	W-50C	✓	✓	✓
Surface Warfare (SUW)				
Bombing Exercise (Air-to-Surface) (at sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B	✓	✓	✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A	✓	✓	✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C	✓	✓	✓
GUNEX (Surface-to-Surface) Boat	W-50C, R-6606	✓	✓	✓
GUNEX (Surface-to-Surface) Ship	W-386, W-72	✓	✓	✓
Laser Targeting	W-386 (Air-K)	✓	✓	
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	VACAPES OPAREA	✓		
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓	
Air Warfare (AW)				
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)		✓	
GUNEX (Air-to-Air)	W-72A		✓	✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A		✓	✓
GUNEX (Surface-to-Air)	W-386, W-72	✓	✓	✓
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)	✓	✓	✓
Air Intercept Control (AIC)	W-386, W-72	✓	✓	✓
Detect to Engage (DTE)	W-386, W-72	✓	✓	✓

TABLE 3.13-1
SUMMARY OF POTENTIAL STRESSORS TO TRANSPORTATION RESOURCES (Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Aircraft Overflights (Disturbance)	Military Expended Materials
Strike Warfare (STW)				
HARM Missile Exercise	W-386 (Air E,F,I,J)		✓	✓
Amphibious Warfare (AMW)				
Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓		✓
Electronic Combat (EC)				
Chaff Exercise- aircraft	W-386, W-386 (Air-K) and W-72	✓	✓	✓
Chaff Exercise- ship	W-386 and W-72	✓	✓	✓
Flare Exercise- aircraft	W-386, W-386 (Air-K) and W-72		✓	✓
Electronic Combat (EC) Operations- aircraft	W-386 (Air-K)		✓	
EC Operations- ship	VACAPES OPAREA	✓		
Test and Evaluation				
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓		

Affected Environment

3.13.1.3 Ocean Traffic

Military

The VACAPES OPAREA covers an area of approximately 27,661 square nautical miles(nm^2) of sea space off the coast of Delaware, Maryland, Virginia, North Carolina. (Figure 1.1-1). The Navy operates for 1,400 steaming days[16] per year within the VACAPES OPAREAS (Table 2.2-4).The volume of undersea space associated with a particular portion of VACAPES OPAREA varies greatly based on the

[16] Steaming days are a measurement of time for a single vessel, at sea, within a 24 hour timeframe. One steaming day is 24 hours and partial steaming days are based on a 24 hour period. Two steaming days could be one ship for 48 hours or four ships for 12 hours each.

sea floor depth. The edge of the continental shelf cuts along the western third of the OPAREA. Sea floor depths along the continental shelf are uniformly shallow and center around 30 fathoms (180 feet) at its seaward edge. East of the shelf edge the sea floor drops steeply, reaching approximately 2,160 fathoms (13,000 feet) along the southeast corner of the VACAPES OPAREA. While most of the continental shelf is uniform in depth, several underwater canyons extend shoreward from the shelf edge. VACAPES undersea space is summarized as having the following:

- An area of 27,661 nm^2;
- Shallow littoral waters less than 10 fathoms (60 feet);
- Shallow offshore waters less than 100 fathoms (600 feet);
- Deepwater sloping sea floor and canyons to 1,600 fathoms (9,600 feet); and
- Deepwater ocean areas to 2,160 fathoms (13,000 feet).

Figure 3.13-1 shows the areas where submarine operations are normally conducted. Submarines typically use transit lanes ECHO and WHISKEY and the entire W-386, but avoid areas 1, 47A, 44A-D, and 8A-D. In W-72 submarines typically avoid use of areas 2A, 3A, and 3B1-3B4. Tables 2.2-1 and 2.2-2 depict the current usage of these areas. Commander, Submarine Force, U.S. Atlantic Fleet is the Submarine Exercise Area Coordinator (SEAC) for the submarine operating area (SUBOA) within the VACAPES OPAREA. Clearance is provided by Fleet Area Control and Surveillance Facility (FACSFAC) VACAPES prior to surface ships transiting VACAPES OPAREA. Under normal circumstances FACSFAC VACAPES does not exercise any control over vessel operation in cleared areas. Clearance for a surface area does not include the airspace above or the subsurface below. Units are required to obtain clearance for all hazardous or exclusive operations within the OPAREA. Subsurface operations may be requested and conducted in all areas with 48 hours notice, except VACAPES OPAREA 3B which can be scheduled in real time.

Civilian

The east coast of the United States is heavily traveled by marine vessels, with several commercial ports occurring near Navy OPAREAs. The inshore areas of the VACAPES OPAREA are particularly heavily traveled as they occur near commercial ports in both Delaware and Virginia; however, the areas in which training would occur (as depicted in Figures 2.2-1, 2.2-2, and 2.2-3) will not be set up in the vessel transit lanes and Navy traffic would not interfere with commercial shipping. Recreational activities offshore consist of game and sport fishing, charter boat fishing, sport diving, water skiing, swimming, dolphin and whale watching, sailing, and power cruising (Virginia Tourism Corporation, 2008). Recreational boats range throughout the coastal waters, depending on season and weather conditions. The South Atlantic Region (from Delaware to Florida) maintained 2.5 million registered boats in 2001 (Fishing News, 2002). The number of registered recreational boats and their nationwide ranking for each state bordering the VACAPES OPAREA is:

- North Carolina – 362,784 (ranking 11th nationwide in registered recreational boats)
- Virginia – 245,073 (ranking 19th nationwide in registered recreational boats)
- Maryland – 205,812 (ranking 24th nationwide in registered recreational boats)
- Delaware – 52,119 (ranking 43rd nationwide in registered recreational boats)

(NMMA, 2006; USCG, 2003, USCG, 2005)

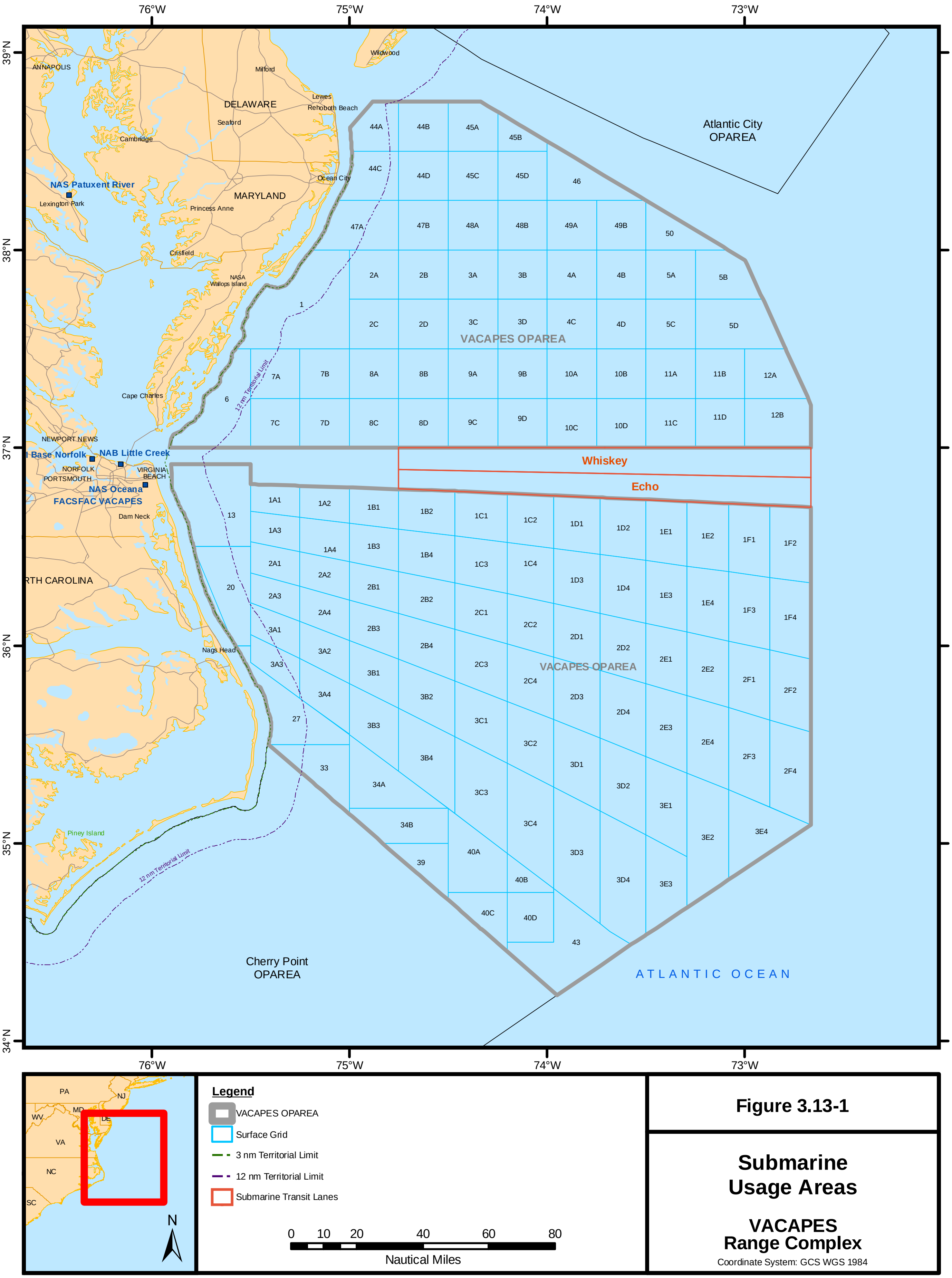


Figure 3.13-1

Submarine Usage Areas

VACAPES Range Complex

Coordinate System: GCS WGS 1984

Sailboats in the 75-foot and larger class, and cruising vessels transiting ocean passages (*e.g.,* from some North Carolina ports to the Bahamas or Bermuda) might favor courses through the vicinity of VACAPES OPAREA. (NMMA, 2007). Commercial used waterways do traverse the VACAPES Range Complex but are controlled by the use of directional commercially used waterways for large vessels (cargo, container ships, and tanker) (Figure 3.13-2). Traffic flow controls are also implemented to ensure that harbors and ports-of-entry remain as uncongested as possible. Military and civilian use of the offshore areas is compatible because naval vessels conducting hazardous operations are confined to areas away from commercially used waterways. Hazardous operations are communicated to all vessels and operators by use of NOTMARs published by the USCG.

Shipwrecks provide habitat suitable for development of artificial reefs, and are popular destinations for divers. Within the VACAPES OPAREA, about 89 shipwrecks are located offshore of North Carolina (Veridian, 2001). Virginia offshore divers are diving for wrecks or artificial reefs, as coral does not occur at this latitude. Popular ship wreck diving destinations occur between 50-160 feet deep (Reef Scuba Accessories, 2007). Despite having several offshore scuba diving locations, (including roughly 525 occurring in the VACAPES OPAREA (Veridian, 2001) in a statewide survey, diving was not given as a significant reason for recreational boating among boat owners (Responsive Management, 2000). Shipwrecks in the VACAPES OPAREA number about 60 offshore of Maryland, 307 offshore of Virginia, and roughly 69 offshore of Delaware (Veridian, 2001).

The VACAPES OPAREA contains submarine transit lanes ECHO and WHISKEY, which are used by submarines transiting submerged (*i.e.,* 98 feet or lower). Submarines entering the surface area (surface down to, but not including, 98 feet) should expect mutual usage of the area. Unless an exclusive surface area clearance has been obtained from FACSFAC VACAPES by the SEAC, surface units may be assigned operations in these areas. FACSFAC VACAPES grants concurrent surface and exclusive subsurface clearances to the SEAC for submarine operations. Under normal circumstances, FACSFAC VACAPES does not communicate with or exercise control over submarines that are in transit or are conducting operations within the VACAPES OPAREA.

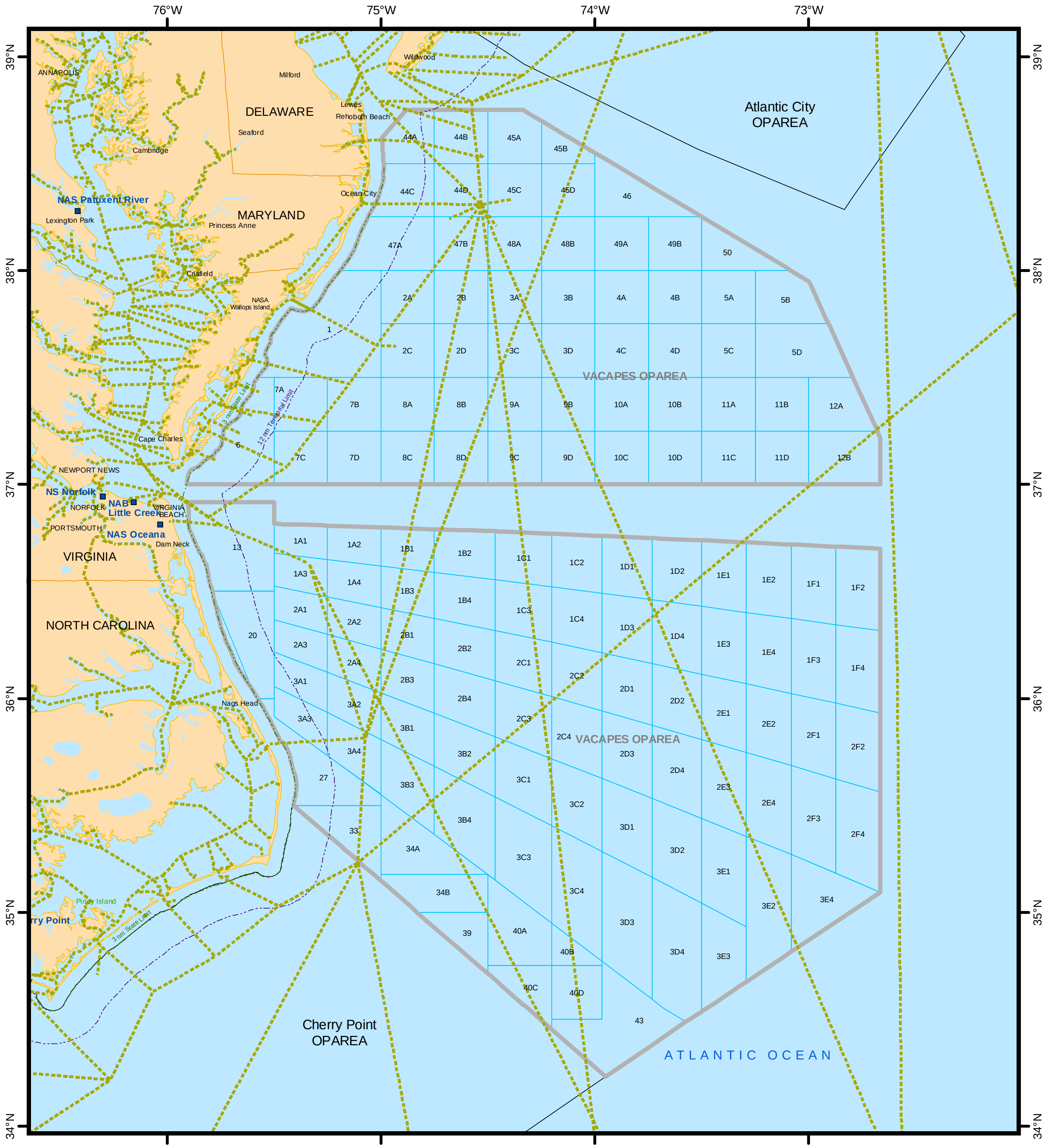
3.13.1.4 Lower Chesapeake Bay

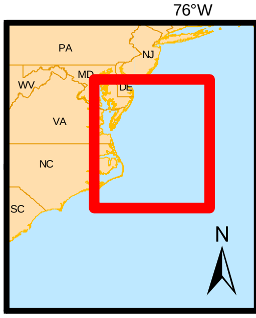
The Lower Chesapeake Bay is home to the Port of Virginia, the third-busiest port facility on the East Coast. In 2005 the port accommodated nearly 16 million short tons of imports and exports, amounting to 20 percent of the total of East Coast maritime trade. The port handled 2,815 vessel calls, an average of about seven per day.

Ships transiting through the Lower Chesapeake Bay area utilize two primary commercially used waterways: the Thimble Shoals Channel, which leads to Hampton Roads, and the Chesapeake Channel, which leads to points north including the Port of Baltimore. These two channels pass over the underwater (tunnel) sections of the Chesapeake Bay Bridge-Tunnel system.

The Chesapeake Bay Bridge-Tunnel crosses the mouth of the Chesapeake Bay and connects the City of Virginia Beach to Cape Charles on the eastern shore. From shore to shore the crossing is 17.6 miles and is supported financially by tolls with an average traffic volume on the Bridge-Tunnel of 9,700 vehicles per day (approximately 10 percent of which are large trucks), reaching 20,000 vehicles per day on busy summer days (Kozel, 2005).

The Bridge-Tunnel facility encompasses approximately 20 miles to accommodate vehicular traffic. The facility provides a link via highway US 13 between Virginia's Eastern Shore and Hampton Roads, Virginia. The crossing consists of a series of low-Thimble Shoals and Chesapeake navigation channels.





Legend

VACAPES OPAREA

Surface Grid

3 nm State Limit

12 nm Territorial Limit

Commercially Used Waterways

Note:
VACAPES OPAREA surface grid coordinates reference:
FACSFAC VACAPES Instruction 3120.1J, (January 2001).

0 12.5 25 50 75 100

Nautical Miles

Figure 3.13-2

Commercially Used Waterways in the Vicinity of the VACAPES Study Area

VACAPES Range Complex

Coordinate System: GCS WGS 1984

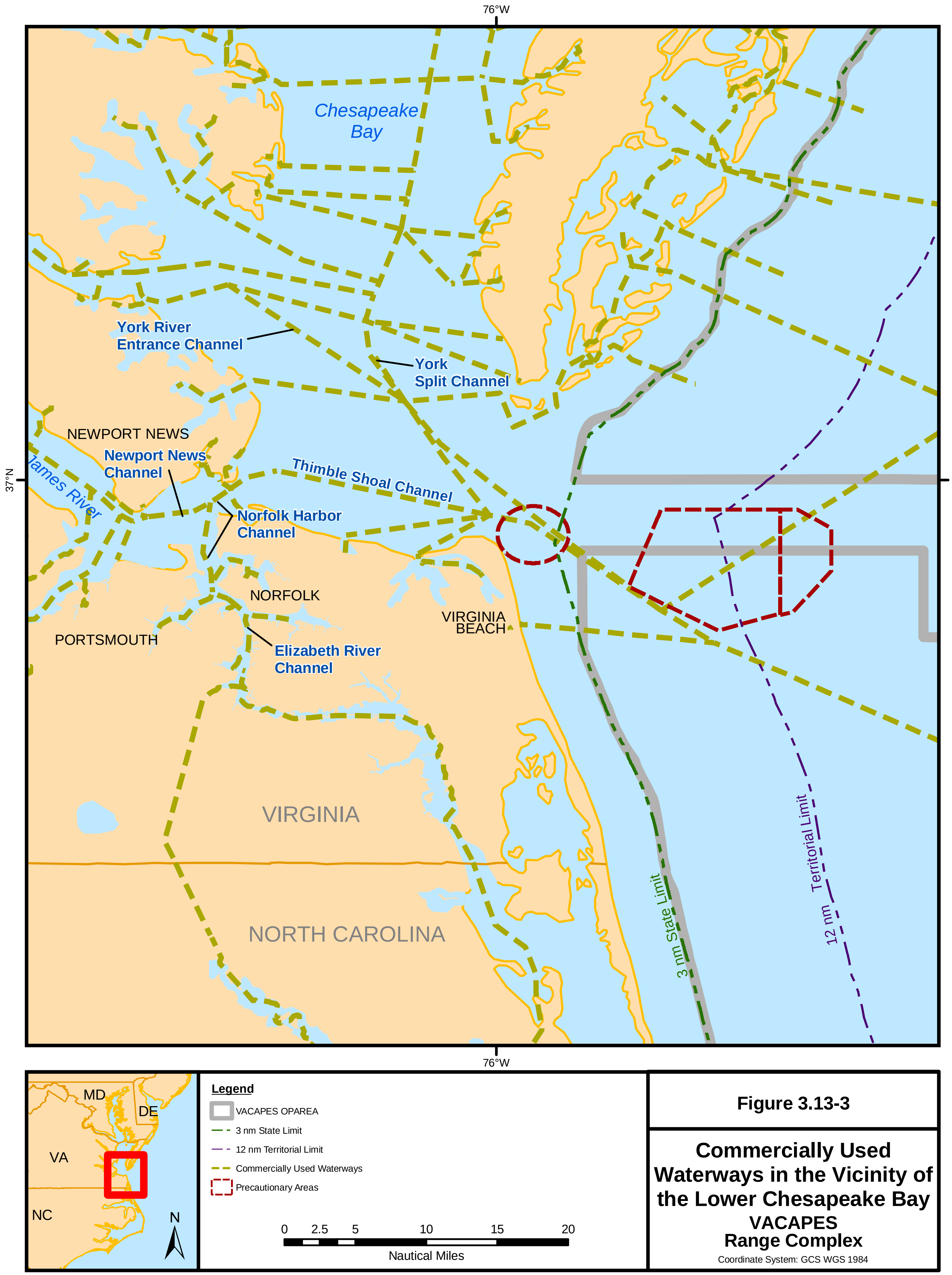


Figure 3.13-3

Commercially Used Waterways in the Vicinity of the Lower Chesapeake Bay

VACAPES Range Complex

Coordinate System: GCS WGS 1984

Two manmade islands (approximately 5.25 acres each) are located on each end of the facility. There are also high level bridges over two other navigation channels: North Channel Bridge and Fisherman Inlet Bridge (CBBT, 2008)

3.13.1.5 Air Traffic

The VACAPES OPAREA airspace covers an area of approximately 28,672 nm^2 of special use airspace over the sea space OPAREA. Requests to schedule the airspace, surface, and subsurface training areas, and hazardous events (those involving firing or dropping ordnance) are coordinated directly with FACSFAC VACAPES. The FACSFAC VACAPES operations schedule is published weekly and lists assigned radio frequencies and area assignment times for events controlled by FACSFAC VACAPES or which involve commercial aircraft. Full and specific guidelines, procedures, and restrictions are provided in FACSFAC VACAPES Instruction 3120.1 Series.

Military

Warning Areas of the VACAPES Range Complex are large blocks of SUA generally overlaying the VACAPES OPAREA from the surface to an unlimited altitude. Operations conducted in these Warning Areas include all weather flight training; Unmanned Aerial Vehicle (UAV) flights; refueling; test flights; rocket and missile firing; bombing; fleet training; independent unit training; anti-submarine warfare; aircraft carrier, ship and submarine operations; and anti-air and surface gunnery. The total operations in these areas were 13,784 in Fiscal Year 2003 (the baseline year for operations). The Warning Areas of the VACAPES Range Complex include Warning Area W-50A/B/C; W-72A/B, W-110, W-386A/B/C/D/E/F/G/H/I/J; and W-387A/B (Figure 1.1-1).

FACSFAC VACAPES is the principal controlling authority for the VACAPES Range Complex. FACSFAC is in essence an air traffic control facility that coordinates closely with the FAA to ensure control of SUA that consists of warning areas and restricted areas, military operating areas, air traffic control assigned airspace, and surface/subsurface operating areas. FACSFAC VACAPES is located at NAS Oceana and has responsibility for the following activities and procedures:

- Schedule, coordinate, and provide range control for surface and airborne missile firing exercises.
- Coordinate, schedule, and oversee associated commercial and military aircraft services support.
- Act as Regional Airspace Coordinator for DoN activities and the FAA.
- Provide full air traffic control services by direct interface with FAA and military/civil approach controls.

FACSFAC VACAPES has authority to coordinate services and firing notices, issue weekly target and OPAREA schedules, and prescribe necessary additional regulations governing matters within the VACAPES Range Complex. They provide the Atlantic Fleet with surveillance and functional area support services to include scheduling, monitoring, and controlling DoD air, surface and subsurface units operating in the Study Area for the VACAPES EIS/OEIS. As a designated Air Traffic Control facility, FACSFAC VACAPES is required to provide air traffic separation consistent with FAA guidelines to ensure the safe, efficient, expeditious flow of air traffic. Radar surveillance and radio communications assists in providing area containment and air traffic control separation between high-performance military aircraft and the high volume of commercial aircraft transiting the numerous jet routes along the Atlantic coast.

Military aircraft originating from NAS Oceana are controlled by FACSFAC VACAPES upon entering VACAPES airspace. Aircraft transiting from other areas are under control of the appropriate Air Route Traffic Control Center (ARTCC) prior to transiting into VACAPES airspace. Clearance is provided to the appropriate ARTCC for those aircraft transiting the VACAPES airspace using a grid system.

The Atlantic Fleet Exercise Coordination Center (AFECC) is a component of FACSFAC VACAPES responsible for performing as the single point of contact for scheduling and coordinating all fleet training exercises. The AFECC coordinates and schedules airspace, sea space, targets, electronic warfare services, and other assets for all large scale exercises. AFECC is responsible for the coordination of operational area assignments, ranges, airspace, mobile sea range (MSR) assets, fixed and mobile targets, Large Area Tracking Range (LATR), electronic attack, and commercial air services. AFECC coordinates with all DoD, government and civilian agencies to ensure compliance with all requirements and regulations for the safe use of ranges, assets, and services. Offshore SUA within the VACAPES Range Complex is summarized in Table 2.1-1 and depicted in Figure 1.1-1 and described in the following paragraphs. Table 2.2-1 depicts the current usage of these areas (DoN, 2006).

W-72 is airspace assigned by FACSFAC VACAPES using an air grid system. Airspace not in use for warning area activities is released to the FAA on a real-time basis. Any altitudes not being used by the military may be released to the FAA. Activities conducted in the area include tactical air combat training, exclusive air operations, basic flight maneuvers, Missile Exercise (MISSILEX), Tracking Exercise (TRACKEX), electronic warfare, air recovery, surveillance, carrier flight operations, carrier fly off, submarine warfare, air intercept control, balloon, chaff, photo, tactical air launch decoy, search and rescue, bombing exercises, law enforcement operations, and air-to-air refueling. Refer to Appendix D for detailed descriptions of these training events (DoN, 2006).

W-110 is SUA located offshore over surface areas 27, 33, 34, 39, 40, and 43 of the VACAPES OPAREA. FACSFAC VACAPES retains W-110 on a continuous basis and is the sole provider of control services in the area. This area is neither requested nor released to FAA. This area is subject to 15 minute deactivation by FACSFAC VACAPES to facilitate airway traffic at altitudes FL230 and below traveling on Atlantic Route 8. Additionally, FACSFAC VACAPES can coordinate altitudes above FL230 from FAA, if required. Activities conducted in the area include carrier flight operations, search and rescue, law enforcement operations, and transition between warning areas (DoN, 2006).

Restricted Area (R-) 6606 and W-50 are associated with the Dam Neck Range and are located approximately 5 nm east of the NAS Oceana TACAN between the coast at NAS Oceana Dam Neck Annex and the 3 nm territorial sea limit. The airspace encompasses the surface to FL510. Airspace not used for military activities may be released to NAS Oceana Approach Control and FAA Washington Center on a real-time basis. Activities conducted within R-6006 include parachute drops, Research, Development, Test, and Evaluation (RDT&E), drone transit and recovery, exclusive air operations, remotely piloted vehicle operations, and anti-submarine tactical air control (DoN, 2006).

W-386 has been subdivided by FACSFAC VACAPES into sub-areas AIR-A through AIR-K. In addition, FACSFAC VACAPES has stabled three test tracks (A, B, and C), two air corridors (VICTOR and LANGLEY), and six ingress/egress points (ATLIC, OUTES, DART, HEELS, TRAXX, and HORNT). Airspace not in use for warning area activities may be released to the FAA on a real-time basis. Air-to-air, air-to-surface, surface-to-air, and surface-to-surface missile exercises, gunnery exercises, and rocket exercises using conventional ordnance may be authorized in W-386. Activities conducted in the area include ACM, tactical air combat training, exclusive air operations, carrier flight operations, carrier fly off, balloon, chaff, photo, remotely piloted vehicles, tactical air-launched decoy, surface-to-surface and surface-to-air gunnery, and air-to-air refueling (DoN, 2006).

W-387 A/B is retained by FACSFAC VACAPES on a continuous basis and is the sole provider of control services in the area. FACSFAC VACAPES also controls all inbound/outbound Atlantic Route 9 traffic. Activities conducted in W-387 A/B include carrier flight operations, carrier fly off, air-to-air refueling, airborne warning and control, search and rescue, law enforcement operations, and area transits. No ordnance is authorized (DoN, 2006).

Civilian

Close coordination between military and civilian air traffic control facilities enables effective, real-time, joint use of the VACAPES Range Complex warning areas. Under these procedures, regardless of the schedule for the use of a military warning area, civilian aircraft may use warning area airspace, until a military aircraft is actually enroute to that area. FACSFAC VACAPES has the responsibility to ensure civilian air carrier transit of SUA does not conflict with DoD operations and training. Civilian aircraft operating under IFR clearances, authorized by the Washington ARTCC, normally fly on formal airway route structures. The Washington Control Center is the fifth busiest Air Traffic Control Center in the United States, handling nearly 5 million flights during 2004-2005, and covering an area of 165,000 square miles (DoN, 2006).

All airspace outside the territorial limits is located in international airspace. Because the offshore airspace use Study Area is in international airspace, the procedures outlined in International Civil Aviation Authority (ICAO) Document 444, *Rules of the Air and Air Traffic Services* are followed. The FAA acts as the U.S. agent for aeronautical information to the ICAO, and air traffic in the over-water Study Area is managed by the Washington ARTCC.

3.13.1.6 Range Safety Procedures

All range safety precautions and regulations contained in Commander, in Chief, U.S. Atlantic Fleet (CINCLANTFLT) Instruction 3120.26, "Atlantic Fleet Operating Areas and Warning Areas," apply in the VACAPES OPAREA. In addition, FACSFAC VACAPES imposes additional safety requirements. The following general rules apply to area clearances within FACSFAC VACAPES OPAREA:

- Dropping any ordnance, live or inert, or explosive fire is considered a hazardous event. All hazardous or exclusive operations and exercises conducted in the FACSFAC VACAPES OPAREA require clearance from FACSFAC VACAPES.
- The firing or dropping of ordnance must be scheduled with FACSFAC VACAPES. Firing exercises are not authorized without prior FACSFAC VACAPES approval.
- Small arms (munitions .50 caliber and under) qualifications on ships do not require FACSFAC VACAPES approval. The unit conducting small arms fire is responsible for clearing their area.
- Non-hazardous/concurrent air, surface and subsurface operations, such as independent steaming exercise transits, navigation drills, deck landing qualifications, and helicopter operations do not require a specific clearance/message request.
- Flare drops are considered a non-hazardous event, but all airborne/surface units must contact FACSFAC VACAPES prior to dropping flares to prevent errant search-and-rescue reporting.
- Publications of NOTMARs and NOTAMs by the USCG and FAA. The Navy provides information about potentially hazardous activities planned for the VACAPES Range Complex.

3.13.2 Environmental Consequences

The traffic analysis addresses air and ocean traffic in the VACAPES EIS/OEIS Study Area. The principal issue is the potential for existing or proposed military air or vessel traffic to affect existing transportation conditions. Impacts on traffic are considered with respect to the potential for disruption of transportation pattern and systems, and changes in existing levels of transportation safety.

Impacts to air traffic might occur if an alternative has potential to result in an increase in the number of flights that could be accommodated within established operational procedures and flight patterns; requires airspace modification; or results in an increase in air traffic that might increase collision potential between military and non-participating civilian operations.

Impacts on ocean vessel traffic might occur if the extent or degree to which an alternative would seriously disrupt the flow of commercial surface shipping or recreational fishing or boating. A serious disruption occurs when a vessel is unable to proceed to its intended destination due to exclusion from areas in the VACAPES Range Complex. However, the need to use alternative routes during the time of exclusion does not constitute a serious disruption.

3.13.2.1 No Action Alternative

Both military and non-military entities have been sharing the use of the airspace and ocean surface that encompasses the VACAPES Range Complex for more than 30 years. Military, commercial, and general aviation activities have established an operational co-existence consistent with federal, state, and local plans and policies and compatible with each interest's varying objectives. The No Action Alternative includes training and testing operations that are and have been routinely conducted in the area for decades. Ongoing, continuing operations identified in this EIS/OEIS will continue to use the existing offshore OPAREA and Warning Areas. Although the nature and intensity of use varies over time and by individual area, the continuing training operations represent precisely the kinds of operations for which these areas were created (*i.e.,* those that present a hazard to other vessels).

Currently the Navy uses the VACAPES OPAREA for 1,400 steaming days per year. There are 5,966 annual fixed-wing and 1,743 helicopter sorties in the OPAREA. None of the alternatives include proposed airspace modifications and would not change the existing relationship of the Navy's Special Use Airspace with federal airways, uncharted visual flight routes, and airport related air traffic operations.

FACSFAC VACAPES is the principal controlling authority for activities within the VACAPES Range Complex. Through close coordination with the FAA, FACSFAC VACAPES ensures that hazardous activities are carefully scheduled to avoid conflicts with civilian activities and safety standards are maintained while allowing the maximum amount of civilian access to airspace and sea space.

The stressors from proposed activities that would likely impact transportation activities stem from increases in vessel movement, aircraft overflights, military expended materials, and the associated increase in training activities; however, conflicts in the VACAPES Range Complex are handled through a single point of contact system that ensures the needs of both the military and civilian sectors are met. Military activities are either scheduled or announced ahead of execution or take place in an area that is designated for exclusive military use.

Implementation of the No Action Alternative would have no impact on transportation resources in U.S. Territory. Further, implementation of the No Action Alternative would not cause harm to transportation resources in non-territorial waters.

3.13.2.2 Alternative 1

The Navy can accomplish the proposed activities associated with Alternative 1 without modifications or need for additional designated ocean or airspace. Alternative 1 includes introduction of Organic Mine Countermeasures (OMCM) operations that would result in additional restrictions to civilian traffic during OMCM operational periods. The addition of OMCM to the current Mine Countermeasures Exercises conducted in the VACAPES OPAREA would likely result in an additional 20 steaming days per year that the Navy would be operating in the training area and that civilians might be restricted from the existing operational areas. This is a 1.4 percent increase from the current conditions.

The proposed increase in training operations, force structure changes, and enhanced range capabilities associated with implementation of Alternative 1 do not significantly impact sea or ocean space transportation in or near the VACAPES Study Area.

Implementation of Alternative 1 would have no impact on transportation resources in U.S. Territory. Further, implementation of Alternative 1 would not cause harm to transportation resources in non-territorial waters.

3.13.2.3 Alternative 2 (Preferred Alternative)

The potential impacts to transportation assets associated with implementation of Alternative 2 would be similar to those described for Alternative 1. Alternative 2 includes implementation of Alternative 1 with additional increases in operations (see Table 2.2-4), with the exception of an 85 percent decrease in HE bombs dropped, and designation of Mine Warfare Training Areas within the VACAPES Study Area to provide additional support during training events. There is an expected increase of 20 steaming days per year due to Navy training. This is a 1.4 percent increase over the current time spent in the OPAREA. The placement of both temporary and permanent non-explosive mine shapes on or near the sea floor would not pose a navigation or fishing hazard. Mooring lines would only be left in place for as long as the mine shape is in the water (Section 2.2.5).

Implementation of Alternative 2 would have no impact on transportation resources in U.S. Territory. Further, implementation of Alternative 2 would not cause harm to transportation resources in non-territorial waters.

3.13.3 Unavoidable Significant Environmental Effects

There are no unavoidable significant environmental effects as a result of implementation of the No Action Alternative, Alternative 1, or Alternative 2.

3.13.4 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.14-2, the environmental effects of the No Action Alternative, Alternative 1, and Alternative 2 on transportation would have no impact.

TABLE 3.13-2
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON TRANSPORTATION IN THE VACAPES RANGE COMPLEX

Alternative and Stressor	NEPA (U.S. Territory)	EO 12114 (Non-Territorial Waters, >12 nm)
No Action		
Vessel Movements (Disturbance) Aircraft Overflights (Disturbance) Military Expended Materials	Military, commercial, and general aviation activities have established an operational co-existence consistent with federal, state, and local plans and policies and compatible with each interest's varying objectives. Activities under the No Action Alternative include activities that are and have been routinely conducted in the area for decades.	Military, commercial, and general aviation activities have established an operational co-existence consistent with federal, state, and local plans and policies and compatible with each interest's varying objectives. Activities under the No Action Alternative include activities that are and have been routinely conducted in the area for decades.
Impact Conclusion	Implementation the No Action Alternative would have no impact on transportation resources in U.S. Territory.	Implementation of the No Action Alternative would not cause harm to transportation resources in non-territorial waters.
Alternative 1		
Vessel Movements (Disturbance) Aircraft Overflights (Disturbance) Military Expended Materials	The Navy can accomplish the proposed activities associated with Alternative 1 without modifications or need for additional designated ocean or airspace. The increased training operations do not conflict with any airspace use plans, policies, and controls.	The Navy can accomplish the proposed activities associated with Alternative 1 without modifications or need for additional designated ocean or airspace. The increased training operations do not conflict with any airspace use plans, policies, and controls.
Impact Conclusion	Implementation Alternative 1 would have no impact on transportation resources in U.S. Territory.	Implementation of Alternative 1 would not cause harm to transportation resources in non-territorial waters.
Alternative 2		
Vessel Movements (Disturbance) Aircraft Overflights (Disturbance) Military Expended Materials	The Navy can accomplish the proposed activities associated with Alternative 2 without modifications or need for additional designated ocean or airspace. The increased training operations do not conflict with any airspace use plans, policies, and controls.	The Navy can accomplish the proposed activities associated with Alternative 2 without modifications or need for additional designated ocean or airspace. The increased training operations do not conflict with any airspace use plans, policies, and controls.
Impact Conclusion	Implementation Alternative 2 would have no impact on transportation resources in U.S. Territory.	Implementation of Alternative 2 would not cause harm to transportation resources in non-territorial waters.

3.14 DEMOGRAPHICS

3.14.1 Introduction and Methods

Demographics were assessed through the identification and evaluation of population trends, age, race and ethnicity, poverty levels, and education. The study area for demographics included the states of Delaware, Maryland, Virginia, and North Carolina.

3.14.1.1 Assessment Methods and Data Used

This section was prepared primarily by compiling and evaluating existing information supplied by the U.S. Census Bureau (Census Bureau), state and local governmental agencies, and local organizations as shown in the reference section.

People do not live within the VACAPES Range Complex in non-territorial waters more than 12 nm from the shore. Therefore, demographics were considered only from a NEPA perspective and were not evaluated in accordance with EO 12114.

Impacts to demographics were assessed in terms of their direct effects on populations and indirect effects on related social resources such as housing. The level of significance of impacts can vary depending on the location of a proposed action. For example, if an action would create 10 jobs in an urban setting, the impact may not be noticeable, but the creation of the same 10 jobs might have significant impacts in a rural region. If an alternative would result in substantial shifts in population trends, or substantially change regional spending and earning patterns, it would be significant.

3.14.1.2 Warfare Areas and Associated Environmental Stressors

Aspects of the proposed actions likely to act as stressors to demographics were identified by conducting a detailed analysis of the warfare areas, operations, and specific activities included in the alternatives. No potential stressors to demographics were identified.

3.14.2 Affected Environment

Population Trends

During the period April 1, 2000 to July 1, 2006:

- The population of Delaware increased by 8.9 percent;
- Maryland population increased by 6.0 percent;
- Virginia population increased by 8.0 percent;
- North Carolina increased by 10.1 percent; and
- The population of the United States experienced a 6.5 percent increase (U.S. Census Bureau, 2007).

In the United States, there were 355,866 Navy and Marine Corps personnel in active duty military installations in 2002 (the latest year reported by the U.S. Census Bureau). Delaware had 17 Maryland had 15,853, Virginia had 52,120, and North Carolina had 43,522. Civilian personnel affiliated with the Navy and Marine Corps on military installations in 2002 included 177,695 in the United States, none in Delaware, 15,524 in Maryland, 34,492 in Virginia, and 7,281 in North Carolina (U.S. Census Bureau, 2003).

Age Structure

The latest year for which age distribution data are available is 2005. In that year:

- In Delaware, 6.6 percent of the population was under the age of 5, 23.2 percent was under the age of 18, and 13.3 percent was over the age of 65.

- Maryland had 6.8 percent of the population under the age of 5, 25.1 percent under the age of 18, and 11.5 percent over the age of 65.
- Virginia's population under the age of 5 was 6.8 percent, 24.1 percent was under the age of 18, and 11.4 percent was over the age of 65.
- North Carolina had 7.0 percent of the population under the age of 5, 24.7 percent under the age of 18, and 12.1 percent over the age of 65.
- The age distributions for states near the VACAPES study area were similar to those of the entire United States, which included 6.8 percent under the age of 5, 24.8 percent under the age of 18, and 12.4 percent over the age of 65 (U.S. Census Bureau, 2007).

Race and Ethnicity

Table 3.14-1 shows the self-reported race and ethnicity of residents of the states of Delaware, Maryland, Virginia, and North Carolina, and the entire the United States. Totals would exceed 100 percent because of individuals reporting race and ethnicity in multiple categories (for example, reporting in both "white" and "white, not Hispanic"). The populations of each state show the same high diversity of the entire nation, but with somewhat higher percentages of the populations in all fours states identifying themselves as Black, and somewhat lower percentages identifying themselves as White, Hispanic, or Latino.

TABLE 3.14-1
RACE AND ETHNICITY FOR STUDY AREA STATES

Race/Ethnicity	Delaware (percent)	Maryland (percent)	Virginia (percent)	North Carolina (percent)	United States (percent)
White	74.9 [a/]	64.0	73.6	74.1	80.2
Black	20.7	29.3	19.9	21.8	12.8
American Indian or Alaska Native	0.4	0.3	0.3	1.3	1.0
Asian	2.7	4.8	4.6	1.8	4.3
Native Hawaiian and other Pacific islander	0.1	0.1	0.1	0.1	0.2
Persons reporting 2 or more races	1.4	1.5	1.6	1.0	1.5
Hispanic or Latino origin	6.0	5.7	6.0	6.4	14.4
White, not Hispanic	69.6	59.2	68.2	68.3	66.9

a/ Source: U.S. Census Bureau, 2007. All values are from 2005.

Poverty Levels

The percent of the population living below the poverty level in the United States and in the states of Delaware, Maryland, Virginia, and North Carolina is provided in Table 3.14-2. By this measure, residents of Delaware, Maryland, and Virginia are doing better than average economically, but North Carolina had a greater proportion of residents in poverty than the national average.

TABLE 3.14-2
PERCENT OF POPULATION WITH INCOMES BELOW THE POVERTY LEVEL

Delaware (percent)	Maryland (percent)	Virginia (percent)	North Carolina (percent)	United States (percent)
9.6 [a/]	9.2	9.5	13.8	12.7

a/ Source: U.S. Census Bureau, 2007. All values are from 2004.

Education

In the year 2000, the percentage of households in Delaware that spoke a primary language other than English was 9.5 percent. Maryland households that spoke a primary language other than English totaled

12.6 percent. In Virginia, the value was 11.1 percent and in North Carolina, it was 8.0 percent. The percentage of households in the United States that spoke a language other than English as the primary household language was 17.9 percent.

Except in North Carolina, the education levels achieved by residents are better than those of the United States population.

- In Delaware, 82.6 percent of the population graduated from high school and 25 percent held a bachelor's degree or higher.
- In Maryland, 86.4 percent of the population graduated from high school and 30.6 percent held a bachelor's degree or higher.
- In Virginia, 81.5 percent of the population graduated from high school and 29.5 percent held a Bachelor's degree or higher.
- In North Carolina, 78.1 percent of the population graduated from high school and 22.5 percent held a bachelor's degree or higher.
- In the United States, 80.4 percent of the population graduated from high school and 24.4 percent held a bachelor's degree or higher (U.S. Census Bureau, 2007).

3.14.3 Environmental Consequences

Impacts to demographics were assessed in terms of their direct effects on local populations and related effects such as jobs and education within the study area. Demographic impacts would be significant if an alternative resulted in a substantial shift in factors such as population trends, job availability, or community concerns such as poverty and education.

3.14.3.1 No Action Alternative

The No Action Alternative would continue current Navy practices and operations, including surge operations consistent with the Fleet Readiness Training Plan. Training activities conducted within the VACAPES Study Area would continue at current levels, as shown in Table 2.2-4. This alternative would not result in changes to either the local population or job availability; therefore, there would not be any impacts to demographics.

3.14.3.2 Alternative 1

Alternative 1 would not require the basing or relocation of additional personnel within the study area. The features of Alternative 1 that would increase or modify training operations and implement force structure changes would be achieved within current staffing levels of the installations that support the range complex. As a result, none of the Alternative 1 elements would result in a change to demographics within the study area. There would not be any shifts in population trends; age, race, or ethnicity distribution; poverty levels; or education.

3.14.3.3 Alternative 2 (Preferred Alternative)

Alternative 2 would not result in any personnel changes within the study area. The features of Alternative 2 that would increase or modify training operations and implement force structure changes would be achieved within current staffing levels of the installations that support the Range Complex. This would include the installation and use of additional mine warfare training areas in the lower Chesapeake Bay. As a result, none of the Alternative 2 elements would result in a change to demographics within the Study Area. There would not be any shifts in population trends; age, race, or ethnicity distribution; poverty levels; or education.

3.14.4 Unavoidable Significant Environmental Effects

There would not be any unavoidable significant environmental effects as a result of implementation of the No Action Alternative, Alternative 1, or Alternative 2.

3.14.5 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.14-3, the No Action Alternative, Alternative 1, and Alternative 2 would not have substantial environmental impacts on demographics.

TABLE 3.14-3
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON DEMOGRAPHICS IN THE VACAPES STUDY AREA

Alternative and Stressor	NEPA (Territorial Waters, 0 to 12 nm)	EO 12114 (Non-Territorial Waters, >12 nm)
No Action Alternative		
None	No impact on demographic characteristics such as population trends; age, race, or ethnicity distribution; poverty levels; or education.	Not evaluated because this region is outside the demographics study area.
Impact conclusion	No impact on demographics in U.S. territory.	Not evaluated because this region is outside the demographics study area.
Alternative 1		
None	No impact on demographic characteristics such as population trends; age, race, or ethnicity distribution; poverty levels; or education.	Not evaluated because this region is outside the demographics study area.
Impact conclusion	No impact on demographics in U.S. territory.	Not evaluated because this region is outside the demographics study area.
Alternative 2		
None	No impact on demographic characteristics such as population trends; age, race, or ethnicity distribution; poverty levels; or education.	Not evaluated because this region is outside the demographics study area.
Impact conclusion	No impact on demographics in U.S. territory.	Not evaluated because this region is outside the demographics study area.

3.15 Regional Economy

3.15.1 Introduction and Methods

Regional economy is assessed through evaluation of economic factors including industry, commercial fishing, tourism, and recreational fishing. The study area for assessment of the regional economy includes the states of Delaware, Maryland, Virginia, and North Carolina.

3.15.1.1 Assessment Methods and Data Used

This section was prepared primarily by compiling and evaluating existing information supplied by the U.S. Census Bureau, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), state and local governmental agencies, and local organizations as shown in the reference section. Data were collected on commercial fishery landings, types of fishing gear used, and fishing effort. NMFS collects data regarding fisheries, target species, landed tonnage, and gear types by state. It is important to note that the state boundaries and borders of the operating areas (OPAREA) are not congruent and as a result some state information is not relevant to the discussion of the individual OPAREAs.

People do not live within the VACAPES Range Complex in non-territorial waters more than 12 nm from the shore. Therefore, regional economics were considered only from a NEPA perspective and were not evaluated in accordance with EO 12114.

3.15.1.2 Warfare Areas and Associated Environmental Stressors

Impacts to the regional economy were assessed in terms of their direct effects on the local economy sectors of industry, commercial fishing, tourism, and recreational fishing. If significant direct effects were found, the analysis would be expanded to consider indirect effects to related socioeconomic resources, such as earnings, income, and transportation). If impacts would result in substantial shifts in earning, spending, or access trends, such that they would affect regional spending and earning patterns, they would be important. Such impacts might be experienced if commercial or recreational activities were denied access to areas where they previously had occurred, or if substantial additional areas were opened to these activities.

Stressors to the regional economy would include changes in intensity or duration of training activities that would affected the abilities of recreational or commercial boaters and fishermen to harvest in areas and at levels of production that have traditionally done so. Table 3.15-1 depicts aspects of the proposed actions that are likely to act as stressors to the regional economy. These stressors were identified by conducting a detailed analysis of the warfare areas, operations, and specific activities included in the alternatives.

3.15.2 Affected Environment

3.15.2.1 Industry

The 2002 U.S. Census indicates that the greatest numbers of establishments in the United States were in the retail trade industry. The states of Delaware, Maryland, Virginia, and North Carolina reflect that trend, with the retail trade industry leading the states with the greatest numbers of establishments (3,727, 19,394, 28,914, and 35,851 respectively).

The commercial fishing industry was included in the category of “other services (except public administration).” The fishing industry, which is the industry most likely to be affected by the alternatives analyzed in this EIS/OEIS, is not among the most lucrative industries in the study area. Of the top ten industries for the states adjacent to the study area, “Other Services” (of which fishing is a sub-category) appeared to consistently rank 4th or 5th in number of establishments. Specifically, in Delaware it ranked

5th with 1,626, in Maryland it ranked 4th with 10,217, in Virginia it ranked 5th with 14,583, and in North Carolina it ranked 5th with 13,826).

TABLE 3.15-1
SUMMARY OF POTENTIAL STRESSORS TO REGIONAL ECONOMY RESOURCES

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Aircraft Overflights (Disturbance)	Military Expended Materials
Mine Warfare (MIW)				
Mine countermeasures exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓
Mine countermeasures exercise (MCM)	W-50A/C, W-386, W-72	✓	✓	✓
Mine neutralization	W-50C	✓	✓	✓
Surface Warfare (SUW)				
Bombing exercise (air-to-surface) (at sea)	W-386 (Air-K), W-72A (Air-3B), W-72A/B	✓	✓	✓
Missile exercise (MISSILEX) (air-to-surface)	W-386 (Air-K), W-72A	✓	✓	✓
Gunnery exercise (GUNEX) (air-to-surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C	✓	✓	✓
GUNEX (surface-to-surface) boat	W-50C, R-6606	✓	✓	✓
GUNEX (surface-to-surface) ship	W-386, W-72	✓	✓	✓
Laser targeting	W-386 (Air-K)	✓	✓	
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- Ship	VACAPES OPAREA	✓		
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓	
Air Warfare (AW)				
Air combat maneuver (ACM)	W-72A (Air-2A/B, 3A/B)		✓	
GUNEX (air-to-air)	W-72A		✓	✓
MISSILEX (air-to-air)	W-386 (Air D, G, H, K), W-72A		✓	✓
GUNEX (surface-to-air)	W-386, W-72	✓	✓	✓
MISSILEX (surface-to-air)	W-386 (Air D, G, H, K)	✓	✓	✓
Air intercept control (AIC)	W-386, W-72	✓	✓	✓
Detect to engage (DTE)	W-386, W-72	✓	✓	✓
Strike Warfare (STW)				
HARM missile exercise	W-386 (Air E, F, I, J)		✓	✓

TABLE 3.15-1
SUMMARY OF POTENTIAL STRESSORS TO REGIONAL ECONOMY RESOURCES (Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Aircraft Overflights (Disturbance)	Military Expended Materials
Amphibious Warfare (AMW)				
FIREX with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓		✓
Electronic Combat (EC)				
Chaff exercise - aircraft	W-386, W-386 (Air-K), W-72	✓	✓	✓
Chaff exercise - ship	W-386, W-72	✓	✓	✓
Flare exercise - aircraft	W-386, W-386 (Air-K), W-72		✓	✓
Electronic combat (EC) operations - aircraft	W-386 (Air-K)		✓	
EC operations - ship	VACAPES OPAREA	✓		
Test and Evaluation				
Shipboard Electronic Systems Evaluation Facility (SESEF) utilization	VACAPES OPAREA	✓		

The United States cruise industry has experienced steady growth in numbers of passengers, with an average, annual growth from 1980 to 2004 of 8.2 percent (CLIA, 2005). The cruise industry contributed $35.7 billion to the United States economy in 2006. The total income generated by the cruise industry in 2006 included purchases of goods and services (such as air transportation, food and beverages, and ship maintenance and refurbishment) and cruise line and port operations. From this source, Delaware annually realizes an income of about $10 million, Maryland realizes an income of $101 million, Virginia realizes an income of $122 million, and North Carolina realizes an income of $108 million (CLIA, 2006).

3.15.2.2 Commercial Fishing

The Mid-Atlantic Fishery Management Council (MAFMC) is responsible for management of fisheries in federal waters that occur predominately off the mid-Atlantic coast. Delaware, Maryland, Virginia, and North Carolina are some of the states with voting representation on the council.

The MAFMC develops fishery management plans (FMP) to aid in the process of managing and conserving fisheries within council purview. Fishery management practices are in force for several fisheries and are applicable both to commercial and recreational fishing.

The objectives of the FMPs vary, but they are generally geared toward ensuring the long-term sustainability of the subject fish species and meeting specific management goals. FMPs generally utilize geographic and seasonal fishery closures, catch limits and quotas, size and age limits, gear restrictions, and access controls to manage the fishery resources.

The MAFMC has developed six FMPs to promote the long-term health and stability of the managed fisheries (MAFMC, 2007). These FMPs include the following fisheries:

- Atlantic mackerel, squid, and butterfish;
- Bluefish;
- Dogfish;
- Atlantic surfclam and ocean quahog;
- Summer flounder, scup, and black sea bass; and
- Tilefish.

Additional FMPs are in place for certain highly migratory species. These are applicable in federal waters off the North Carolina coast and include the following species (NMFS Final Consolidated Atlantic Migratory Species Fishery Management Plan, 2006):

- Atlantic swordfish;
- Atlantic tuna;
- Atlantic sharks; and
- Atlantic billfish.

Both the MAFMC and the South Atlantic Fishery Management Council (SAFMC) manage fisheries in federal waters off the coast of North Carolina. FMPs developed by the SAFMC (SAFMC, 2007) that apply to North Carolina include the following fisheries:

- South Atlantic snapper/grouper;
- Coastal migratory pelagics (mackerels);
- Shrimp fishery;
- Spiny lobster;
- Golden crab;
- Coral, coral reefs, and live/hard bottom habitat;
- *Sargassum;*
- Dolphin/wahoo; and
- Habitat.

3.15.2.3 State Landings

The National Marine Fisheries Service (NMFS) incorporates commercial landing data into the NMFS Statistics and Economics Division databases. Sources include comprehensive surveys of all coastal states' landings through a system of cooperative state and federal collection systems. The data include landing weighout reports, state-mandated fishery or mollusk trip-tickets from seafood dealers, shipboard and portside interviews, federal logbooks of fishery catch and effort, and biological sampling of catches (NMFS, 2007d).

The NMFS Fisheries Statistics Division collects data and coordinates data collection efforts with state and federal agencies. Data are collected through a multi-survey method that includes telephone surveys of households and for-hire boat operators, shore fishers, and state and federal data collection programs. Collected statistics are then integrated and disseminated through databases that are made available to other agencies and the public. Landing data do not indicate location of harvest, as species may be taken offshore from another state, but reported in the state in which the fishermen landed.

Delaware

As shown in Table 3.15-2, the annual commercial landings and associated revenues in Delaware have been declining. The 7,140,238 pounds (worth $7,660,123) that were produced in 2001 decreased to a low of 4,287,586 pounds (valued at $5,418,902) in 2004. The average over the five-year period was 5,431,349 pounds worth an annual average of $6,092,851.

There are no major ports that report commercial fishery landings for the State of Delaware. The NMFS Fisheries Statistics and Economics Division (NMFS, 2007f) reports that for the year 2006:

- Delaware had 705,000 pounds of fish harvested (valued at $1,059,000) within 0 to 3 miles from the shore.
- Shellfish harvested within 0 to 3 miles from the Delaware shore equaled 3,553,000 pounds (valued at $4,314,000).
- The 2006 Delaware harvest of fish from 3 to 200 miles from shore was 103,000 pounds (valued at $196,000).
- The shellfish harvest from 3 to 200 miles was 20,000 pounds (valued at $123,000).
- Neither fish nor shellfish had a reportable harvest on the high seas.

TABLE 3.15-2
DELAWARE COMMERCIAL LANDINGS (2001-2005), ALL SPECIES [a/]

Year	Pounds	Dollars
2001	7,140,238	$7,660,123
2002	5,857,268	$6,066,848
2003	5,017,922	$5,204,088
2004	4,287,586	$5,418,902
2005	4,853,732	$6,114,293
Total	27,156,746	$30,464,254

a/ Source: NMFS, 2007e.

Maryland

Maryland annual commercial landings during the years 2001 through 2005 fluctuated, with a substantial year 2005 increase after decreases for the years 2003 and 2004 (Table 3.15-3). The annual weight averaged 55,018,522 pounds, with associated average revenue of $53,321,551.

The only major port reporting commercial fishery landings for the State of Maryland was Ocean City. In 2006, there were 10.3 million pounds of commercial harvest that resulted in revenue of $13.3 million. Comparatively, in 2001, Ocean City reported a commercial harvest of 13.2 million pounds and revenue of $8.6 million.

The NMFS reports that for the year 2006:

- Maryland had 11,487,000 pounds of fish harvest (valued at $7,925,000) within 0 to 3 miles from the shore.
- Shellfish harvested within 0 to 3 miles from the Maryland shore equaled 30,312,000 pounds (valued at $32,784,000).
- The 2006 Maryland harvest of fish from 3 to 200 miles from shore was 1,076,000 pounds (valued at $1,867,000).
- The shellfish harvest from 3 to 200 miles was 8,341,000 (valued at $10,969,000).
- Neither fish nor shellfish had a reportable harvest on the high seas.

TABLE 3.15-3
MARYLAND COMMERCIAL LANDINGS (2001-2005), ALL SPECIES [a/]

Year	Pounds	Dollars
2001	55,539,093	$55,590,858
2002	53,184,660	$49,013,039
2003	49,349,923	$49,033,244
2004	49,558,406	$49,300,782
2005	67,460,529	$63,669,831
Total	275,092,611	$266,607,754

a/ Source: NMFS, 2007e.

Virginia

Over the five-year period ending in 2005, commercial landings ranged between a high of 561,792,162 pounds in 2001 and a low of 441,493,030 pounds in 2005 (Table 3.15-4). The five-year average was 474,842,197 pounds, with an average value of $137,843,877.

The state of Virginia has three major ports, but consistent reports of commercial harvests were not available.

- The last year that Cape Charles-Oyster reported commercial harvest was in 1998, with 2.6 million pounds ($1.4 million).
- Chincoteague reported 4.2 million pounds in 2006 and 2.6 million pounds in 2001 ($11.7 million and $2.6 million respectively).
- The Hampton Roads area reported 13.2 million pounds in 2006 and 28.0 million pounds in 2001 ($51.0 million and $56.9 million respectively).

TABLE 3.15-4
VIRGINIA COMMERCIAL LANDINGS (2001-2005), ALL SPECIES [a/]

Year	Pounds	Dollars
2001	561,792,162	$119,600,470
2002	442,489,524	$123,274,708
2003	446,827,713	$130,641,050
2004	481,608,557	$160,441,740
2005	441,493,030	$155,261,417
Total	2,374,210,986	$689,219,385

a/ Source: NMFS, 2007e.

North Carolina

Over the five-year period ending in 2005, commercial landings ranged between a high of 160,276,917 pounds in 2002 and a low of 79,152,597 pounds in 2005 (Table 3.15-5). The five-year average was 130,635,166 pounds and the average annual value was $80,023,902.

Several ports in North Carolina report commercial fish landings, but consistent reports of commercial harvests were not available.

- In 2006, Beaufort-Morehead City reported 6.7 million pounds of commercial harvest with revenue of $10.9 million. The 2001 harvest was 67.5 million pounds with a value of $17.9 million.

- The last year that Elizabeth City had a reportable commercial harvest was 1996. That harvest was 6.5 million pounds valued at $5.4 million.
- Oriental-Vandemere had a 2006 commercial harvest of 4.3 million pounds and revenue of $5.5 million. In 2001, the harvest was 4.9 million pounds, valued at $6.9 million.
- Sneads Ferry-Swansboro reported 2.6 million pounds in 2006 and revenues of $5.5 million. In 2001, the harvest was 2.8 million pounds valued at $5.6 million. The first reportable commercial harvest for Sneads-Ferry was in 2000, and there was not sufficient commercial harvest to report in 2004 or 2005.
- Wanchese-Stumpy Point reported 26.5 million pounds and revenue of $21.7 million in 2006. In 2001, the harvest was 31.9 million pounds and worth $26.1 million.

The NMFS reports that for the year 2006:

- North Carolina fish harvest within 0 to 3 miles from shore was 12,375,000 pounds (valued at $10,487,000).
- The shellfish harvest within 0 to 3 miles from shore was 31,851,000 pounds (valued at $35,766,000).
- The fish harvest from 3 to 200 miles from shore was 23,201,000 pounds (valued at $24,164,000).
- The shellfish harvest from 3 to 200 miles from shore was 1,214,000 pounds (valued at $1,468,000).
- Neither fish nor shellfish had a reportable harvest on the high seas.

TABLE 3.15-5
NORTH CAROLINA COMMERCIAL LANDINGS (2001-2005), ALL SPECIES [a/]

Year	Pounds	Dollars
2001	137,893,280	$85,971,487
2002	160,276,917	$92,260,783
2003	139,401,486	$84,925,717
2004	136,451,548	$77,138,498
2005	79,152,597	$59,823,025
Total	653,175,828	400,119,510

a/ Source: NMFS, 2007e.

3.15.2.4 Fishing Gear

<u>**Delaware**</u>

The principal gear used to harvest the fish and shellfish landed on the Delaware coast is pots and traps. Between 2001 and 2005, almost 60 percent of the commercial harvest landed in the state was captured using while pots and traps (Table 3.15-6).

TABLE 3.15-6
2001-2005 AVERAGE ANNUAL
COMMERCIAL LANDINGS BY GEAR TYPE – DELAWARE [a/]

Gear Type	Revenue (dollars)	Percent of Total
Pots and traps	$3,619,958	60
Dredge	1,282,596	21
Gill nets	726,083	12
Hand lines	49,073	>1
Other gear types	415,141	7
Total all gear	$6,092,851	100 [b/]

a/ Source: NMFS, 2007c.
b/ Numbers may not total exactly because of rounding.

Maryland

The principal gear used to harvest fish and shellfish landed on the Maryland coast are pots and traps, and dredge. Between 2001 and 2005, almost 47 percent of the commercial harvest landed in the state was captured using pots and traps, and dredge was used to capture 14 percent (Table 3.15-7).

**TABLE 3.15-7
2001-2005 AVERAGE ANNUAL
COMMERCIAL LANDINGS BY GEAR TYPE - MARYLAND [a/]**

Gear Type	Revenue (dollars)	Percent of Total
Pots and traps	$25,026,857	47
Dredge	7,443,334	14
Pound nets	3,735,377	7
Gill nets	2,322,862	4
Otter trawl	1,080,853	2
Tongs	1,057,936	2
Scrapes	982,110	2
Hand lines	633,911	1
Long lines	150,600	>1
Other gear types	10,887,711	20
Total all gear	$53,321,551	100 [b/]

a/ Source: NMFS, 2007c.
b/ Numbers may not total exactly because of rounding.

Virginia

The principal gear used to harvest the fish and shellfish landed on the Virginia coast are dredge, seines, and pots and traps. As shown in Table 3.15-8, between 2001 and 2005, almost 47 percent of the commercial harvest landed in the state was captured using dredge, while seines and pots and traps were used to capture 17 and 16 percent, respectively.

North Carolina

The principal gear used to harvest fish and shellfish landed on the North Carolina coast are pots and traps, otter trawl, and gill nets. Between 2001 and 2005, almost 37 percent of the commercial harvest landed in the state was captured using pots and traps, while otter trawl and gill nets were used to capture 26 and 12 percent, respectively (Table 3.15-9).

3.15.2.5 Tourism

Delaware

Although 8.1 million visitors traveled to Delaware in 2005, the state is ranked 47th among the 48 contiguous states in total visitor volume (TIA, 2006). There are not significant numbers of visitors who report traveling to the state to boat or sail (Delaware Economic Development Office, 2006).

Maryland

Maryland tourist spending in 2005 was $10.7 billion, supporting 115,800 jobs (Maryland Office of Tourism Development, 2006). Three percent of visitors to the state participated in boating or sailing activities (Maryland Tourism Development Board, 2006).

TABLE 3.15-8
2001-2005 AVERAGE ANNUAL
COMMERCIAL LANDINGS BY GEAR TYPE - VIRGINIA [a/]

Gear Type	Revenue (dollars)	Percent of Total
Dredge	$64,636,162	47
Seines	23,951,423	17
Pots and traps	21,962,533	16
Otter trawl	11,631,548	8
Gill nets	7,817,808	6
Pound nets	4,088,161	3
Tongs	1,801,871	1
Hand lines	722,585	1
Long lines	133,575	>1
By hand	59,892	>1
Other gear types	1,038,319	1
Total all gear	$137,843,877	100 [b/]

a/ Source: NMFS, 2007c.
b/ Numbers may not total exactly because of rounding.

TABLE 3.15-9
2001-2005 AVERAGE ANNUAL
COMMERCIAL LANDINGS BY GEAR TYPE – NORTH CAROLINA [a/]

Gear Type	Revenue (dollars)	Percent of Total
Pots and traps	$29,370,184	38
Otter trawl	20,817,604	27
Gill nets	9,359,565	12
Hand lines	3,620,112	5
Seines	3,262,239	4
Troll lines	2,398,540	3
By hand	1,875,530	2
Pound nets	1,741,803	2
Rakes	1,517,657	2
Dredge	1,489,505	2
Tongs and grabs	497,397	1
Bag nets	352,149	<1
Spears	146,225	<1
Other gear types	788,931	1
Total all gear	$77,237,441	100 [b/]

a/ Source: NMFS, 2007c.
b/ Numbers may not total exactly because of rounding.

Virginia

Virginia receives 54 million domestic visitors a year (2004-2005) (Virginia Tourism Corporation, 2007), who annually spend about $16.5 billion in the state (Virginia Tourism Authority, 2006). Data on the numbers of visitors who participate in boating or sailing activities were not available.

North Carolina

In 2005, 45 million visitors to North Carolina contributed $15 billion to the state economy (North Carolina Department of Commerce, 2007). Tourism is more important to Dare County than to any other county in North Carolina, with half of all jobs in the county directly dependent on tourist spending. Half of all lodging sales in this area occur in the high-tourism months of June, July, and August (Palmquist, *et al*., 2002).

About 5 percent of domestic visitors to the coastal regions of the state who were polled in a visitor profile survey cited boating or sailing as the reason for their visit. Nearly 10 percent visited to hunt or fish, which includes saltwater fishing. Spring and summer months accounted for the highest visitation to this area, with 61 percent of coastal visits occurring during this time (North Carolina Division of Tourism, Film and Sports Development 2005).

3.15.2.6 Recreational Fishing

The NMFS is required to collect statistics on marine recreational fishing. The information is obtained through recreational fishing participant telephone surveys, access site angler intercept surveys, a sampling of angler trips, and voluntary sampling of angler trips by participants. Additionally, through survey, the number of boat trips and catch per trip are compiled to contribute to the total catch conclusions (NMFS, 2007b).

The NMFS 2006 preliminary report on commercial and recreational landings indicates that, in 2005, 7.8 million people participated in marine recreational fishing in the Atlantic Ocean (NMFS, 2007a). These people took more than 52 million trips and caught almost 243 million fish. Almost 30 percent of the total Atlantic catch came on saltwater trips that fished primarily in the state territorial seas, and 60 percent came on trips that fished primarily in inland waters.

Several agencies began the coordinated publication of state-specific recreational fishing informational brochures in April 2007. They include state fish, game, parks, and recreation agencies; Division of Marine Fisheries; SAFMC; Atlantic States Marine Fisheries Commission; U.S. Department of Commerce; and NOAA. Through the state brochures, the following recreational fishing statistics were reported:

- Delaware reports that 45 percent of the recreational anglers lived outside the state, 53 percent of the saltwater fishing trips were taken via private or rental boat, and 43 percent of the recreational fishing was conducted from the shore. Only 1 percent of the saltwater fishing trips were taken by charter boat. Five percent were in federal waters, 14 percent were in state waters, and 81 percent were inland.
- Maryland reports that 24 percent of the recreational anglers lived outside the state, 81 percent of the saltwater fishing trips were taken via private or rental boat, and 34 percent of the recreational fishing was conducted from the shore. Five percent of the saltwater fishing trips were taken by charter boat. Three percent were in federal waters, eight percent were in state waters, and 91 percent were inland.
- Virginia reports that 23 percent of the recreational anglers lived outside the state, 63 percent of the saltwater fishing trips were taken via private or rental boat, and 36 percent of the recreational fishing was conducted from the shore. One percent of the saltwater fishing trips were taken by charter boat. Three percent were in federal waters, 18 percent were in state waters, and 79 percent were inland.

- North Carolina reports that 37 percent of the recreational anglers lived outside the state, 35 percent of the saltwater fishing trips were taken via private or rental boat, and 61 percent of the recreational fishing was conducted from the shore. Four percent of the saltwater fishing trips were taken by charter boat. Ten percent were in federal waters, 65 percent were in state waters, and 25 percent were inland.

Favored fishing areas change over time with changes in fish populations and communities, changes in preferred target species, or changes in fishing modes and styles. Popular fishing sites are characterized by relative ease of access, ability to anchor or secure the boat, and abundant presence of target fish. Fishermen focusing on areas of bottom relief not only catch reef-associated fish but also coastal pelagic species that may be attracted to the habitat. A detailed discussion of fishing habitat can be found in Appendix F (Essential Fish Habitat).

3.15.3 Environmental Consequences

The environmental consequences of the regional economy are assessed in terms of the direct impacts on the local economy. Regional economic impacts could occur if the direct effects on industry, commercial fishing, tourism, or recreational fishing from alternative chosen for implementation resulted in a substantial shift in regional spending or earning patterns.

3.15.3.1 No Action Alternative

The No Action Alternative would continue current Navy practices. Training operations and major range events would continue at current levels, and there would not be any impacts to industry, commercial fishing, tourism, or recreational fishing. The inshore areas of the VACAPES OPAREA are particularly heavily traveled as they occur near commercial ports in both Delaware and Virginia; however, the areas in which training would occur (as depicted in Figures 2.2-1, 2.2-2, and 2.2-3) would not be in the vessel transit lanes and Navy traffic would not interfere with commercial shipping. Under NEPA, the No Action Alternative in U.S. territory would have no effect on the regional economy.

3.15.3.2 Alternative 1

Alternative 1 would increase or modify training operations and implement force structure changes. The stressors to industry, commercial fishing, tourism, or recreational fishing that could be associated with these changes would be related to vessel movements, aircraft overflights, and military expended materials. Actions associated with Alternative 1 would not impact the primarily land-based industries in the VACAPES EIS/OEIS Study Area.

Training missions in the VACAPES Study Area that are potentially incompatible with civilian commercial or recreational activities already are conducted in restricted areas designed for that activity. The Navy has established procedures to ensure users of joint use areas are cleared before exercises begin. These procedures would ensure that the proposed actions associated with Alternative 1 would not result in impacts to industry, state landings, fishing gear, tourism, or recreational fishing in the study area.

Industry –The fishing industry is reflected in the category of "other services (except public administration)." Of the 537,576 establishments (companies) in this category in the United States, 40,252 (less than 1%) potentially operate in or near the VACAPES Range Complex EIS/OEIS Study Area. Because of existing Navy practices that allow joint use of most areas, impacts on this industry would be minimal.

Most industries that contribute to the regional economy are land-based. The leading industry in the study area is retail trade. This and other land-based industries would not be affected by the changes in training operations that would be associated with Alternative 1.

State Landings – Based on the size of the VACAPES Study Area and the limited change in numbers and types of Navy operations within this area, the increase in likelihood of contact between Navy operations and commercial fishing practices would be negligible compared to the No Action Alternative. Training missions in the VACAPES Study Area that are potentially incompatible with civilian commercial activities already are conducted in restricted areas designed for that activity. The Navy has established procedures to ensure users of joint use areas are cleared before exercises begin. These procedures would ensure that the proposed actions associated with Alternative 1 would not result in impacts to state landings in the Study Area. Because the training areas are not proposed to change with implementation of Alternative 1, the areas that traditionally produce state landings are not expected to change.

Fishing Gear – Fishing activities have the potential to interact with equipment used during the proposed Navy training operations. Commercial bottom-fishing gear represents about a third of the gear types used in the study area, and it has the greatest potential for negative effects. Interaction with bottom-fishing gear could result in the loss of or damage to both commercial fishing gear and naval hardware.

Alternative 1 would have a minimal impact on commercial fishing gear. This conclusion is based on the large size of the study area, the relatively small changes in naval operations that would be associated with this alternative, and the familiarity of local commercial fishermen with Navy use areas and practices and how to avoid them. Changes in naval activities that would have the greatest potential for conflict with fishing gear (mine warfare activities) would occur in areas designed for those activities where fishing is not likely to occur.

Tourism – Tourism in the study area encompasses many activities that do not involve boating or sailing. While tourism is an important economic activity in the vicinity, only a small percentages of visitors (less than five percent) report coming to the area for boating or sailing activities (North Carolina Division of Tourism, Film and Sports Development, 2005).

Tourism activities could be affected by Navy activities on a short-term and infrequent basis. However, because the Navy issues prior notice of area restrictions, mariners such as charter boat captains would know in advance to choose another area for a day's activities. Therefore, impacts to tourism would be minimal.

Recreational Fishing – As indicated in the EFH study in Appendix F, the popular fishing sites are characterized by relative ease of access, ability to anchor or secure the boat, and abundant presence of target fish. For all states in the study area, at least 25 percent of the recreational fishing occurs inland and 10 percent or less occurs in federal waters or beyond, which is the area where most of the Navy OPAREA training occurs. As a result, the changes in training operations that would occur with Alternative 1 would not increase interference with recreational fishing.

Alternative 1 would not have any impacts to industry, commercial fishing, tourism, or recreational fishing. Under NEPA, Alternative 1 in U.S. territory would have no effect on the regional economy.

3.15.3.3 Alternative 2 (Preferred Alternative)

Most impacts to industry, commercial fishing, tourism, and recreational fishing with implementation of Alternative 2 would be the same as those described for Alternative 1. The only differences would be associated with the mine warfare training areas that would be established in the lower Chesapeake Bay. Changes would occur in these training areas, based on greater use of helicopter sorties (92 percent increase over the No Action Alternative annually) and the deployment of 20-40 bottom and moored mine shapes per training area. There would be an 85 percent decrease in HE bombs dropped under Alternative 2 and the BOMBEX area would only be performed in W-386 (Air-K). This decrease in BOMBEXs would allow more commercial and recreational use of W-72 (Air-3b) as in the No Action Alternative or Alternative 1. The effects of Alternative 2would be highly localized and would not have a measurable impact on study area industry, state landings, fishing gear, tourism, or recreational fishing. Under NEPA, Alternative 2 in U.S. territory would have no effect on the regional economy.

3.15.4 Unavoidable Significant Environmental Effects

There would not be any unavoidable significant environmental effects on the regional economy as a result of implementation of the No Action Alternative, Alternative 1, or Alternative 2.

3.15.5 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.15-10, the No Action Alternative, Alternative 1, and Alternative 2 would not have substantial environmental impacts on the regional economy.

TABLE 3.15-10
SUMMARY OF ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES ON THE REGIONAL ECONOMY IN THE VACAPES RANGE COMPLEX

Alternatives and Stressors	NEPA (Territorial Waters, 0 to 12 nm)	EO 12114 (Non-Territorial Waters, >12 nm)
No Action		
Vessel movements (disturbance)	No impacts would occur to industry, commercial fishing, tourism, or recreational fishing. No substantial shift in regional spending and earning patterns.	Not evaluated because this area is outside the regional economy study area.
Aircraft overflights (disturbance)		
Military expended materials		
Impact conclusion	The No Action Alternative would have no impact to the regional economy.	Not evaluated because this area is outside the regional economy study area.
Alternative 1		
Vessel movements (disturbance)	No impact would occur to industry, commercial fishing, tourism, or recreational fishing. No substantial shift in regional spending and earning patterns.	Not evaluated because this area is outside the regional economy study area.
Aircraft overflights (disturbance)		
Military expended materials		
Impact conclusion	Alternative 1 would have no impact to the regional economy.	Not evaluated because this area is outside the regional economy study area.
Alternative 2		
Vessel movements (disturbance)	No impact would occur to industry, commercial fishing, tourism, or recreational fishing. No substantial shift in regional spending and earning patterns.	Not evaluated because this area is outside the regional economy study area.
Aircraft overflights (disturbance)		
Military expended materials		
Impact conclusion	Alternative 2 would have no impact to the regional economy.	Not evaluated because this area is outside the regional economy study area.

3.16 RECREATION

3.16.1 Introduction and Methods

This section considers effects to non-commercial recreation activities in the study area. Commercial recreation activities are addressed in the regional economy section of this EIS/OEIS.

Offshore areas of the Atlantic Coast from Delaware to North Carolina are in use by both military and civilian interests. Civilian activities are compatible with Navy ships, which account for only 3 percent of the total ship presence out to 200 nm (CNA, 2001). Naval vessels and aircraft conducting operations that are not compatible with civilian activities, such as hazardous weapons firing, are confined to OPAREAs away from shipping lanes, and to special use airspace (SUA). Hazardous operations are communicated in advance to all vessels and operators by use of notices to mariners (NOTMAR), issued by the U.S. Coast Guard (USCG), and notices to airmen (NOTAM), issued by the Federal Aviation Administration (FAA). NOTMARs can be found on the Internet at www.nga.mil/portal/site/maritime and NOTAMs are available on the Internet at https://www.notams.jcs.mil.

NOTMARs and NOTAMs provide civilians, such as recreational boaters, fishers, divers, and aircraft operators with notice that the military will be operating in a specific area, and allow these civilian groups to plan their activities accordingly. Schedules are updated when changes occur up, until the date of the operation. If operations are cancelled at any time, this information is posted and the area is again identified as clear for public use.

3.16.1.1 Assessment Methods and Data Used

Information regarding personal watercraft (PWC) was obtained in part from the USCG. Statistical data from the National Marine Manufacturers Association (NMMA) were also consulted with regard to recreational boating. State divisions of tourism, parks, and recreation provided state-specific PWC and recreational boating data.

The sport diving industry does not maintain statistics on numbers of individuals diving in specific regions of the country or on commonly used sites (Davison, 2007; DEMA, 2006). Dive locations identified in this document were established through the use of:

- The NOAA Office of Coast Survey’s Automated Wreck and Obstruction Information System;
- A survey of state dive charter company websites;
- Veridian Corporation’s 2001 Global Maritime Wrecks Database; and
- State tourism and parks and recreation information.

National Marine Fisheries Service (NMFS) collects statistics on marine recreational fishing. The information is obtained through recreational fishing participant telephone surveys, access site angler intercept surveys, a sampling of angler trips, and voluntary sampling of angler trips by participants. Through surveys, the number of boat trips and catch per trip are determined and total catch is estimated.

Favored fishing hotspots change over time with changes in fish populations and communities, preferred target species, or fishing modes and styles. Popular fishing sites are characterized by relative ease of access, ability to anchor or secure the boat, and abundant presence of target fish. Anglers focusing on areas of bottom relief habitat not only catch reef-associated fish but also coastal pelagic species that may be attracted to the habitat. A more extensive discussion of fishing habitat is found in Appendix F.

3.16.1.2 Warfare Areas and Associated Environmental Stressors

Impacts to recreation are assessed in terms of anticipated levels of disruption of or improvement in current levels of access to recreation areas. Impacts may result from physical restriction of recreation areas. As shown in Table 3.16-1, stressors that would likely impact recreational interests include vessel movements (disturbance), aircraft overflights (disturbance), and military expended materials. These stressors were identified by conducting a detailed analysis of the warfare areas, operations, and specific activities included in the alternatives.

TABLE 3.16-1
SUMMARY OF POTENTIAL STRESSORS TO RECREATION RESOURCES

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Aircraft Overflights (Disturbance)	Military Expended Materials
Mine Warfare (MIW)				
Mine countermeasures exercise (MCM)	Lower Chesapeake Bay	✓	✓	✓
Mine countermeasures exercise (MCM)	W-50A/C, W-386, W-72	✓	✓	✓
Mine neutralization	W-50C	✓	✓	✓
Surface Warfare (SUW)				
Bombing exercise (air-to-surface) (at sea)	W-386 (Air-K), W-72A (Air-3B), W-72A/B	✓	✓	✓
Missile exercise (MISSILEX) (air-to-surface)	W-386 (Air-K), W-72A	✓	✓	✓
Gunnery exercise (GUNEX) (air-to-surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C	✓	✓	✓
GUNEX (surface-to-surface) boat	W-50C, R-6606	✓	✓	✓
GUNEX (surface-to-surface) ship	W-386, W-72	✓	✓	✓
Laser targeting	W-386 (Air-K)	✓	✓	
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- ship	VACAPES OPAREA	✓		
VBSS/MIO- Helicopter	VACAPES OPAREA	✓	✓	
Air Warfare (AW)				
Air combat maneuver (ACM)	W-72A (Air-2A/B, 3A/B)		✓	
GUNEX (air-to-air)	W-72A		✓	✓
MISSILEX (air-to-air)	W-386 (Air D, G, H, K), W-72A		✓	✓
GUNEX (surface-to-air)	W-386, W-72	✓	✓	✓
MISSILEX (surface-to-air)	W-386 (Air D, G, H, K)	✓	✓	✓
Air intercept control (AIC)	W-386, W-72	✓	✓	✓
Detect to engage (DTE)	W-386, W-72	✓	✓	✓

TABLE 3.16-1
SUMMARY OF POTENTIAL STRESSORS TO RECREATION RESOURCES (Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Aircraft Overflights (Disturbance)	Military Expended Materials
Strike Warfare (STW)				
HARM missile exercise	W-386 (Air E, F, I, J)		✓	✓
Amphibious Warfare (AMW)				
FIREX with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓		✓
Electronic Combat (EC)				
Chaff exercise - aircraft	W-386, W-386 (Air-K), W-72	✓	✓	✓
Chaff exercise - ship	W-386, W-72	✓	✓	✓
Flare exercise- aircraft	W-386, W-386 (Air-K), W-72		✓	✓
Electronic combat (EC) operations - aircraft	W-386 (Air-K)		✓	
EC operations - ship	VACAPES OPAREA	✓		
Test and Evaluation				
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓		

3.16.2 Affected Environment

Because the VACAPES Range Complex does not include land, all civilian recreational activities in the range complex are conducted from boats. The most common activities include fishing, diving on shipwrecks and artificial reefs, whale watching, sailing, and cruising.

In 2005, 7.8 million residents participated in marine recreational fishing in the Atlantic Ocean. These visitors took more than 52 million trips and caught a total of almost 243 million fish. Of that total, approximately 30 percent came from the study area for the VACAPES EIS/OEIS.

Over 30 percent of the total Atlantic catch came on saltwater trips that fished primarily in the state territorial seas, and 60 percent came on trips that fished primarily in inland waters (this is an estimate that does not include the High Sea). Using this distribution of trips in saltwater and inland waters, Table 3.16-2 shows the estimated number of trips (not the number of anglers actually participating) in 2005 for inland and saltwater settings for the states in the VACAPES EIS/OEIS Study Area. The data in this table are reported by state, and a breakout for the lower Chesapeake Bay is not available.

TABLE 3.16-2
RECREATIONAL ANGLERS IN THE VACAPES EIS/OEIS STUDY AREA [a/]

State	Number of Trips	Inland Trips (60 percent)	Saltwater Trips (30 percent)
Delaware	1,163,000	698,000	349,000
Maryland	3,254,000	1,952,000	976,000
Virginia	3,791,000	2,275,000	1,137,000
North Carolina	6,823,000	4,094,000	2,047,000

a/ Source: NMFS, 2007a

3.16.2.1 Delaware

Recreational Boating and Diving. Recreational activities primarily include game and sport fishing, charter boat fishing, sport diving, whale watching, sailing, and power cruising. Delaware ranks 43rd in the nation for the number of recreational boats registered in the state (USCG, 2005). Recreational boats range throughout the Delaware coastal waters, with use depending on season and weather conditions.

Travel between the most popular cruising destinations along the Delaware coast does not require traversing Navy OPAREAs. However, some recreational vessels, in particular sailboats and motor cruisers in the 50-foot and larger class, travel considerable distances offshore and could enter the VACAPES OPAREA. However, because registered boats 25 feet or larger represent less than 1 percent of total U.S. recreational boats (NMMA, 2007), the presence of such vessels in the OPAREA would be uncommon.

Although dive trip opportunities are not as numerous as in states farther south, at least one charter company offers wreck diving trips from the Delaware shore (aquaventuresonline.com). At least 25 shipwreck sites are common destinations for divers (Reef Scuba Accessories, 2007), with about 69 total shipwrecks occurring in the VACAPES Study Area off the coast of Delaware (Veridian, 2001). Figure 3.12-1 illustrates the general locations of wrecks, many of which are in the VACAPES EIS/OEIS Study Area.

Recreational Fishing. Table 3.16-3 provides Delaware fish catch recreational landings for the years 2002 through 2006. As shown in the table, total recreational landings declined sharply from more than 1.5 million in 2002 to fewer than 0.3 million in 2005, but then recovered to 0.7 million landings in 2006. In most years, the highest numbers of landings occurred in the July-August period, with these two months accounting for 26 to 58 percent of annual recreational take.

TABLE 3.16-3
DELAWARE RECREATIONAL LANDINGS [a/]

Months	2002	2003	2004	2005	2006
Jan-Feb	0 [b/, c/]	0	0	0	0
Mar-Apr	13,667	14,833	17,596	679	1,437
May-Jun	282,660	113,391	51,477	58,837	311,521
Jul-Aug	909,046	298,612	74,574	134,720	245,713
Sep-Oct	345,181	206,132	138,927	39,765	109,750
Nov-Dec	12,521	22,883	4,368	43,055	44,432
Year total	1,563,075	655,851	286,942	277,056	712,853

a/ Source: NMFS, 2007b.
b/ Numbers represent the total of all species and all methods of harvest in the Federal Exclusive Economic Zone, which for most states is the state boundary (3 nm) out to 200 nm.
c/ Because of data collection problems, months that indicate zero (0) did not have data available.

3.16.2.2 Maryland

Recreational Boating and Diving. Recreational activities in Maryland are the same as those identified for Delaware. Maryland ranks 24th in the nation for the number of recreational boats registered in the state (USCG, 2005), with 205,812 boats registered in 2005 (NMMA, 2007). Recreational boats range throughout the Maryland coastal waters, depending on season and weather conditions.

Travel between the most popular cruising destinations along the Maryland coast does not require traversing Navy OPAREAs. As in Delaware, sailboats and motor cruisers of 50 feet or more sometimes travel considerable distances offshore, but there are relatively few of these vessels (NMMA, 2007) and their presence in the OPAREA is uncommon.

For divers, there are many shipwrecks and artificial reefs between Ocean City and the boundary of the VACAPES Study Area (Figure 3.12-1). There are an estimated 60 shipwrecks offshore of Maryland (Veridian, 2001). Artificial reefs were constructed offshore of Ocean City by the Maryland Department of Natural Resources in the 1990s. In 2006, the Coastal Conservation Association executed a memorandum of understanding with the State of Maryland, Department of Natural Resources to assist with the funding and development of the Maryland Artificial Reef Initiative, which seeks to preserve and add to the reefs in Maryland waters. The ocean dive season in this area of the country runs from May through October (Weedon, 2003).

Recreational Fishing. Table 3.16-4 provides Maryland recreational fish landings for the years 2002 through 2006. The recreational take in this state has decreased since 2002, but a clear pattern throughout all years is not evident. The July-August period usually has the highest numbers, in some years accounting for more than 80 percent of the annual catch, but substantial numbers of fish also are taken in the May-June and September-October periods.

TABLE 3.16-4
MARYLAND RECREATIONAL LANDINGS [a/]

Months	2002	2003	2004	2005	2006
Jan-Feb	0 [b/, c/]	0	0	0	0
Mar-Apr	44,386	30,455	28,155	5,801	10,505
May-Jun	224,932	197,358	105,151	91,671	258,186
Jul-Aug	2,013,137	275,356	765,197	1,284,432	559,841
Sep-Oct	400,494	1,041,117	37,955	81,662	146,105
Nov-Dec	0	50,265	0	16,675	12,072
Year total	2,682,949	1,594,551	936,458	1,480,241	986,709

a/ Source: NMFS, 2007b.
b/ Numbers represent the total of all species and all methods of harvest in the Federal Exclusive Economic Zone, which for most states is the state boundary (3 nm) out to 200 nm.
c/ Because of data collection problems, months that indicate zero (0) did not have data available.

3.16.2.3 Virginia

Recreational Boating and Diving. Recreational activities in Virginia primarily include dolphin and whale watching cruises, pleasure cruising, water skiing, fishing, and swimming (Virginia Tourism Corporation, 2007). Virginia ranks 19th in the nation for the number of recreational boats registered in the state (USCG, 2005), with 245,073 boats registered in 2005 (NMMA, 2007). This number is anticipated to increase, based on an expected increase in coastal populations (VDH, 2007).

Recreational boats range throughout the Virginia coastal waters, depending on season and weather conditions. Travel between the most popular cruising destinations along the Virginia coast does not require traversing the VACAPES OPAREA. Large recreational vessels may sometimes use the area, but there are few vessels of this type (NMMA, 2007) and their presence is uncommon.

All diving sites off the coast of Virginia are to shipwrecks and five artificial reefs. Coral does not occur at this latitude. Popular shipwreck diving destinations occur at depths between 50 feet and 160 feet (Reef Scuba Accessories, 2007), with 307 of the total 525 wrecks in the VACAPES Study Area occurring offshore of Virginia (Veridian, 2001) (Figure 3.12-1). However, despite the presence of offshore scuba diving locations, in a statewide survey, diving was not given as a significant reason for recreational boating among boat owners (Responsive Management, 2000).

Recreational Fishing. Recreational fishing is a major industry in Virginia. More than 30 species of game fish occur in the VACAPES Study Area, and these fish are targeted during recreational fishing tournaments that occur throughout the spring, summer, and fall. Table 3.16-5 provides Virginia recreational fish catch for the years 2002 through 2006. The annual highest catch (2002) was more than three times the lowest annual catch (2006) but a clear pattern is not evident throughout the period. Although more fish are caught in the warm months than in winter, the seasonal is less apparent than in the more northern states of the study area.

TABLE 3.16-5
VIRGINIA RECREATIONAL LANDINGS [a/]

Months	2002	2003	2004	2005	2006
Jan-Feb	0 [b/, c/]	0	0	0	0
Mar-Apr	186,263	37,663	123,776	86,891	60,058
May-Jun	682,604	405,351	258,150	580,994	289,369
Jul-Aug	678,758	273,352	803,278	217,633	203,762
Sep-Oct	73,627	206,848	28,942	416,683	17,639
Nov-Dec	133,530	47,402	171,753	365	4,458
Year Total	1,754,782	970,616	1,385,899	1,302,566	575,286

a/ Source: NMFS, 2007b.
b/ Numbers represent the total of all species and all methods of harvest in the Federal Exclusive Economic Zone, which for most states is the state boundary (3 nm) out to 200 nm.
c/ Because of data collection problems, months that indicate zero (0) did not have data available.

In terms of landings by weight, tuna and mackerel were the first-ranked species group in 2002 in the federal waters recreational fishery off the coast of Virginia. Tuna and mackerel accounted for more than 34 percent of the total recreational landings from federal waters off Virginia. Dolphin was the second-ranked species group and represented more than 15 percent of the landings in 2002.

More than 135,000 fishing trips were taken in 2002 by individual recreational anglers fishing in federal waters off the coast of Virginia. More than 1.4 million people participated in recreational fishing in marine fishing areas, including the state territorial sea and federal waters.

3.16.2.4 North Carolina

Recreational Boating and Diving. Recreational activities in North Carolina are similar to those identified for Delaware and Maryland. North Carolina ranks 11th in the nation in number of recreational boats registered in the state (USCG, 2005), with 362,784 boats (NMMA, 2007).

Recreational boats range throughout the North Carolina coastal waters, depending on season and weather conditions. Travel between the most popular cruising destinations does not require traversing the VACAPES Range Complex, but large recreational vessels and cruising vessels transiting ocean passages from some North Carolina ports to the Bahamas or Bermuda might favor courses through the VACAPES Study Area. However, the presence of these vessels in the OPAREA is relatively uncommon.

Shipwrecks provide habitat suitable for development of artificial reefs, and are popular destinations for divers. Within the VACAPES Study Area, about 89 shipwrecks are located off North Carolina (Veridian, 2001).

Recreational Fishing. Table 3.16-6 provides North Carolina recreational fish catch for the years 2002 through 2006. In contrast to the other states, the number of landings has been steady or increasing during this period. The take in May-June is similar to that in July-August, and substantial catches occur from March through late fall.

TABLE 3.16-6
NORTH CAROLINA RECREATIONAL LANDINGS [a/]

Months	2002	2003	2004	2005	2006
Jan-Feb	0 [b/, c/]	0	26,698	26,061	70,128
Mar-Apr	876,752	675,188	1,236,176	1,806,782	502,123
May-Jun	5,447,372	5,415,552	4,517,388	2,129,716	5,326,483
Jul-Aug	2,183,770	5,761,653	3,195,412	6,097,507	3,719,142
Sep-Oct	1,762,664	1,441,839	1,205,901	2,160,146	4,664,639
Nov-Dec	1,486,112	987,098	1,648,644	1,243,464	2,914,161
Year Total	11,756,670	14,281,330	11,830,219	13,463,676	17,196,676

a/ Source: NMFS, 2007b.
b/ Numbers represent the total of all species and all methods of harvest in the Federal Exclusive Economic Zone, which for most states is the state boundary (3 nm) out to 200 nm.
c/ Because of data collection problems, months that indicate zero (0) did not have data available.

3.16.2.5 Lower Chesapeake Bay

Recreational activities offshore in the lower Chesapeake Bay include fishing, kayaking, diving, and canoeing. Many of these activities are centered on the Chesapeake Bay's more than 1,800 shipwrecks (Chesapeake Bay Program, 2008). Another important resource is the Lower Chesapeake Bay Bridge Tunnel, which functions as one of the largest artificial reefs ever constructed. The tunnel includes 20 miles of bridge pylons, four man-made rock islands, two underwater tunnels, and a 625-foot-long fishing pier (CBBT, 2008), and provides year-round opportunities to fish along its entire length. Favored fishing locations change over time (see Appendix F), but the best catch usually occurs on low light days, at night, or at dusk. Bottom fishing is the most common method of fishing (Adams Fishing Adventures, 2007).

3.16.3 Environmental Consequences

Factors used to assess the significance of impacts on recreational activities include an alternative's potential to increase restricted military activities such that civilian recreational use would be entirely excluded from an area. A serious disruption would occur if civilian recreational activities were entirely excluded from areas in the VACAPES Range Complex. Temporary displacement of recreational activities would not constitute a serious disruption.

3.16.3.1 No Action Alternative

Vessel operators have considerable discretion in their choice of recreation locations As a result, temporary clearances for safety purposes that would be implemented under the No Action Alternative would have little or no effect on the numbers of vessels or people involved in recreational activities, the success of their activities, or the satisfaction of participants in their recreational experience.

When a safety clearance of the OPAREA is required, a NOTMAR is provided in advance. This notification would continue to allow boaters to select an alternate destination without substantially affecting their activities.

Among the approximately 15 million angler trips that annually occur in Delaware, Maryland, Virginia, and North Carolina, about 60 percent (9 million) occur in inland waters (see Table 3.16-2). The No Action Alternative would not have any effects on activities of these recreationists. Only about 30 percent (4.5 million angler trips) occur in saltwater, and most of these are within the state territorial boundaries (within 3 nm of shore). Most diving also occurs in shallow waters (less than 160 feet deep) close to shore. Although some of these activities may occasionally be displaced by Navy training, impacts would be short-term. Similarly, the requirement for larger recreational vessels transiting the OPAREA to avoid specified areas that were being used for training would not cause any serious disruptions.

The potential stressors of vessel movements, aircraft overflights, and military expended materials would be confined to the OPAREA. The continued use of NOTMARs issued by the USCG and NOTAMs issued by the FAA to notify vessels and operators of the requirement to avoid hazardous operations would help ensure that periodic closures of areas did not affect recreational experiences.

The Navy is required to avoid recreational boaters in the range complex when conducting training operations (DoN, 2006). The No Action Alternative would not have a significant impact on recreational activities as they are currently implemented because of the Navy's policy of avoidance.

In accordance with the NEPA, naval activity in U.S. territory under the No Action Alternative would have no significant impact on recreational activities. In accordance with EO 12114, naval activity in non-territorial waters would not cause harm to recreational activities.

3.16.3.2 Alternative 1

The Navy could accomplish the proposed activities associated with Alternative 1 without modifications to or the need for additional designated ocean or airspace. Throughout most of the study area, impacts would not change from those described for the No Action Alternative.

Alternative 1 would include organic mine countermeasures (OMCM) operations that would result in additional restrictions to civilian traffic during OMCM operational periods. The addition of OMCM to the current mine countermeasures exercises conducted in the VACAPES Study Area would likely result in an additional 20 steaming days per year that the Navy would be operating and that civilians might be restricted from part of the existing OPAREA. Because much of the steaming would be performed concurrently with existing operations, the change in steaming time would represent a 1.4 percent increase from current conditions. This would not significantly impact recreation in the VACAPES Study Area.

In accordance with the NEPA, implementation of Alternative 1 would have no significant impact on recreation resources in U.S. territory. In accordance with EO 12114, implementation of Alternative 1 would not cause harm to recreation resources in non-territorial waters.

3.16.3.3 Alternative 2 (Preferred Alternative)

Most impacts to recreation resources from Alternative 2 would be similar to those described for the No Action Alternative. For OMCM operations, the effects of Alternative 2 would be identical to those associated with Alternative 1.

Alternative 2 would increase operations and would establish mine warfare training areas within the VACAPES Study Area (see Table 2.2-4). All proposed actions would be implemented within existing military operating areas. The placement of temporary and permanent, non-explosive mine shapes on or near the sea floor would not pose a navigation or fishing hazard. Mooring lines would only be left in place only for as long as a mine shape was in the water (Section 2.2.5). Because of their small size (about

2 feet per side), the mine shape anchors would be too small to provide fish habitat and would not enhance recreational fishing or diving.

In accordance with the NEPA, implementation of Alternative 2 would have no significant impact on recreation resources in U.S. territory. In accordance with EO 12114, implementation of Alternative 2 would not cause harm to recreation resources in non-territorial waters.

3.16.4 Unavoidable Significant Environmental Effects

There would not be any unavoidable significant environmental effects with respect to recreation as a result of implementing the No Action Alternative, Alternative 1, or Alternative 2.

3.16.5 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.16-7, No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on recreation. Furthermore, the No Action Alternative, Alternative 1, and Alternative 2 would not cause harm to recreation in non-territorial waters.

TABLE 3.16-7
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON RECREATION IN THE VACAPES STUDY AREA

Alternatives and Stressors	NEPA (U.S. Territory)	EO 12114 (Non-Territorial Waters, >12 nm)
No Action		
Vessel movements (disturbance)	Significant impacts on recreation would not occur because of the use of NOTMARs, NOTAMs, and exclusive use areas for Navy activities.	Significant impacts on recreation would not occur because of the use of NOTMARs, NOTAMs, and exclusive use areas for Navy activities.
Aircraft overflights (disturbance)		
Military expended materials		
Impact conclusion	No impact on recreation in U.S. territory.	No harm on recreation in non-territorial waters.
Alternative 1		
Vessel movements (disturbance)	Significant impacts on recreation would not occur because of the use of NOTMARs, NOTAMs, and exclusive use areas for Navy activities.	Significant impacts on recreation would not occur because of the use of NOTMARs, NOTAMs, and exclusive use areas for Navy activities.
Aircraft overflights (disturbance)		
Military expended materials		
Impact conclusion	No impact on recreation in U.S. territory.	No harm on recreation in non-territorial waters.
Alternative 2		
Vessel movements (disturbance)	Significant impacts on recreation would not occur because of the use of NOTMARs, NOTAMs, and exclusive use areas for Navy activities.	Significant impacts on recreation would not occur because of the use of NOTMARs, NOTAMs, and exclusive use areas for Navy activities.
Aircraft overflights (disturbance)		
Military expended materials		
Impact conclusion	No impact on recreation in U.S. territory.	No harm on recreation in non-territorial waters.

3.17 ENVIRONMENTAL JUSTICE

3.17.1 Introduction and Methods

Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was issued on February 11, 1994. This EO requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental impacts of its programs, policies, and activities on minority and low-income populations. The United States Environmental Protection Agency (USEPA) and Council on Environmental Quality (CEQ) emphasize the importance of incorporating environmental justice review in the analyses conducted by federal agencies under the National Environmental Policy Act (NEPA) of 1969 and of developing protective measures that avoid disproportionate environmental impacts on minority and low-income populations.

Objectives of this EO as it pertains to this EIS/OEIS include development of federal agency implementation strategies, identification of minority and low-income populations where proposed federal actions could have disproportionately high and adverse human health and environmental impacts, and participation of minority and low-income populations in the public participation process.

Protection of Children

The President issued EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, in 1997. This order requires each federal agency to "…make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and shall...ensure that its policies, programs, activities, and standards address disproportionate risks to children…." This order was issued because a growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health risks and safety risks.

Navy Supplemental Environmental Planning Policy

EO 12898 and EO 13045 require each federal agency to identify and address impacts of their programs, policies, and activities. The Navy chose to ensure compliance with EO 12898 and EO 13045 through implementation of the Chief of Naval Operations (CNO) Supplemental Environmental Planning Policy (23 September 2004). This policy provides instructions for naval personnel to identify and assess stressors to, and disproportionately high and adverse impacts upon, minorities, low-income populations, and children. A component of this policy institutes processes that result in consistent and efficient consideration of environmental impacts on Navy decision-making.

3.17.1.1 Assessment Methods and Data Used

This section was prepared by compiling and evaluating existing information supplied by the U.S. Census Bureau and state and local governmental agencies and local organizations, as shown in Chapter 7 (References). These were the same references used to develop the regional economy, demographics, transportation, recreation, and public health and safety sections. A review of the resources was conducted to identify stressors and to determine whether the identified stressors would result in disproportionately high and adverse impacts for the purposes of the environmental justice analysis. An evaluation was then conducted to determine if further analysis was needed to determine if impacts could disproportionately fall on minorities, low-income populations, or children.

People, including minority and low-income populations and children, do not live within the VACAPES Range Complex in non-territorial waters more than 12 nm from the shore. Therefore, environmental justice was considered only from a NEPA perspective and was not evaluated in accordance with EO 12114.

3.17.1.2 Warfare Areas and Associated Environmental Stressors

The CEQ's environmental justice guidance under NEPA identifies factors that are to be considered to the extent practicable when determining whether environmental impacts to minority populations and low-income populations are disproportionately high and adverse. These factors include whether there is or would be an effect on the natural or physical environment that adversely affects a minority population, low-income population, or Indian tribe. Such impacts may include ecological, cultural, human health, economic, or social impacts when those impacts are interrelated to impacts to the natural or physical environment. Other factors to be considered if adverse impacts are projected include:

- Whether they will appreciably exceed those same impacts to the general population or other appropriate comparison group; and
- Whether these populations have been affected by cumulative or multiple exposures from environmental hazards.

The methods used to conduct the impacts analysis for environmental justice included a review of conclusions for resources discussed in other sections of this Chapter 3 to determine if such stressors exist. Where impacts were identified, an evaluation was conducted to determine if further analysis was needed to determine if impacts could disproportionately fall on minority populations or low-income populations. A review of the conclusions for the resources in Chapter 3 revealed that there were no significant environmental impacts that would require additional analysis. The lack of significant impacts means that there are no disproportionately high or adverse impacts to minority populations or low-income populations.

3.17.2 Affected Environment

The VACAPES EIS/OEIS Study Area includes the airspace, seaspace, and undersea space of the OPAREA and warning areas of the VACAPES Range Complex, including the area from the mean high tide line, up to and extending seaward of the 3-nm western boundary of the OPAREA. The affected environment is primarily open water and the states of Delaware, Maryland, Virginia, and North Carolina. Populations that could be impacted would be fisherman and recreational users of the open water areas, most of whom are likely to live in the coastal areas of these states.

The latest year for which data are available is 2005. During that period, 6.6 percent of Delaware's population was under the age of five, Maryland had 6.8 percent of the population under the age of five, the Virginia population under the age of five was 6.8 percent, and 7.0 percent of North Carolina's population was under the age of five (U.S. Census Bureau, 2007).

In the Delaware, the percent of the population with incomes below the poverty level is 9.6 percent. This value is 9.2 percent in Maryland, 9.5 percent in Virginia, and 13.8 percent in North Carolina. All of these values are similar to the United States rate of 12.7 percent.

The non-white population (which includes Black, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, Hispanic or Latino origin, and persons reporting two or more races) is 31.3 percent of the Delaware total population, 41.7 percent of the Maryland total population, 32.5 percent of the Virginia total population, and 32.4 percent of the North Carolina total population. All of these are similar to the United States value of 34.2 percent non-white.

North Carolina's educational attainment of high school and bachelor's degrees are slightly lower than that of the United States. Delaware, Maryland, and Virginia all report educational attainment statistics slightly higher than the United States average.

The major industry in Delaware, Maryland, Virginia, and North Carolina is retail trade. Fishing is ranked fourth or fifth in the top ten industries in the states (Delaware, Virginia, and North Carolina ranked 5th and Maryland ranked 4th).

3.17.3 Environmental Consequences

Environmental impacts related to environmental justice or protection of children could occur if they would disproportionately affect minorities, low-income populations, or children.

3.17.3.1 No Action Alternative

The No Action Alternative would continue current Navy and Marine Corps training. Because current operations would occur entirely in open water areas with no permanent populations, no disproportionate impacts would occur to land-based populations unless they obtained a living from fishing or other uses of open water areas.

The fishing industry in Delaware, Virginia, and North Carolina ranks fifth in the state; Maryland fishing industry ranks fourth in the state. As described in Section 3.15, this industry is unlikely to be impacted, because the No Action Alternative is the continuation of current training activities. As a result, the No Action Alternative would not result in a finding of any disproportional impacts to minorities, low-income populations, or children in U.S. territory.

3.17.3.2 Alternative 1

Alternative 1 would increase the tempo of activities that already occur in the VACAPES Study Area. It would not result in any disproportional impacts to minorities, low-income populations, or children. Navy activities in U.S. territory would have no impact on environmental justice under Alternative 1.

3.17.3.3 Alternative 2 (Preferred Alternative)

Alternative 2 would change the tempo of activities that already occur in the VACAPES Study Area. It would not result in any disproportional impacts to minorities, low-income populations, or children. Navy activities in U.S. territory would have no impact on environmental justice under Alternative 2.

3.17.4 Unavoidable Significant Environmental Effects

There would not be any unavoidable significant environmental effects related to environmental justice as a result of implementation of the No Action Alternative, Alternative 1, or Alternative 2.

3.17.5 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.17-1, the No Action Alternative, Alternative 1, and Alternative 2 would not have substantial environmental impacts on environmental justice.

TABLE 3.17-1
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES IN THE VACAPES STUDY AREA

Alternative and Stressor	NEPA (Territorial Waters, 0 to 12 nm)	EO 12114 (Non-Territorial Waters, >12 nm)
No Action		
No stressors identified	No effects that would disproportionately affect minority or low-income populations or the environmental health or level of safety risks to children.	Not evaluated because this area is outside the regional economy study area.
Impact conclusion	The No Action Alternative would have no impact on environmental justice or the protection of children.	Not evaluated because this area is outside the regional economy study area.
Alternative 1		
No stressors identified	No effects that would disproportionately affect minority or low-income populations or the environmental health or level of safety risks to children.	Not evaluated because this area is outside the regional economy study area.
Impact conclusion	Alternative 1 would have no impact on environmental justice or the protection of children.	Not evaluated because this area is outside the regional economy study area.
Alternative 2		
No stressors identified	No effects that would disproportionately affect minority or low-income populations or the environmental health or level of safety risks to children.	Not evaluated because this area is outside the regional economy study area.
Impact conclusion	Alternative 2 would have no impact on environmental justice or the protection of children.	Not evaluated because this area is outside the regional economy study area.

3.18 Public Health and Safety

3.18.1 Introduction and Methods

Public health and safety issues include potential hazards inherent in vessel movements, flight operations, mine warfare, aerial bombardment, firing of weapons, and underwater demolition. The Navy observes every possible precaution in the planning and execution of all onshore and offshore activities to prevent injury to people.

3.18.1.1 Assessment Methods and Data Used

All current and proposed training operations were examined for the possibility of civilians or uninvolved military personnel being placed in a hazardous environment associated with Navy training that could cause personal injury. Current Navy safety procedures and their implementation according to existing Navy instructions were assessed for their protection of the public from the hazardous training operations proposed in the alternatives.

3.18.1.2 Warfare Areas and Associated Environmental Stressors

Impacts to public health and safety were assessed based on the potential for Navy training operations to injure or otherwise harm civilians or uninvolved military personnel. Impacts could result from physical injury caused directly by hazardous operations, or as an indirect result of hazardous materials expended from a training event.

Stressors that potentially could impact public health and safety are identified in Table 3.18-1. These include disturbance from and collisions with surface and subsurface ships; noise and strikes associated with aircraft use; mine warfare training activities, including the deployment and recovery of mine shapes; the use of non-explosive practice munitions (NEPM); the use of bombs, missiles, and other explosive ordnance; and the release of military expended material (MEM).

Electromagnetic radiation (EMR) is produced by radar, navigational aids, and electronic warfare (EW) systems. Lasers, which are used in range-finding and targeting systems, have the potential to damage living tissue, particularly in the eye. Because they are used across several types of stressors, the potential effects from EMR and lasers are considered separately from the other stressors.

Amplification on some of the effects that relate to public health and safety is provided in other sections of this chapter as follows.

- Military expended materials, including hazardous materials and hazardous wastes, are addressed in Section 3.2.
- Water quality impacts are considered in Section 3.3.
- Effects on air quality are evaluated in Section 3.4.

Noise that is transmitted through the air is evaluated in Section 3.5.

3.18.2 Affected Environment

Military, commercial, institutional, and recreational activities take place in the VACAPES Study Area (See Section 1.5). Although the Federal Aviation Administration (FAA) established warning areas for military aircraft operations, most of the airspace and seaspace in the range complex is available for use by all civilian and military users. Only hazardous activities require exclusive use of an area, and periods of these activities are scheduled in advance by the Navy and broadcast through U.S. Coast Guard (USCG) notices to mariners (NOTMAR) and FAA notices to airmen (NOTAM).

The public typically accesses the offshore ocean areas within the study area for recreational purposes such as sport fishing, sailing, boating, and diving. In addition, substantial numbers of civilians are on the water within the range complex as they engage in activities such as commercial fishing or shipping to and from major ports, including the Port of Virginia and Port of Baltimore.

As described below, the Navy has standard operating procedures (SOP) in place to ensure public health and safety, regardless of whether operations are occurring in U.S. territorial waters or international waters. In addition to the preventive measures described below, during all training events or exercises, weapons delivery events are delayed or cancelled if range areas are not clear. Prior to issuing a "Green Range," Navy personnel must ensure that the hazard footprint of the ordnance being fired is clear of non-participating surface vessels, divers, and aircraft.

3.18.2.1 Controlling Procedures

Airspace Controlling Procedures

Fleet Area Control and Surveillance Facility (FACSFAC) VACAPES is a designated air traffic control (ATC) facility. As such, it is required to provide air traffic separation consistent with FAA guidelines to ensure the safe, efficient, expeditious flow of air traffic. Radar surveillance and radio communications assist in providing area containment and air traffic control separation between military aircraft and the high volume of commercial aircraft transiting the numerous jet routes along the Atlantic Coast.

FACSFAC VACAPES may issue airspace clearances by warning area (for example, W-72 or Warning Area/Special Operating Area W-72A). However, because the need exists to precisely define smaller parcels of airspace, FACSFAC VACAPES has instituted a special operating area management concept.

Within the VACAPES OPAREA, airspace and surface clearances are issued separately, except in W-72 where the surface and air grids are aligned. In other warning areas, airspace does not always encompass the same area as the assigned surface operating areas. This situation exists in the following instances:

- Atlantic Route 8 and Atlantic Route 9, which partially overlay surface operating areas, are not included in the airspace clearance issued when using the Surface Area Grid Reference System.
- Two or more warning areas may overlay a surface operating area. The airspace clearance issued using the Surface Area Grid Reference System includes only the airspace overlying the surface grids within a specified warning area and not the entire surface grid.

FACSFAC VACAPES and the FAA Command Center work together to implement the Severe Weather Avoidance Plan (SWAP), which is an approved plan between both organizations to help minimize the effects of severe weather on civilian airline traffic flow along the eastern seaboard. If DoD training requirements are not impacted, SWAP will normally be implemented from altitudes FL290 to FL390 to facilitate the FAA ATC system when flight through portions of airspace is difficult or impossible because of severe weather. Subject to military training requirements, GIANTKILLER (VACAPES' tactical call sign) may release portions of SWAP special use airspace (SUA) located within W-386 and W-50. Upon completion of all military training within the warning areas, FACSFAC VACAPES releases the warning areas from FL240 and above to the FAA on a real-time basis.

Surface and Subsurface Controlling Procedures

Clearance for a surface area does not include the airspace above or the subsurface below. Units are required to obtain clearance for all hazardous or exclusive operations within the OPAREA. Subsurface operations may be requested and conducted in all areas with 48 hours notice, except VACAPES OPAREA 3B (Figure 2.1-1), which can be scheduled in real time.

Submarine transit lanes ECHO and WHISKEY extend from the eastern boundary of the VACAPES OPAREA to a line about 60 nm west from the mouth of the Chesapeake Bay. These lanes are used by submarines traveling to and from OPAREAs. Submarines that enter the surface area (that is, surface down to, but not including, 98 feet) should expect mutual use of the area. Unless an exclusive surface

TABLE 3.18-1
SUMMARY OF POTENTIAL STRESSORS TO PUBLIC HEALTH AND SAFETY

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
Mine Warfare (MIW)									
Mine Countermeasures Exercise (MCM)	Lower Chesapeake Bay			✓	✓	✓	✓		
Mine Countermeasures Exercise (MCM)	W-50A/C W-386, W-72			✓	✓	✓	✓		
Mine Neutralization	W-50C	✓				✓	✓	✓	✓
Surface Warfare (SUW)									
Bombing Exercise (Air-to-Surface) (at sea)	W-386 (Air-K) W-72A (Air-3B) W-72A/B			✓	✓		✓	✓	✓
Missile Exercise (MISSILEX) (Air-to-Surface)	W-386 (Air-K) W-72A			✓	✓		✓	✓	✓
Gunnery Exercise (GUNEX) (Air-to-Surface)	W-386 (Air-K), W-72A, W-72A (Air-1A), W-50C			✓	✓		✓		✓
GUNEX (Surface-to-Surface) Boat	W-50C, R-6606	✓	✓				✓		✓
GUNEX (Surface-to-Surface) Ship	W-386, W-72	✓	✓				✓		✓
Laser Targeting	W-386 (Air-K)			✓	✓				
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- Ship	VACAPES OPAREA	✓	✓						
VBSS/MIO- Helo	VACAPES OPAREA	✓	✓	✓	✓				
Air Warfare (AW)									
Air Combat Maneuver (ACM)	W-72A (Air-2A/B, 3A/B)			✓	✓				
GUNEX (Air-to-Air)	W-72A			✓	✓				✓
MISSILEX (Air-to-Air)	W-386 (Air D, G, H, K) W-72A			✓	✓		✓	✓	✓

TABLE 3.18-1
SUMMARY OF POTENTIAL STRESSORS TO PUBLIC HEALTH AND SAFETY (Continued)

Warfare Area and Operation	Training Areas	Vessel Movements (Disturbance)	Vessel Movements (Collisions)	Aircraft Overflights (Disturbance)	Aircraft Overflights (Strikes)	Mine Warfare Deployment/Recovery	Non-Explosive Practice Munitions	Underwater Detonations and High Explosive Ordnance	Military Expended Materials
GUNEX (Surface-to-Air)	W-386, W-72	✓	✓	✓	✓		✓		✓
MISSILEX (Surface-to-Air)	W-386 (Air D, G, H, K)	✓	✓	✓	✓		✓		✓
Air Intercept Control (AIC)	W-386, W-72			✓	✓				
Detect to Engage (DTE)	W-386, W-72			✓	✓				
Strike Warfare (STW)									
HARM Missile Exercise	W-386 (Air E,F,I,J)			✓	✓		✓	✓	✓
Amphibious Warfare (AMW)									
Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	W-386 (7C/D, 8C/D), W-72 (1C1/2) (Preferred Areas), W-386 (5C/D) (Secondary Areas)	✓					✓	✓	✓
Electronic Combat (EC)									
Chaff Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓	✓				✓
Chaff Exercise- ship	W-386 and W-72	✓	✓						✓
Flare Exercise- aircraft	W-386, W-386 (Air-K) and W-72			✓	✓				✓
Electronic Combat (EC) Operations- aircraft	W-386 (Air-K)			✓	✓				
EC Operations- ship	VACAPES OPAREA	✓	✓						
Test and Evaluation									
Shipboard Electronic Systems Evaluation Facility (SESEF) Utilization	VACAPES OPAREA	✓	✓						

area clearance has been obtained from FACSFAC VACAPES by the Submarine Exercise Area Coordinator (SEAC), surface units may be assigned operations in these areas. FACSFAC VACAPES grants concurrent surface and exclusive subsurface clearances to the SEAC for submarine operations.

In all waters where submarine operations are scheduled, surface units are directed to use one or more of the following (unless operations are part of an exercise involving the location of ships): cavitation speeds, active fathometer with maximum depth mode on, or as a last resort, sonar. This requirement may be waived by the Officer Conducting the Exercise (OCE) for surface participants when the Submarine Operating Authority (SUBOPAUTH) approves coordinated exercises involving submarines.

3.18.2.2 Range Safety Procedures

All range safety precautions and regulations contained in COMLANTFLTINST 3120.26, Atlantic Fleet Operating Areas and Warning Areas, apply in the VACAPES OPAREA. In addition, FACSFAC VACAPES imposes additional safety requirements, listed below, which may be waived by the FACSFAC VACAPES commanding officer, as the situation dictates.

- Dropping any ordnance, any use of high-explosive munitions or NEPM, or any live fire is a hazardous event. All hazardous or exclusive operations and exercises conducted in the FACSFAC VACAPES OPAREA require clearance from FACSFAC VACAPES.
- The firing or dropping of ordnance must be scheduled with FACSFAC VACAPES. Firing exercises are not authorized without prior FACSFAC VACAPES approval.
- Small-arms (munitions .50-caliber and under) qualifications on ships do not require FACSFAC VACAPES approval. The unit conducting small-arms fire is responsible for clearing their area.
- Non-hazardous/concurrent air, surface and subsurface operations, such as independent steaming exercise transits, navigation drills, deck-landing qualifications, and helicopter operations do not require a specific clearance or message request.

3.18.2.3 Range Inspection Procedures

Within the VACAPES OPAREA and warning areas, all units conducting firing or other hazardous activity must comply with Section 8, Chapter 1 of CINCLANTFLTINST 3120.26 and all Fleet exercise publications. FACSFAC VACAPES promulgates NOTAMs as applicable. OCEs may not authorize firing or jettisoning of aerial targets unless the area is confirmed to be clear of nonparticipating civilian and military units.

NASOCEANAINST 3710.19A requires all pilots using the Navy Dare County Bombing Range who are unfamiliar with a target to make a familiarization run to obtain a positive target identification. Flight leaders must require at least one familiarization run on unmanned targets (Palmetto Point and Stumpy Point, if they are operational) to ensure that the target is clear.

3.18.2.4 Coordination Procedures

FACSFAC VACAPES provides Fleet surveillance and functional area support services that include scheduling, monitoring, and controlling DoD air, surface, and subsurface units operating in Warning Area 105 (Narragansett Bay OPAREA) southward to W-122 (Cherry Point OPAREA). In addition, its mission includes the following activities and procedures:

- Coordinate DoD use of oceanic airspace east of the warning areas to the Azores, and in the Gulf of Mexico.
- Schedule inland aircraft target ranges and military training routes.
- Provide air intercept control services.
- Schedule, coordinate, and provide range control for surface and airborne missile firing exercises.

- Provide facility support, coordination, and information warfare (IW) opposition force (OPFOR) training equipment maintenance and scheduling support for Commander Second Fleet, Commander Carrier Group Four, and associated opposition forces and data collection teams involved with major joint exercises and Fleet exercises for Atlantic Fleet assets.
- Coordinate, schedule, and oversee associated commercial and military aircraft services support (Atlantic and Pacific Fleet requirements).
- Act as regional airspace coordinator for DoN activities and the FAA.
- Act as a certified Class VI ATC facility.
- Provide full ATC services by direct interface with FAA and military/civil approach controls.
- Coordinate operations with USCG search and rescue, anti-immigration interdiction defense operations, federal drug interdiction teams, Maritime Homeland Security Operations, and Trusted Agent for Southeast Air Defense Sector and Northeast Air Defense Sector.
- Provide facility support for Naval Surface Warfare Center (NSWC) Corona in the operation, maintenance, and services for the Large Area Tracking Range (LATR).
- Provide facility support to the Atlantic Fleet Exercise Coordination Center in the coordination and prioritization of all requests for assets, services, surface operating areas, special use airspace, and altitude reservations required for integrated and joint military exercises.

Close coordination between military and civilian ATC facilities enables effective, real-time, joint use of the VACAPES Range Complex warning areas. Under this procedure, regardless of the schedule for the use of a military warning area, civilian aircraft may use warning area airspace until a military aircraft is actually enroute to that area. FACSFAC VACAPES has the responsibility to ensure civilian air carrier transit of SUA does not conflict with DoD operations and training. Specific guidelines, procedures, and restrictions are outlined in FACSFACVACAPESINST 3120.1.SERIES.

In the late 1990s, Naval Aviation Systems Team (Aircraft Division), Patuxent River, explored the feasibility of using the Atlantic Test Range Complex to enhance naval aviation operator training. The scope soon expanded to include naval (Navy and Marine Corps), Army, and Air Force training, and others. The Commander, Fleet Forces Command endorsed the concept and the formation of the Chesapeake Regional Ranges Cooperative (CRRC). Through a memorandum of agreement, the members of the CRRC collaborate in supporting the RDT&E and interoperability requirements of DoD acquisition managers. They also support and cooperate in all phases of warfighter readiness training and Joint Forces warfare experimentation. Currently, the CRRC includes the following organizations:

- Naval Air Warfare Center, Aircraft Division (NAWCAD), Patuxent River, Maryland;
- NASA Wallops Flight Facility, Wallops, Virginia;
- Maryland Army National Guard, 2nd Battalion, 115th Infantry, Chestertown, MD;
- U.S. Army Garrison, Fort A.P. Hill, Bowling Green, Virginia;
- Naval Surface Warfare Center, Port Hueneme Division, Dam Neck, Virginia; and
- U.S. Fleet Forces (USFF N7) (training ranges), Norfolk, VA.

In addition to the coordination activities that occur among the members of the CRRC, the Airspace Management Branch, Range Operations Division provides aircraft control and traffic advisory for extensive airspace resources covering regions over the Chesapeake Bay and the Atlantic Ocean along the coastline of Delaware, Maryland, and Virginia. The branch also serves as liaison to FACSFAC VACAPES, FAA, and Air Operations.

3.18.2.5 Links to Other Ranges

FACSFAC VACAPES controls the offshore warning areas and operating area in the vicinity of the Atlantic Test Ranges. As a designated ATC facility, FACSFAC VACAPES is responsible for all aircraft (general, military, and commercial) operating within its area of responsibility, the scheduling of offshore warning areas and operating areas, and preparing NOTAMs and NOTMARs for broadcast by the FAA and USCG, respectively. FACSFAC VACAPES also coordinates ATC and flight monitoring.

FACSFACVACAPESINST 3120.1 SERIES applies for all standard Fleet operations, such as training. For non-standard operations, such as RDT&E testing, NAWCAD assumes control and responsibility for the safe conduct of NAWCAD exercises or operations within VACAPES Range Complex warning areas, pursuant to the current letter of agreement between FACSFAC VACAPES and NAWCAD.

3.18.2.6 Scheduling

VACAPES Range Complex is scheduled by FACSFAC VACAPES using a manual system that provides schedule information in a tabular format to the Fleet via naval message. This format is produced weekly and changes are made to the schedule via naval message. The schedule is also posted in the same format to the FACSFAC VACAPES web site.

LATR services may be scheduled at the FACSFAC VACAPES weekly range scheduling meeting conducted on Wednesdays at 0900 at the NAS Oceana TACTS (Building 310). LATR is scheduled by event number, two weeks in advance. Surface units requiring LATR to support training during smaller exercises and operations must request LATR Ship Instrumentation Packages at least five working days prior to the underway period. Priorities for the use of the LATR by flying units are set by the fighter and strike fighter commanders.

Detailed scheduling procedures for the VACAPES OPAREA, warning areas, restricted areas, and ranges are established by FACSFAC VACAPES. Table 3.18-2 summarizes the scheduling activities for the various VACAPES Range Complex components.

TABLE 3.18-2
RANGE SCHEDULING ACTIVITIES

Range Complex Component	Scheduling Activity
VACAPES OPAREA Special Use Airspace	FACSFAC VACAPES
Oceana TACTS	Naval Surface Warfare Center NAS Oceana, Virginia Beach, VA 23460

a/ Source: DoN, 2006; U.S. Navy, 2000a

3.18.2.7 Communications

All units and platforms operating within the VACAPES OPAREA are required to maintain positive two-way radio communication with VACAPES' tactical call sign GIANTKILLER, FACSFAC's primary high-frequency and Link Coordination Windows, and Fleet Satellite High Communications. Upon clearance, units may conduct operations, both tactical and live-fire, at the discretion of the Commanding Officer and without positive control from FACSFAC VACAPES. Call sign and frequency changes, authentications, and encryptions are in accordance with Fleet operating instructions or messages.

Aircraft will not operate in FACSFAC VACAPES airspace without an operable, two-way, air-to-ground radio. Aircraft operating at less than 5,000 feet above mean sea level (MSL) may experience difficulty in establishing or maintaining two-way radio communication with GIANTKILLER and may be required to climb to at least 5,000 feet MSL to reestablish communications with GIANTKILLER.

Long-range aircraft, such as the P-3 and C-130, that enter the VACAPES OPAREA for extended operations are required to issue an operations normal report (OPS Normal) every hour while under GIANTKILLER's jurisdiction. All other aircraft, including helicopters, are required to give OPS Normal reports every half-hour. Appropriate procedures for lost communications, transponder failure, and search-and-rescue are contained in FACSFACVACAPESINST 3120.1 SERIES.

All air-to-ground communications are recorded for possible use in an aircraft accident investigation or if a question arises about what information passed between range control and the pilot. In the event neither occurrence arises, the recordings are deleted and the tapes are reused.

3.18.3 Environmental Consequences

Public safety impacts are significant if the general public is substantially endangered as a result of Navy activities within the VACAPES Range Complex. For each training activity or group of similar activities, an estimate of risk to the general public was formulated, based on the Navy's current set of safety procedures for range activities.

Activities in the VACAPES Range Complex would be conducted in accordance with guidance provided in FACSFAC VACAPES Instruction 3120. The instruction provides operational and safety procedures for all normal range events. Its emphasis is on providing information to range users so they can operate safely and avoid affecting non-military activities such as shipping, recreational boating, diving, and commercial or recreational fishing.

Several factors were considered in evaluating the effects of the Navy's activities on public safety. These factors include proximity to the public, access control, scheduling, public notification of events, frequency of events, duration of events, range safety procedures, operational control of training events, and safety history.

3.18.3.1 No Action Alternative

Public Safety

Under the No Action Alternative, Fleet training activities would continue to be conducted in the VACAPES OPAREA. Offshore operations would continue to expend ordnance and other materials, including bombs, missiles, NEPM, shells, bullets, marine markers (smoke floats), and targets from vessels and aircraft. The ordnance used in offshore operations would include high-explosive, wholly inert, and non-explosive practice munitions.

As under current conditions, a range safety officer (RSO) would always be on duty while activities were in progress. The RSO would halt any activity if a potentially unsafe condition arose. The continued use of RSOs under the No Action Alternative would ensure that projectiles, targets, and missiles were operated safely, and that air operations and other hazardous Fleet training activities were safely executed in controlled areas.

The Navy would continue to implement its standard range safety procedures, which are proven effective in avoiding risks to the public and to Navy activities. When aircraft or surface vessels fire ordnance, range procedures and safety practices would ensure there were no vessels or aircraft in the intended path or impact area of the ordnance. Before any training event would be allowed to proceed, the target area would be determined to be clear using ship sensors, visual surveillance of the range from aircraft and range safety boats, and radar and acoustic data.

The hazard footprint for the ordnance to be used is based on the range of the weapon, and includes a large safety buffer to account for the item going off-target or functioning prematurely. For activities with a large hazard footprint (for example, MISSILEXs), special sea and air surveillance measures would be taken to search for, detect, and clear the area of intended activities. Aircraft would continue to be required to make a preliminary pass over the intended target area to ensure that it was clear of boats, divers, or other non-participants. Aircraft carrying ordnance would not be allowed to over-fly surface vessels.

Target areas would be cleared of personnel prior to conducting training, so the only public health and safety issue would be in the very rare occasion when an activity exceeded the safety area boundaries.

Risks to public health and safety would be further reduced by providing termination systems on some missiles. In cases where a weapon system did not have a flight termination capability, the target area would be determined to be clear of unauthorized vessels and aircraft, based on the flight distance the vehicle can travel, plus a 5-mile area beyond the system performance parameters.

There would be about 210 helicopter sorties annually within the VACAPES Study Area that would involve towing either the MK-104 or MK-105 mine-sweeping system in the water (see Table 2.2-4). These systems would be deployed from the dock at NS Norfolk, and MH-53 or MH-60S helicopters would tow the equipment in the water while flying at 75 to 100 feet above water level for 15 to 20 miles into the Chesapeake Bay. If the aircraft encountered a commercial or recreational vessel, the aircrew either would stop forward progress or maneuver the aircraft safely around the vessel before continuing the mission.

All training activities would continue to comply with DoD Directive 4540.01, "*Use of International Airspace by U.S. Military Aircraft and for Missile/Projectile Firings*" (DoD, 2007). These documents specify procedures for conducting aircraft operations and firing missiles and projectiles. The missile and projectile firing areas would continue to "be selected so that trajectories are clear of established oceanic air routes or areas of known surface or air activity" (DoD, 2007).

Recreational diving activities within the VACAPES OPAREA takes place primarily at known diving sites, including shipwrecks and artificial reefs. The locations of these popular dive sites are well-documented, dive boats are typically well-marked, and diver-down flags would be visible from and avoided by ships conducting training under the No Action Alternative. As a result, interactions between training activities within the offshore areas and scuba diving would be minimized. Similar knowledge and avoidance of popular fishing areas would help reduce interactions with recreational anglers.

Most naval training conducted under the No Action Alternative would occur well out to sea, while most civilian activity, other than shipping and some commercial fishing, is conducted within a few miles of land. This separation would help prevent interferences among military and civilian activities and reduce the potential for incidents that would threaten the safety of civilians.

FACSFAC VACAPES would continue to use its ATC function, and to work with the FAA, to provide separation between military aircraft and civilian aircraft in the study area. The scheduling and coordination activities of FACSFAC VACAPES with agencies such as the USCG and interdiction teams for illegal immigrants and drugs would continue to ensure that neither agents nor the individuals they were assisting or seeking would be endangered by training activities. Continued implementation of the SWAP program would continue to enhance civilian aviation during inclement weather.

The Navy would continue to recover many of the targets that were used in training so that they would not pose a collision risk. Unrecoverable pieces of MEM are typically small (such as the 19-inch-long, 3-inch-diameter MK-25 marker), constructed of soft materials (such as target cardboard boxes or tethered target balloons), or intended sink to the bottom after their useful function was completed (such as shot-up 55-gallon steel drums), so that they would not represent a collision risk to civilian vessels. Additional information on the fate of these materials is provided in Section 3.2.

The Navy would continue to temporarily limit public access to areas where there was a risk of injury or property damage through the use of NOTAMs and NOTMARs. Public safety would continue to be enhanced by providing the public with information that would let them take an active role in avoiding interactions with naval training and ensuring their own safety.

All of these public safety measures were developed over a long period of time of public interaction. They are all proven effective, and are currently employed on a routine basis in the VACAPES Range Complex.

Their continued implementation under the No Action Alternative would ensure that no changes in, and no adverse effects to, public safety would occur.

Public Health

Management of MEM in conjunction with Navy training exercises in the VACAPES Study Area is addressed in Section 3.2. While continued releases of hazardous materials, such as metals, hydraulic fluid, fuel and other hydrocarbons, propellants, and unconsumed explosives would occur, the liquid and soluble constituents of concern would quickly disperse in the water column. Solid constituents of concern would rapidly settle to the ocean floor and soon become buried in sediment, coated by corrosion, or encrusted by benthic organisms. Because of the very small quantities of these materials relative to the extent of the sea ranges, the effective dilution volume provided by the ocean, and the remoteness of the sea ranges relative to human populations, their effect on human health would not be detectable. Details regarding the fate and transport of MEM constituents are provided in Section 3.2.

Sources of EMR include radar, navigational aids, and electronic warfare (EW) systems. These systems are the same as, or similar to, civilian navigational aids and radars at local airports and television weather stations throughout the United States. EW systems emit EMR similar to that from cell phones, hand-held radios, commercial radio stations, and television stations. SOPs are in place to protect Navy personnel and the public from EMR hazards. These include setting the heights and angles of EMR transmissions to avoid direct exposure, posting warning signs, establishing safe operating levels, and activating warning lights when radar systems are operational. Measures also are in place to avoid excessive exposure from EMR emitted by military aircraft. The No Action Alternative would not result in any change in EMR types or use, and would not result in any change in impacts on public health.

Laser hazards also exist within the VACAPES Study Area, where these high-energy light sources are used for precision range finding and by target-designation systems for guided munitions. A comprehensive safety program exists for the use of lasers. SOPs protect individuals from the hazard of severe eye injury caused by the nature of the laser light. The completion of a laser safety course, use of protective goggles, maintenance of a medical surveillance program, and implementation of mishap reporting procedures are required by all units conducting laser training. Laser safety requirements for aircraft require a dry run to ensure that target areas are clear. In addition, during actual laser use, the aircraft run-in headings are restricted to preclude inadvertent lasing of areas where personnel may be present. Continued use of these procedures would ensure that changes in public health relating to the use of lasers would not occur with the implementation of the No Action Alternative.

Summary

In accordance with the NEPA, naval activity in U.S. territory under the No Action Alternative would have no significant impact on public health and safety. In accordance with EO 12114, naval activity in non-territorial waters would not cause harm to public safety.

3.18.3.2 Alternative 1

Under Alternative 1, training and RDT&E operations would be increased or modified to the minimal extent possible to meet Navy and DoD current and near-term operational training and RDT&E requirements. Under this alternative, force structure changes would be accommodated and range complex capabilities would be enhanced. To accommodate recent force structure changes with the introduction of the MH-60S Seahawk Multi-Mission Helicopter, training areas would be established, including limited capability to support Organic Mine Countermeasures (OMCM).

In addition to maintaining current levels of operations (the No Action Alternative baseline), Alternative 1 at the VACAPES Range Complex would support the FRTP.

As summarized in Table 2.2-5 and detailed in Table 2.2-4, 2.2-6, and 2.2-7, the increased training tempo would result in more steaming hours by vessels, more sorties flown by fixed-wing aircraft and helicopters, more use of explosive munitions and NEPM, more underwater detonations, and more deployment of expendable materials. All of these activities have the potential to pose a risk to public health and safety. However, the Navy would continue to apply the risk reduction measures that were described for the No Action Alternative. These measures would be effective in protecting the public so that no measurable changes in accidents, injuries, or illnesses would be expected with the implementation of Alternative 1.

Increased use of the MH-60S and training to support OMCM would pose many of the same types of risks that were described for the No Action Alternative, and the measures described for that alternative would be effective in protecting public health and safety. Additional risks posed by these activities would be associated with increased aircraft overflights and ordnance. Safety measures that would be implemented for exercises in support of OMCM would include

- Avoiding shipping lanes, popular dive sites, shipwrecks, and recreational fishing areas when selecting training area locations;
- If a training area was fouled by recreational pursuits, cancelling or delaying training until the training area was clear; and
- Using the live fire mine countermeasures platforms (RAMICS, AMNS, and MK-103) only in W-50A and W-50C because they already are designated as live-fire areas.

As a result of these measures, there would not be measurable changes in accidents, injuries, or illnesses compared to the No Action Alternative.

In accordance with the NEPA, naval activity in U.S. territory under Alternative 1 would have no significant impact on public health and safety. In accordance with EO 12114, naval activity in non-territorial waters would not cause harm to public safety.

3.18.3.3 Alternative 2 (Preferred Alternative)

Training events proposed under Alternative 2 would have all the components of Alternative 1, but with additional increases in many operations (except for a decrease in the use of high-explosive bombs) and the designation of additional mine warfare training areas. The safety procedures implemented under this alternative would be the same as those described for the No Action Alternative and Alternative 1, and would be equally effective in protecting public health and safety. Therefore, for the types of operations that would have been included in the other alternatives, Alternative 2 would not result in any measurable changes in accidents, injuries, or illnesses.

As summarized in Tables 2.2-5 and 2.2-7, Alternative 2 would result in a substantial decrease in the use of high-explosive bombs. This alternative would eliminate the use of MK-84 bombs (944.8 pounds net explosive weight [NEW]), MK-82 bombs (192.2 pounds NEW), and MK-20 bombs (109.7 pounds NEW), and would reduce the numbers of MK-83 bombs (415.8 pounds NEW) used in bombing exercises by 85 percent. However, these changes would not result in any reductions in risk to public health and safety. Because of the Navy's strict implementation of safety measures, current use of these high-explosive bombs has not resulted in any civilian deaths or injuries, and their reduced use under Alternative 2 would not change this safety record.

Alternative 2 would establish six separate MIW training areas, including two in the lower Chesapeake Bay and four in the VACAPES OPAREA. Safety measures that would be implemented for the establishment and use of these training areas would include

- Avoiding shipping lanes, popular dive sites, shipwrecks, and recreational fishing areas when selecting training area locations;
- If a training area was fouled by recreational pursuits, cancelling or delaying training until the training area was clear; and
- Using the live fire mine countermeasures platforms (RAMICS, AMNS, and MK-103) only in W-50A and W-50C because they already are designated as live-fire areas.

As a result of these measures, there would not be measurable changes in accidents, injuries, or illnesses compared to the No Action Alternative.

In accordance with the NEPA, naval activity in U.S. territory under Alternative 2 would have no significant impact on public health and safety. In accordance with EO 12114, naval activity in non-territorial waters would not cause harm to public safety.

3.18.4 Unavoidable Significant Environmental Effects

There would not be any unavoidable significant environmental effects on public health and safety as a result of implementation of the No Action Alternative, Alternative 1, or Alternative 2.

3.18.5 Summary of Environmental Effects (NEPA and EO 12114)

As summarized in Table 3.18-3, No Action Alternative, Alternative 1, and Alternative 2 would have no significant impact on public health and safety. Furthermore, the No Action Alternative, Alternative 1, and Alternative 2 would not cause harm to public health and safety in non-territorial waters.

TABLE 3.18-3
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON PUBLIC HEALTH AND SAFETY IN THE VACAPES STUDY AREA

Alternative and Stressor	NEPA (Territorial Waters, 0 to 12 nm)	Executive Order 12114 (Non-Territorial Waters, >12 nm)
No Action		
Vessel movements (disturbance and collisions)	SOPs are in place to avoid civilian craft. Use of NOTMARs would provide the public with information that would enable them to avoid interactions with naval training and help ensure their own safety.	SOPs are in place to avoid civilian craft. Use of NOTMARs would provide the public with information that would enable them to avoid interactions with naval training and help ensure their own safety.
Aircraft overflights (disturbance and strikes)	FACSFAC VACAPES would provide separation between military and civilian aircraft. Use of NOTAMs would provide civilian aviators with information that would enable them to avoid interactions with naval training and help ensure their own safety.	FACSFAC VACAPES would provide separation between military and civilian aircraft. Use of NOTAMs would provide civilian aviators with information that would enable them to avoid interactions with naval training and help ensure their own safety.
Mine warfare deployment and recovery	SOPs are in place to avoid civilian interactions during mine countermeasure and mine neutralization activities.	SOPs are in place to avoid civilian interactions during mine countermeasure and mine neutralization activities.
Non-explosive practice munitions	SOPs are in place to exclude civilian activities from areas of NEPM use.	SOPs are in place to exclude civilian activities from areas of NEPM use.
Underwater detonations and high-explosive ordnance	SOPs are in place to ensure ranges are clear before ordnance deliveries and detonations begin.	SOPs are in place to ensure ranges are clear before ordnance deliveries and detonations begin.
Expended materials	Most large pieces would be recovered. Most other pieces would be small or soft, or would sink to the bottom after use. Hazardous materials or hazardous waste would only be released into the water in small volumes and quickly would be diluted.	Most large pieces would be recovered. Most other pieces would be small or soft, or would sink to the bottom after use. Hazardous materials or hazardous waste would only be released into the water in small volumes and quickly would be diluted.
Electromagnetic radiation (EMR) and lasers	SOPs are in place to protect Navy personnel and the public from hazards resulting from the use of EMR and lasers.	SOPs are in place to protect Navy personnel and the public from hazards resulting from the use of EMR and lasers.
Impact conclusion	No significant impact to public health and safety.	No harm to public health and safety.
Alternative 1		
Vessel movements (disturbance and collisions)	SOPs are in place to avoid civilian craft. Use of NOTMARs would provide the public with information that would enable them to avoid interactions with naval training and help ensure their own safety.	SOPs are in place to avoid civilian craft. Use of NOTMARs would provide the public with information that would enable them to avoid interactions with naval training and help ensure their own safety.
Aircraft overflights (disturbance and strikes)	FACSFAC VACAPES would provide separation between military and civilian aircraft. Use of NOTAMs would provide civilian aviators with information that would enable them to avoid interactions with naval training and help ensure their own safety.	FACSFAC VACAPES would provide separation between military and civilian aircraft. Use of NOTAMs would provide civilian aviators with information that would enable them to avoid interactions with naval training and help ensure their own safety.
Mine warfare deployment and recovery	SOPs are in place to avoid civilian interactions during mine countermeasure and mine neutralization activities.	SOPs are in place to avoid civilian interactions during mine countermeasure and mine neutralization activities.
Non-explosive practice munitions	SOPs are in place to exclude civilian activities from areas of NEPM use.	SOPs are in place to exclude civilian activities from areas of NEPM use.

TABLE 3.18-3 (Continued)
SUMMARY OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES ON PUBLIC HEALTH AND SAFETY IN THE VACAPES STUDY AREA

Alternative and Stressor	NEPA (Territorial Waters, 0 to 12 nm)	Executive Order 12114 (Non-Territorial Waters, >12 nm)
Underwater detonations and high-explosive ordnance	SOPs are in place to ensure ranges are clear before ordnance deliveries and detonations begin.	SOPs are in place to ensure ranges are clear before ordnance deliveries and detonations begin.
Expended materials	Most large pieces would be recovered. Most other pieces would be small or soft, or would sink to the bottom after use. Hazardous materials or hazardous waste would only be released into the water in small volumes and quickly would be diluted.	Most large pieces would be recovered. Most other pieces would be small or soft, or would sink to the bottom after use. Hazardous materials or hazardous waste would only be released into the water in small volumes and quickly would be diluted.
EMR and lasers	SOPs are in place to protect Navy personnel and the public from hazards resulting from the use of EMR and lasers.	SOPs are in place to protect Navy personnel and the public from hazards resulting from the use of EMR and lasers.
Impact conclusion	No significant impact to public health and safety.	No harm to public health and safety.
Alternative 2		
Vessel movements (disturbance and collisions)	SOPs are in place to avoid civilian craft. Use of NOTMARs would provide the public with information that would enable them to avoid interactions with naval training and help ensure their own safety.	SOPs are in place to avoid civilian craft. Use of NOTMARs would provide the public with information that would enable them to avoid interactions with naval training and help ensure their own safety.
Aircraft overflights (disturbance and strikes)	FACSFAC VACAPES would provide separation between military and civilian aircraft. Use of NOTAMs would provide civilian aviators with information that would enable them to avoid interactions with naval training and help ensure their own safety.	FACSFAC VACAPES would provide separation between military and civilian aircraft. Use of NOTAMs would provide civilian aviators with information that would enable them to avoid interactions with naval training and help ensure their own safety.
Mine warfare deployment and recovery	SOPs are in place to avoid civilian interactions during mine countermeasure and mine neutralization activities.	SOPs are in place to avoid civilian interactions during mine countermeasure and mine neutralization activities.
Non-explosive practice munitions	SOPs are in place to exclude civilian activities from areas of NEPM use.	SOPs are in place to exclude civilian activities from areas of NEPM use.
Underwater detonations and high-explosive ordnance	SOPs are in place to ensure ranges are clear before ordnance deliveries and detonations begin.	SOPs are in place to ensure ranges are clear before ordnance deliveries and detonations begin.
Expended materials	Most large pieces would be recovered. Most other pieces would be small or soft, or would sink to the bottom after use. Hazardous materials or hazardous waste would only be released into the water in small volumes and quickly would be diluted.	Most large pieces would be recovered. Most other pieces would be small or soft, or would sink to the bottom after use. Hazardous materials or hazardous waste would only be released into the water in small volumes and quickly would be diluted.
EMR and lasers	SOPs are in place to protect Navy personnel and the public from hazards resulting from the use of EMR and lasers.	SOPs are in place to protect Navy personnel and the public from hazards resulting from the use of EMR and lasers.
Impact conclusion	No significant impact to public health and safety.	No harm to public health and safety.

3.19 SUMMARY OF ATLANTIC FLEET ACTIVE SONAR TRAINING AND AGGREGATE IMPACTS IN THE VACAPES RANGE COMPLEX

The VACAPES Range Complex EIS/OEIS incorporates by reference the Final Atlantic Fleet Active Sonar Training (AFAST) Environmental Impact Statement / Overseas Environmental Impact Statement (EIS/OEIS) (DoN, 2008). Because sonar use and sonar effects cross and go beyond OPAREA boundaries, the Navy comprehensively analyzed all Atlantic Fleet sonar training in a separate Final EIS/OEIS. Active sonar training, however, is an integral component of fleet readiness training within each range complex; therefore, the Final AFAST EIS/OEIS analysis and conclusions are summarized herein so the direct and indirect impacts of all components of fleet training in the VACAPES Range Complex can be comprehensively evaluated under NEPA and EO 12114. The reader should refer to the AFAST Final EIS/OEIS (available at http://afasteis.gcsaic.com) for the full description and analysis of active sonar activities along the East Coast and within the Gulf of Mexico. The Final AFAST EIS/OEIS was released to the public on December 12, 2008 (73 FR 75715). The Navy's consultation with NMFS, under the MMPA, concluded when the Final Rule was filed for public inspection with the Office of the Federal Register (74 FR 4844) on January 22, 2009 and the annual Letter of Authorization was subsequently issued. The Navy's consultation with NMFS, in accordance with Section 7 of the ESA, concluded when the Biological Opinion was signed on January 16, 2009 and the annual Incidental Take Statement was subsequently issued.

The Final AFAST EIS/OEIS analyzes the potential environmental effects associated with the designation of sonar use areas and the use of mid- and high-frequency active sonar technology and the improved extended echo ranging (IEER) system during Atlantic Fleet training exercises. The IEER system consists of an explosive source sonobuoy (AN/SSQ-110A) and an air deployable active receiver (ADAR) sonobuoy (AN/SSQ-101). The Navy is developing the Advanced Extended Echo Ranging (AEER) system as a replacement to the IEER system. The AEER system would use a new active sonobuoy (AN/SSQ-125) that utilizes a tonal (or a ping) versus an impulsive (or explosive) sound source as a replacement for the AN/SSQ-110A. The AEER system will still use the ADAR sonobuoy as the systems receiver. In addition, the Final AFAST EIS/OEIS incorporates research, development, test, and evaluation (RDT&E) active sonar activities similar, and coincident with, Atlantic Fleet training. For the purposes of the Final AFAST EIS/OEIS, "active sonar activities" refers to training, maintenance, and RDT&E activities involving mid- and high-frequency active sonar and explosive source sonobuoy (AN/SSQ-110A) During active sonar activities, surface ships, submarines, helicopters, and marine patrol aircraft use active sonar during Anti-Submarine Warfare (ASW), Mine Warfare (MIW), object detection/navigation, and maintenance events. The activities involving active sonar described in the Final AFAST EIS/OEIS are not new and do not involve significant changes in systems, tempo, or intensity from past activities.

The Navy analyzed four alternatives in the Final AFAST EIS/OEIS. Under Alternative 1, active sonar areas would be designated using an environmental analysis to determine locations that would minimize environmental effects to biological resources while still meeting operational requirements. Under Alternative 2, active sonar training areas would be designated using the same environmental analysis conducted under Alternative 1; however, these areas would be adjusted seasonally to minimize effects to marine resources. Under Alternative 3, sonar training would not occur within certain environmentally sensitive areas, which would be designated areas of increased awareness. The No Action Alternative can be regarded as continuing with the present course of action. Under the No Action Alternative, the Navy would continue conducting active sonar activities within and adjacent to existing OPAREAs rather than designate active sonar areas or areas of increased awareness.

The Deputy Assistant Secretary of the Navy (Environment), considered the following factors: the Congressional mandates in 10 U.S.C. § 5062; the Navy, DoD, and other federal agencies' operational, testing, and training requirements; environmental impacts; and comments received during the EIS/OEIS process in determining whether and how to designate areas where active sonar activities would occur within and adjacent to existing OPAREAs located along the East Coast of the U.S. and in the Gulf of Mexico. After carefully weighing all of these factors and analyzing the data presented in the EIS/OEIS, the DASN (E) determined that the Preferred Alternative, the No-Action Alternative, best meets the requirements for the proposed AFAST active sonar activities. The DASN (E) signed the Navy's Record of Decision (74 FR 5650) on January 23, 2009.

3.19.1 Summary of Sonar Activities in the VACAPES Range Complex

Description of Sonar Systems

There are two basic types of sonar: passive and active.

- ***Passive sonars*** are only used to listen to incoming sounds. Passive sonars do not emit sound energy into the water and cannot acoustically affect the environment.
- ***Active sonars*** emit acoustic energy to obtain information concerning a distant object from the reflected sound energy. Active sonars are the most effective detection systems against modern ultra-quiet submarines and sea mines.

Table 3.19-1 identifies the active acoustic systems analyzed in the Final AFAST EIS/OEIS. The systems that were not analyzed include systems that are typically operated at frequencies greater than 200 kHz, such as the AN/AQS-14 or AN/AQS-20. Since active sonar sources operating at 200 kHz or higher attenuate rapidly and are at or outside the upper frequency limit of marine mammals with ultrasonic hearing, further consideration and modeling of these higher frequency acoustic sources were not warranted. Refer to Section 2.2 and Appendix C in the Final AFAST EIS/OEIS for more information on sonar systems used during Atlantic fleet training.

TABLE 3.19-1
ACOUSTIC SYSTEMS ANALYZED IN THE FINAL AFAST EIS/OEIS

Systems That Were Analyzed			
System	***Frequency***	***Associated Platform***	***System Description***
AN/SQS-53	3.5 kHz	DDG and CG hull-mounted sonar	ASW search, detection, and localization; utilized 70% in search mode and 30% track mode
AN/AQS-13[1]	10.0 kHz	Helicopter dipping sonar	ASW sonar lowered from hovering helicopter (approximately 10 pings/dip, 30 seconds between pings)
AN/AQS-22	4.1 kHz	Helicopter dipping sonar	ASW sonar lowered from hovering helicopter (approximately 10 pings/dip, 30 seconds between pings)
Explosive source sonobuoy (AN/SSQ-110A)	Impulsive broadband	MPA deployed	ASW system consists of explosive acoustic source buoy (contains two 4.1 lb charges) and expendable passive receiver sonobuoy
AN/SSQ-125	MF	MPA deployed	ASW system consists of active sonobuoy and expendable passive receiver sonobuoy
AN/SQQ-32	HF	MCM over the side system	Detect, classify, and localize bottom and moored mines
AN/BQS-15	HF	Submarine navigational sonar	Only used when entering and leaving port
AN/SQS-56	7.5 kHz	FFG hull-mounted sonar	ASW search, detection, localization; utilized 70% in search mode and 30% track mode
MK-48 Torpedo	HF	Submarine fired exercise torpedo	Recoverable and non-explosive exercise torpedo; sonar is active approximately 15 min per torpedo run
MK-46/MK-54 Torpedo	HF	Surface ship and aircraft fired exercise torpedo	Recoverable and non-explosive exercise torpedo; sonar is active approximately 15 min per torpedo run

TABLE 3.19-1
ACOUSTIC SYSTEMS ANALYZED IN THE FINAL AFAST EIS/OEIS (Continued)

Systems That Were Analyzed			
AN/SLQ-25 (NIXIE)	MF	DDG, CG, and FFG towed array	Towed countermeasure to avert localization and torpedo attacks (approximately 20 mins per use)
AN/SQS-53 and AN/SQS-56 (Kingfisher)	MF	DDG, CG, and FFG hull-mounted sonar (object detection)	Only used when entering and leaving port
AN/BQQ-10 and AN/BQQ-5	MF	Submarine hull-mounted sonar	ASW search and attack (approximately 1 ping every 2 hours when in use)
Tonal sonobuoy (DICASS) (AN/SSQ-62)	8 kHz	Helicopter and MPA deployed	Remotely commanded expendable sonar-equipped buoy (approximately 12 pings, 30 secs between pings)
ADC MK-1, MK-2, MK-3 and MK-4	MF	Submarine deployed countermeasure	Expendable acoustic countermeasure (approximately 20 mins per use)
Submarine deployed countermeasure (NAE)	MF	Submarine deployed countermeasure	Expendable acoustic countermeasure (approximately 20 mins per use)

Description of Active Sonar Activities

Because the Navy conducts many different types of Independent ULT, Coordinated ULT, Strike Group training, maintenance, and RDT&E active sonar activities, the Navy grouped similar events to form representative scenarios for analysis in the Final AFAST EIS/OEIS. Specific active sonar events are described in more detail in Appendix C of the Final AFAST EIS/OEIS. Note that specific exercise names and other details occasionally change as required to meet the current operational needs. Table 3.19-2 summarizes the active sonar scenarios that typically occur in the VACAPES Study area and seaward. Refer to Section 2.3 and Appendix C in the Final AFAST EIS/OEIS for more detail on Atlantic fleet sonar training events.

In the VACAPES Study Area, all ASW training would occur beyond 12 nm from shore. A limited amount of sonar use during maintenance and navigation/object detection would occur within 12 nm of shore.

3.19.2 Summary of Environmental Consequences

In the following sections, a summary of the environmental consequences due to sonar activities in the VACAPES Study Area is provided by resource area. This is followed by a discussion of the aggregate environmental consequences by resource area due to the combined effects of sonar activities presented in the Final AFAST EIS/OEIS and the VACAPES Range Complex training events, RDT&E activities, and range enhancements proposed in this EIS/OEIS. Only the resource areas potentially impacted by sonar activities are presented below. If other resources are potentially impacted by range complex activities, the environmental consequences are discussed previously in this chapter.

For each resource area potentially affected by sonar activities, the relevant section of the Final AFAST EIS/OEIS is referenced. The reader should refer to the Final AFAST EIS/OEIS for the full discussion and analysis of environmental consequences due to sonar activities.

3.19.2.1 Bathymetry and Sediments

Summary of Environmental Consequences due to AFAST

Potential effects to bathymetry and sediments are discussed in Section 4.3 of the Final AFAST EIS/OEIS. Any potential effects are due to Military Expended Materials (MEM) during sonar activities and not recovered. Materials expended during sonar activities are summarized in Table 3.19-3.

Because a limited quantity of materials would be expended over a large operational area, there would be no significant accumulation of expended material. Materials on the sea floor would eventually be covered by sediments or be overgrown by marine life. Under the AFAST selected alternative, therefore, there would be no significant impact to bathymetry or sediments in territorial waters due to expended materials or sediment displacement. In addition, there would be no significant harm to bathymetry or sediments in non-territorial waters due to expended materials or sediment displacement.

Aggregate Environmental Consequences

The potential impacts to bathymetry and sediments due to range complex activities (other than sonar activities) are presented in Section 3.1 of this EIS/OEIS. Under all alternatives presented in this EIS/OEIS, w hen the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no significant impact to bathymetry or sediments in territorial waters due to expended materials or sediment displacement. In addition, there would be no significant harm to bathymetry or sediments in non-territorial waters due to expended materials or sediment displacement.

TABLE 3.19-2
SUMMARY OF ACTIVE SONAR ACTIVITIES IN THE VACAPES STUDY AREA AND SEAWARD

Event Name	Training Event Scenarios	Events per Year*	Length of Overall Event	Typical Event Area Dimensions	Equipment or Action	Equipment Use or Action per Event	Effects Considered
ULT- Surface Ship ASW	One or two surface ships (CG, DDG, and FFG) conducting ASW localization and tracking training.	69	2 to 6 hours	5 NM x 10 NM to 30 NM x 40 NM	Surface ship MFA ASW sonar (AN/SQS-53 or AN/SQS-56)	1 to 2 ships (CG, DDG, or FFG) pinging 1 to 3 hours each	MFA sonar exposure
					Acoustic countermeasures (AN/SLQ-25 NIXIE, MK-1, MK-2, MK-3, MK-4, or Noise Acoustic Emitter)	2 hours per NIXIE 20 minutes per MK-1, MK-2, MK-3, or MK-4 Noise Acoustic Emitter	MFA sonar exposure and expended materials
					MK-46 or MK-54 Torpedo	Exercise torpedoes could be used for RDT&E	HFA sonar exposure, direct strike, and expended materials
					MK-39 EMATT or MK-30 target	1 EMATT or MK-30 (recoverable) per exercise may be used as a target	Direct strike and expended materials
					Vessel movement	1 to 2 ships maneuvering	Vessel strike
ULT- Surface Ship Object Detection	One ship (CG, DDG, and FFG) conducting object detection during transit in/out of port for training and safety during reduced visibility.	68	1 to 2 hours	5 NM x 10 NM	Surface ship MFA ASW sonar (AN/SQS-53 or AN/SQS-56 Kingfisher) operated in object detection mode	1 ship (CG, DDG, or FFG) pinging for 1 to 2 hours	MFA sonar exposure
					Vessel movement	1 ship maneuvering	Vessel strike

TABLE 3.19-2
SUMMARY OF ACTIVE SONAR ACTIVITIES IN THE VACAPES STUDY AREA AND SEAWARD (Continued)

Event Name	Training Event Scenarios	Events per Year*	Length of Overall Event	Typical Event Area Dimensions	Equipment or Action	Equipment Use or Action per Event	Effects Considered
ULT- Helicopter ASW	One helicopter conducting ASW training using dipping sonar or sonobuoys	25	2 to 4 hours	20 NM x 30 NM	Helicopter dipping sonar (AN/AQS-13 or AN/AQS-22)	1 helicopter dipping up to two hours (10 pings per five-minute dip)	MFA sonar exposure
					Tonal sonobuoy (DICASS) (AN/SSQ-62)	Up to 4 tonal sonobuoys (DICASS)	MFA sonar exposure, direct strike, and expended materials
					Passive sonobuoy (DIFAR) AN/SSQ-53D/E	Number of sonobuoys deployed can vary	Expended materials and direct strike
					MK-46 or MK-54 Torpedo	exercise torpedoes could be used for RDT&E	HFA sonar exposure, direct strike, and expended materials
					MK-39 EMATT or MK-30 target	1 EMATT or MK-30 (recoverable) per exercise may be used as a target	Direct strike and expended materials
ULT- Submarine ASW	One submarine conducting ASW and SUW training using passive and active sonar.	10	2 to 3 days	30 NM x 40 NM	Submarine MFA sonar (AN/BQQ-10)	1 submarine pinging once per two hours (average 36 pings per event)	MFA sonar exposure
					MK-48 Torpedo	Number of exercise torpedoes could be used in a single RDT&E event could vary	HFA sonar exposure, direct strike, and expended materials
					Vessel movement	1 submarine maneuvering	Vessel strike
					MK-39 EMATT or MK-30 target	1 EMATT or MK-30 (recoverable) per exercise may be used as a target	Direct strike and expended materials
					Tactical page buoy	One tactical page buoy may be deployed	Expended materials

TABLE 3.19-2
SUMMARY OF ACTIVE SONAR ACTIVITIES IN THE VACAPES STUDY AREA AND SEAWARD
(Continued)

Event Name	Training Event Scenarios	Events per Year*	Length of Overall Event	Typical Event Area Dimensions	Equipment or Action	Equipment Use or Action per Event	Effects Considered
ULT- Submarine Navigational	One submarine operating sonar for navigation and object detection during transit in/out of port during reduced visibility.	78	1 to 2 hours	5 NM x 10 NM	Submarine MFA and HFA object detection sonar (AN/BQQ-10 or AN/BQS-15)	1 submarine pinging 1 to 2 hours	MFA and HFA sonar exposure
					Vessel movement	1 submarine maneuvering	Vessel strike
ULT- MPA ASW (tonal sonobuoy)	One MPA conducting ASW submarine localization and tracking training using tonal sonobuoys.	79	2 to 8 hours	30 NM x 30 NM to 60 NM x 60 NM	Tonal sonobuoy (DICASS) (AN/SSQ-62)	Up to 10 tonal sonobuoys (DICASS)	MFA sonar exposure, direct strike, and expended materials
					Passive sonobuoy (DIFAR)_AN/SSQ-53D/E	Number of sonobuoys deployed can vary	Expended materials and direct strike
					MK-46 or MK-54 Torpedo	exercise torpedoes could be used for RDT&E	HFA sonar exposure, direct strike, and expended materials
					MK-39 EMATT (repeater) and or MK-30 Target	1 EMATT or MK-30 (recoverable) per exercise may be used as a target	direct strike and expended materials
ULT- MPA ASW (explosive source sonobuoy	One MPA conducting ASW submarine localization and tracking training using explosive source sonobuoy (AN/SSQ-110A).	34	2 to 8 hours	60 NM x 60 NM	explosive source sonobuoy (AN/SSQ-110A)	Up to 14 AN/SQ-110A sonobuoys	Explosive byproducts, pressure wave exposure, impulsive sound exposure, direct strike, and expended materials
					receiver (ADAR) sonobuoy (AN/SSQ-101)	Up to 5 AN/SSQ-101 sonobuoys	Direct Strike and expended materials

TABLE 3.19-2
SUMMARY OF ACTIVE SONAR ACTIVITIES IN THE VACAPES STUDY AREA AND SEAWARD (Continued)

Event Name	Training Event Scenarios	Events per Year*	Length of Overall Event	Typical Event Area Dimensions	Equipment or Action	Equipment Use or Action per Event	Effects Considered
Coordinated ULT- Integrated ASW Course (IAC)	An exercise with three DDGs, one CG, one FFG, two to three helicopters, one to two submarines, and one MPA	0.2	2 to 5 days	120NM X 60NM	Surface ship MFA ASW sonar (AN/SQS-53 or AN/SQS-56)	5 ships pinging for up to 10 hours	MFA sonar exposure
					Helicopter ASW dipping sonar (AN/AQS-13 or AN/AQS-22)	1 helicopter dipping up to one hour (10 pings per five-minute dip)	MFA sonar exposure
					Submarine MFA sonar (AN/BQQ-5 or AN/BQQ-10)	1-2 submarines pinging up to 6 times each	MFA sonar exposure
					Acoustic countermeasures (AN/SLQ-25 NIXIE, MK-2, MK-3, or Noise Acoustic Emitter)	2 hours per NIXIE 20 minutes per MK-2, MK-3, and Noise Acoustic Emitter	MFA sonar exposure, direct strike, and expended materials
					Tonal sonobuoy (DICASS) (AN/SSQ-62)	Helicopters and/or MPA dropping up to 36 sonobuoys	MFA sonar exposure, direct strike, and expended materials
					Passive sonobuoy (DIFAR)_AN/SSQ-53D/E	Number of sonobuoys deployed can vary	Expended materials and direct strike
Coordinated ULT- Group Sail	An exercise with two DDGs with embarked helicopters, and one submarine.	3	2 to 3 days	30 NM x 30 NM	Surface ship MFA ASW sonar (AN/SQS-53 or AN/SQS-56)	2-3 ships pinging for several hours	MFA sonar exposure
					Helicopter ASW dipping sonar (AN/AQS-13 or AN/AQS-22)	1 helicopter dipping up to 6 hours (10 pings per five-minute dip)	MFA sonar exposure
					Submarine MFA sonar (AN/BQQ-5 or AN/BQQ-10)	1 submarine pinging up to two times	MFA sonar exposure

TABLE 3.19-2
SUMMARY OF ACTIVE SONAR ACTIVITIES IN THE VACAPES STUDY AREA AND SEAWARD
(Continued)

Event Name	Training Event Scenarios	Events per Year*	Length of Overall Event	Typical Event Area Dimensions	Equipment or Action	Equipment Use or Action per Event	Effects Considered
					Acoustic countermeasures (AN/SLQ-25 NIXIE, MK-2, MK-3, or Noise Acoustic Emitter)	2 hours per NIXIE 20 minutes per MK-2, MK-3, and Noise Acoustic Emitter	MFA sonar exposure, direct strike, and expended materials
					Tonal sonobuoy (DICASS) (AN/SSQ-62)	1 helicopter dropping up to 4 sonobuoys	MFA sonar exposure, direct strike, and expended materials
					Passive sonobuoy (DIFAR)_AN/SSQ-53D/E	Number of sonobuoys deployed can vary	Expended materials and direct strike
					Vessel movement	3 ships maneuvering	Vessel strike
Strike Group Training- ESG COMPTUEX and CSG COMPTUEX and similar RDT&E	Intermediate level battle group exercise designed to create a cohesive CSG/ ESG prior to deployment or JTFEX. Three DDGs, one FFG, helicopters, one MPA, and two submarines.	0.2 training events and similar RDT&E	21 days	60 NM x 120 NM	Surface ship MFA ASW sonar (AN/SQS-53 and AN/SQS-56)	4 ships (CG, DDG, or FFG) pinging approximately 60 hours each over 10 days	MFA sonar exposure
					Helicopter ASW dipping sonar (AN/AQS-13 or AN/AQS-22)	1 to 4 helicopters (10 pings per five-minute dip) during CSG COMPTUEX	MFA sonar exposure
					Submarine MFA sonar (AN/BQQ-5 or AN/BQQ-10)	2 submarines pinging up to 16 times each	MFA sonar exposure
					Acoustic countermeasures (AN/SLQ-25 NIXIE, MK-2, MK-3, or Noise Acoustic Emitter)	2 hours per NIXIE 20 minutes per MK-2, MK-3, and Noise Acoustic Emitter	MFA sonar exposure, direct strike, and expended materials
					Tonal sonobuoy (DICASS) (AN/SSQ-62)	MPA and/or helicopter dropping 3 to 10 sonobuoys for a total of up to 218 sonobuoys over duration of event	MFA sonar exposure, direct strike, and expended materials
					Passive sonobuoy (DIFAR)_AN/SSQ-53D/E	Number of sonobuoys deployed can vary	Expended materials and direct strike

TABLE 3.19-2
SUMMARY OF ACTIVE SONAR ACTIVITIES IN THE VACAPES STUDY AREA AND SEAWARD (Continued)

Event Name	Training Event Scenarios	Events per Year*	Length of Overall Event	Typical Event Area Dimensions	Equipment or Action	Equipment Use or Action per Event	Effects Considered
					explosive source sonobuoy (AN/SSQ-110A)	2 MPA dropping up to 14 AN/SQ-110A sonobuoys	Explosive byproducts, pressure wave exposure, impulsive sound exposure, direct strike, and expended materials
					receiver (ADAR) sonobuoy (AN/SSQ-101)	Up to 5 AN/SSQ-101 sonobuoys	Direct Strike and expended materials
					Vessel movement	6 ships (CG, DDG, FFG, or submarine) maneuvering	Vessel strike
Strike Group training- JTFEX	Final fleet exercise prior to deployment of the CSG and ESG. Serves as a ready-to-deploy certification for all units. Four DDGs, two FFGs, one helicopter, one MPA, and three submarines.	0.2	10 days	60 NM x 80 NM up to 180 NM x 180 NM	Surface ship MFA ASW sonar (AN/SQS-53 or AN/SQS-56)	6 ships (CG, DDG, FFG) pinging up to 25 hours each	MFA sonar exposure
					Helicopter ASW dipping sonar (AN/AQS-13 or AN/AQS-22)	1 helicopters dipping for up to one hour (10 pings per five-minute dip)	MFA sonar exposure
					Submarine MFA sonar (AN/BQQ-5 or AN/BQQ-10)	3 submarines pinging twice each	MFA sonar exposure
					Acoustic countermeasures (AN/SLQ-25 NIXIE, MK-2, MK-3, or Noise Acoustic Emitter)	2 hours per NIXIE 20 minutes per MK-2, MK-3, and Noise Acoustic Emitter	MFA sonar exposure, direct strike, and expended materials
					Tonal sonobuoy (DICASS) (AN/SSQ-62)	1 MPA and/or 1 helicopter dropping 3 to 10 sonobuoys for a total of up to 174 sonobuoys over duration of event	MFA sonar , direct strike, and expended materials
					Passive sonobuoy (DIFAR) AN/SSQ-53D/E	Number of sonobuoys deployed can vary	Expended materials and direct strike

TABLE 3.19-2
SUMMARY OF ACTIVE SONAR ACTIVITIES IN THE VACAPES STUDY AREA AND SEAWARD
(Continued)

Event Name	Training Event Scenarios	Events per Year*	Length of Overall Event	Typical Event Area Dimensions	Equipment or Action	Equipment Use or Action per Event	Effects Considered
					explosive source sonobuoy (AN/SSQ-110A)	2 MPA dropping up to 14 AN/SSQ-110A sonobuoys	Explosive byproducts, pressure wave exposure, impulsive sound exposure, direct strike, and expended materials
					receiver (ADAR) sonobuoy (AN/SSQ-101)	Up to 5 AN/SSQ-101 sonobuoys	Direct Strike and expended materials
					Vessel movement	9 ships (CG, DDG, FFG, or submarine) maneuvering	Vessel strike
Surface Ship Sonar Maintenance	Pier side and at-sea maintenance to sonar system.	61	0.2 to 4 hours		Surface ship MFA ASW sonar (AN/SQS-53 OR AN/SQS-56)	1 ship (CG, DDG, or FFG) pinging	MFA sonar exposure
Submarine Sonar Maintenance	Pier side and at-sea maintenance to sonar system.	10	1 hour		Submarine MFA sonar (AN/BQQ-5 or AN/BQQ-10)	1 submarine pinging for up to one hour (60 pings per hour)	MFA sonar exposure

* Events per year is an estimate of the average number Atlantic Fleet sonar activities that occur annually within the VACAPES Study Area and seaward of the VACAPES Study Area. Some Coordinated ULT exercises and Strike Group Training are shown as less than one event; this indicates that only a portion of that event is expected to occur in the VACAPES Study Area.

ADC – Acoustic Device Countermeasure; CG – Guided Missile Cruiser; COMPTUEX – Composite Training Unit Exercise; DDG – Guided Missile Destroyer; DICASS – Directional Command-Activated Sonobuoy System; EMATT – Expendable Mobile Acoustic Training Target; FFG – Fast Frigate; HFA – High-Frequency Active; IEER – Improved Extended Echo Ranging; kHz – Kilohertz; JTFEX – Joint Task Force Exercise; MFA – Mid-Frequency Active; MPA – Maritime Patrol Aircraft; NM – Nautical Mile; TORPEX – Torpedo Exercise.

TABLE 3.19-3
SUMMARY OF MILITARY EXPENDED MATERIALS DURING SONAR ACTIVITIES IN THE VACAPES STUDY AREA

Device	Description	Expended Materials	Number Expended per Year*
Sonobuoys	A sonobuoy is an expendable device used for detection of underwater acoustic energy and conducting vertical water column temperature measurements (XBT). Following deployment, sonobuoys descend to specified depths and transmit data measurements to a surface unit via an electrical suspension cable or radio frequency signal. Sonobuoys are cylindrical devices about 12.5 cm (4.9 in) in diameter and 91 cm (36 in) in length, weighing from 6 to 18 kg (14 to 39 lbs). At water impact, a seawater battery activates and deployment initiates. The parachute assembly (aircraft only) is jettisoned and sinks away from the unit, while a float containing an antenna is inflated. The subsurface assembly descends to a selected depth, and the sonobuoy case falls away and sea anchors deploy to stabilize the hydrophone (underwater microphone). The operating life of the seawater battery is eight hours, after which the sonobuoy scuttles itself and sinks to the ocean bottom.	• Parachute assembly (12-18 inch diameter nylon chute) and nylon cord • Fabric floatation unit • Lead chloride, cuprous thiocyanate, or silver chloride batteries, Lithium batteries, or Lithium iron disulfide thermal batteries (XBT does not contain a battery) • Plastic casing • Metal clips • Nylon strap • Electrical wiring (90-4—ft of copper wiring, depending on type of sonobuoy) • Drogue (fabric and frame; on some sonobuoys) • Hydrophone/transducer assembly (configuration and amount of material varies depending on type of sonobuoy – sonobuoys may contain up to 38 lbs of material)	• Listening sonobuoys: 2483 • Tonal sonobuoys: 528 • Explosive source sonobuoys: 147 • Receiver sonobuoys: 52
MK–46/54 Lightweight Torpedoes	MK-46 is a deep-diving, high-speed lightweight torpedo that is launched from helicopters, fixed-wing aircraft, and surface ships. It has an OTTO II fuel propulsion system and uses active acoustic homing. The MK-54 is launched similar to the MK-46. An exercise torpedo that actually “runs” is referred to as an “EXTORP.” Only about 10% of the lightweight shots would be “runners.” All MK-54 shots are “runners.” The remaining shots are non-running “dummy” torpedo shapes called “REXTORPs.” All torpedoes are recovered. A parachute assembly for aircraft-launched torpedoes is jettisoned and sinks.	• Protective nose cover • Suspension bands • Air stabilizer • Release wire • Propeller baffle • Steel-jacketed lead ballast weights - OTTO Fuel II - Parachute (4-9 ft^2.; only on air dropped torpedoes)	• Components from 5 torpedoes

TABLE 3.19-3
SUMMARY OF MILITARY EXPENDED MATERIALS DURING SONAR ACTIVITIES IN THE VACAPES STUDY AREA
(Continued)

Device	Description	Expended Materials	Number Expended per Year*
MK-48 Torpedo	Heavy weight exercise torpedo about 580 cm (19 ft) in length and 53 cm (21 in) in diameter. All torpedoes are recovered.	• Guidance wire (maximum of 0.1 cm [0.04 in] in diameter and composed of a very fine thin-gauge copper-cadmium core with a polyolefin coating); Up to 15 miles of wire is deployed during a run • Flex hose (250 ft long) • OTTO Fuel II	• Components from 6 torpedoes
Acoustic Device Countermeasure (ADC)	Typically cylinder-shaped about 102 to 280 cm (40 to 110 in) in length, 8 to 15 cm (3 to 6 in) in diameter, and weighing between 3 and 57 kg (7 and 125 lbs).	• Lithium sulfur dioxide battery • Metal casing • Wires	• 34 ADCs
EMATT	Approximate shape of 12 by 91 cm (5 by 36 in) with a weight of 10 kg (21 lbs)	• Parachute assembly (12-18 inch diameter nylon chute) and nylon cord • Lithium sulfur dioxide battery • Metal casing • Metal clips • Nylon strap • Electrical wiring	• 87 EMATTs

**The quantity shown is an estimate of the portion of overall AFAST expended materials anticipated to be used in the VACAPES Range Complex or seaward of the VACAPES Range Complex.*

3.19.2.2 Hazardous Materials and Hazardous Waste

Summary of Environmental Consequences due to AFAST

Potential effects due to both hazardous and non-hazardous constituents of materials (referred to as primarily Military Expended Materials in the VACAPES EIS/OEIS) expended during sonar activities are discussed in Section 4.3 of the Final AFAST EIS/OEIS. The components of materials expended during sonar activities are provided in Table 3.19-3. Most of these components are non-hazardous and non-reactive, and, therefore, would have no significant effect. The potential effects due to battery constituents and OTTO Fuel II byproducts were also examined and were found to be minimal.

Because a limited quantity of materials will be expended, and the constituents of the expended materials will have no or minimal effects, under the AFAST selected alternative, there would be no significant impact in territorial waters due to hazardous materials. In addition, there would be no significant harm in non-territorial waters due to hazardous materials.

Aggregate Environmental Consequences

The potential impacts of hazardous materials and hazardous waste (primarily Military Expended Materials) due to range complex activities (other than sonar activities) are presented in Section 3.2 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be less than significant impacts in territorial waters due to hazardous materials. In addition, there would be less than significant harm in non-territorial waters due to hazardous materials.

3.19.2.3 Water Resources

Summary of Environmental Consequences due to AFAST

Potential effects due to water quality due to constituents of expended materials and byproducts formed during sonar activities are discussed in Section 4.3 of the Final AFAST EIS/OEIS. The following sources were examined for potential impacts to water quality:

- Sonobuoy, ADC, and EMATT battery constituents
- Explosion byproducts from explosive-source sonobuoys
- Otto Fuel II combustion byproducts

The constituents of concern for each of these sources are identified and analyzed in detail in the Final AFAST EIS/OEIS; overall, negligible impacts were found. Under the AFAST selected alternative, therefore, there would be no significant impacts to water quality in territorial waters. In addition, there would be no significant harm to water quality in non-territorial waters.

Aggregate Environmental Consequences

The potential impacts to water quality due to range complex activities (other than sonar activities) are presented in Section 3.3 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no significant impact to water quality in territorial waters. In addition, there would be no significant harm to water quality in non-territorial waters.

3.19.2.4 Marine Communities

Summary of Environmental Consequences due to AFAST

The potential effects to marine invertebrates, including shell fish and corals, are discussed in Section 4.9 of the Final AFAST EIS/OEIS. There is very little information available regarding the hearing capability of marine invertebrates. However, no effects to marine invertebrates are anticipated from active sonar since acoustic transmissions are brief in nature. Any small level of mortality caused by the explosive source sonobuoy would not be significant to the population as a whole. In addition, the explosions would occur within the water column. Based on the small net explosive weight (NEW) of the explosive, it is not likely that the pressure wave associated with the detonation would reach the bottom, where the majority of invertebrates live.

The potential effects to marine plants and algae are discussed in Section 4.10 of the Final AFAST EIS/OEIS. No effects to marine plants and algae are anticipated from active sonar because plants and algae are acoustically transparent. Moreover, ships and submarines would not be operating in the shallow waters where sea grasses are present. In addition, *Sargassum* mats are easily identified and would be avoided wherever possible.

Under the AFAST selected alternative, therefore, there would be no significant impacts to marine communities in territorial waters. In addition, there would be no significant harm to marine communities in non-territorial waters.

Aggregate Environmental Consequences

The potential impacts to marine communities due to range complex activities (other than sonar activities) are presented in Section 3.6 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no significant impact to marine communities in territorial waters. In addition, there would be no significant harm to marine communities in non-territorial waters.

3.19.2.5 Marine Mammals

Summary of Environmental Consequences due to AFAST

The Final AFAST EIS/OEIS evaluates potential direct and indirect effects to marine mammals as a result of exposure to in-water sound and non-acoustic interactions during sonar activities in Section 4.4.

Acoustic Effects

Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. The Final AFAST EIS/OEIS analyzed potential effects to marine mammals using the regulatory framework of the MMPA.

- Level A harassment: potential injury (biological tissue is damaged or lost as a result of the action)
- Level B harassment: disruption of natural behavior patterns to the a point where they are abandoned or significantly altered

Although exposure to sound may cause a variety of physiological effects in mammals, the tissues of the ear are most susceptible. Threshold shift (TS), or loss of hearing sensitivity over a subsection of an animal's hearing range, therefore, is used as an indicator of physiological effects. TS can be either permanent (PTS) or temporary (TTS), depending on the duration and intensity of the sound exposure. For the purpose of estimating physiological effects to marine mammals due to sound exposure, the Navy and NMFS have concurred on use of the energy flux density level (EL) method, which takes into account the total sound energy received. Under this method, harassment is correlated to EL as follows:

- Marine mammals predicted to receive a sound exposure with EL of 215 dB re 1 μPa^2-s or greater are assumed to experience PTS and are counted as Level A harassment exposures.
- Marine mammals predicted to receive a sound exposure with EL greater than or equal to 195 dB re 1 μPa^2-s but less than 215 dB re 1 μPa^2-s are assumed to experience TTS and are counted as Level B harassment exposures.

In addition to TTS exposures, Level B harassment includes behavioral responses, such as fleeing and interruption of social or foraging activity. A behavioral response is dependent on many factors, including the species, an individual's characteristics, and the context of the exposure. Because a range of behavioral responses may occur to a particular sound exposure, the Navy, in cooperation with NMFS, has implemented a risk function approach to estimate the number of behavioral responses that NMFS would classify as behavioral harassment. The risk function is a mathematical function which estimates the probability of behavioral response based on the maximum sound pressure level (SPL) to which the animal is exposed. Figure 3.19-1 is the curve resulting from the risk function inputs for odontocetes (except harbor porpoises) and pinnipeds. Figure 3.19-2 is the curve resulting from the risk function inputs for mysticetes. Due to information that suggests harbor porpoises exhibit a very low threshold for response, a single exposure threshold of 120 dB SPL is used to estimate behavioral harassment for this species.

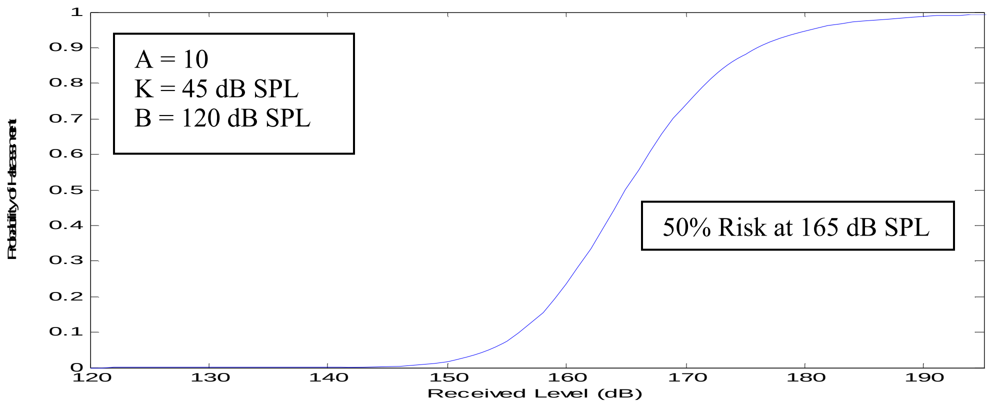


Figure 3.19-1. Risk Function Curve for Odontocetes (except harbor porpoises) (toothed whales) and Pinnipeds

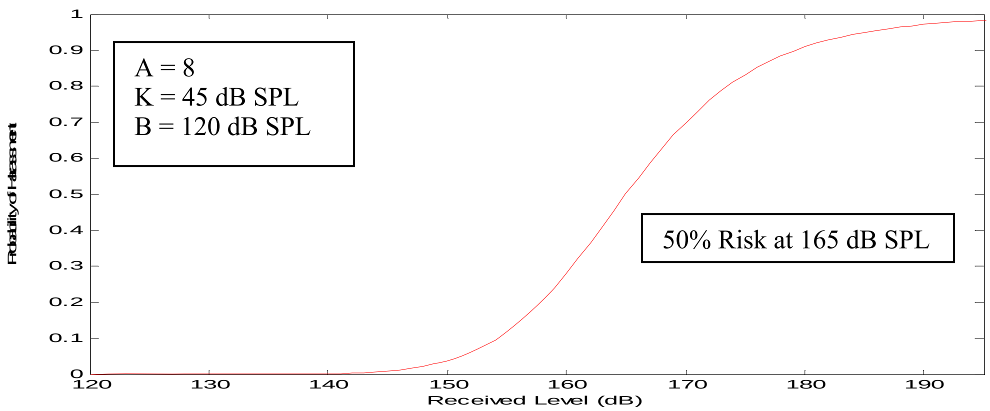


Figure 3.19-2. Risk Function Curve for Mysticetes (Baleen Whales)

Although immediate behavioral effects may occur at a receive level above the physiological thresholds, for purposes of this analysis, behavioral responses to sonar are counted as those occurring beyond the range to physiological effects. Figure 3.19-3 depicts the ranges to effects that correspond to MMPA harassment levels.

The Final AFAST EIS/OEIS also analyzed the effects to marine mammals due to exposure to small explosives during deployment of the AN/SSQ-110A IEER sonobuoy. The Final AFAST EIS/OEIS used the same small explosives criteria (for single explosions) presented in Section 3.7.3.1 of this EIS/OEIS.

To estimate the number of exposures of marine mammals to sound that would result in regulatory levels of harassment, sonar activities were acoustically modeled for the VACAPES Study Area. By analyzing both the acoustic propagation of each source and the estimates of marine mammal presence, annual marine mammal exposures were calculated (Table 3.19-4). When interpreting the modeling results, it is important to recognize the limitations of the model. The model does not reflect implementation of protective measures (such as reducing power levels or ceasing sonar use in the presence of marine mammals) and it assumes that the acoustic footprint extends to the seafloor regardless of the operating environment (in reality the zone of influence for physiological effects is shaped like a bubble in deeper waters). Sonar power reduction would reduce the likelihood of hearing impairment due to close aboard exposure, but some animals could be missed or could surface within the safety zone. Others could receive multiple pings that cause TTS due to added energy of multiple exposures over a short time period.

TABLE 3.19-4
ESTIMATED ANNUAL TAKES OF MARINE MAMMALS FOR VACAPES RANGE COMPLEX UNDER THE AFAST SELECTED ALTERNATIVE

Species	Mortality	PTS	TTS	Risk-Function (Behavioral)
Atlantic spotted dolphin	0	10	1287	97900
Bottlenose dolphin	0	3	405	32657
Clymene dolphin	0	0	51	4299
Common dolphin	0	4	850	47499
Kogia spp.	0	0	5	408
Pantropical spotted dolphin	0	1	108	8998
Pilot whales***	0	1	159	13220
Risso's dolphin	0	1	92	7276
Rough-toothed dolphin	0	0	2	194
Sperm whale**	0	0*	36	3087
Striped dolphin	0	8	839	75409
Beaked whale	0	0	8	771
Fin whale**	0	0	1	68
Humpback whale**	0	0	4	403
Minke whale	0	0	0	21
North Atlantic right whale**	0	0	1	45

* Indicates an exposure greater than or equal to 0.05, therefore, is considered a "may affect" for ESA-listed species.
** Denotes species listed in accordance with the Endangered Species Act
*** Pilot whales include both short- and long-finned pilot whales along the East Coast

In addition, the exposure estimates rely on the best available information from marine mammal surveys. Marine species density models rely on limited survey data, and for some species data are insufficient to estimate densities (blue whale, white-beaked dolphin, hooded seal, and harp seal throughout the AFAST Study Area; harbor porpoise, gray seal, harbor seal, sei whale in the VACAPES Study Area).

Due to the above reasons, quantitative exposure estimates should be used in conjunction with a qualitative analysis to assess potential impacts.

Potential acoustic effects to individual marine mammal species, including those for which density data are not available to quantify potential exposures, are discussed in Sections 4.4.10.3 (ESA-listed species) and 4.4.10.4 (non-ESA-listed species) of the Final AFAST EIS/OEIS. Most exposures would cause short-term recoverable behavioral effects, and protective measures, such as sonar power reduction and shutdown as an animal approaches a vessel, would reduce the likelihood of physiological effects.

The quantified physiological and behavioral effects above account solely for exposures to levels of sound associated with the effects thresholds discussed previously. Other potential acoustic effects are also discussed in the Final AFAST EIS/OEIS. Currently, evidence of acoustically mediated bubble growth and decompression sickness is limited and inconclusive; therefore, these phenomena are discussed but not considered as potential effects. Investigations of air cavity resonance predict it would occur at frequencies lower than those analyzed in the Final AFAST EIS/OEIS. The potential for masking, in which sounds interfere with an animal's ability to hear other sounds, exists; however, due to the intermittent use and narrow-frequency band of sonars, masking effects are considered negligible. The reader should refer to Section 4.4.10.2.4 of the Final AFAST EIS/OEIS for a discussion of what is known about the possibility of these phenomena.

The reader should refer to the Final AFAST EIS/OEIS for full discussion and explanation of the following topics:

- *Conceptual Biological Framework* (Section 4.4.3)- an explanation of the pathways to potential physiological and behavioral effects, including stress responses, due to sound exposure.
- *The Regulatory Framework* (Section 4.4.4)- an explanation of MMPA Level A and Level B harassment and the corresponding biological indicators and exposure zones.
- *Criteria and Thresholds for MMPA Harrassment* (Section 4.4.5)- an explanation of the development of PTS and TTS EL criteria for physiological effects *and* an explanation of the risk function approach used to estimate behavioral responses to sonar exposure.
- *Criteria and Thresholds for Small Explosives* (Section 4.4.6)- an explanation of small explosives criteria.
- *Acoustic Effects Results for Marine Mammals*(Section 4.4.9)- an overview of the acoustic analysis approach and modeling (for more detail on the modeling and assumptions, refer to Final AFAST EIS/OEIS Appendix H).
- *Summary of Potential Acoustic Effects by Marine Mammal Species* (Section 4.4.10)- analysis of acoustic impacts by individual species.

Non-acoustic Effects

The Final AFAST EIS/OEIS also examined the potential non-acoustic effects to marine mammals during sonar activities, including interactions with vessels (Section 4.4.12.1) and interactions with other components of sonar activities, such as entanglement in expended materials (Section 4.4.12.2) and direct animal strike by a deployed item, such as torpedoes, sonobuoys, or training targets (Section 4.4.12.3). As discussed in Section 3.7.3.2 of the VACAPES Range Complex EIS/OEIS, the Navy employs protective measures to reduce the likelihood of vessel strikes. The characteristics of materials expended during sonar activities make them unlikely to be a source of entanglement or ingestion for marine mammals. Due to the large area over which sonar training materials could be deployed from the air, the likelihood of striking an animal that may be near the surface is negligible. In addition, there are no known instances in which an animal has been struck by an exercise torpedo, as torpedoes are designed to home on mechanical signatures or active sonar returns from vessel hulls.

Potential for Strandings

The history of Navy activities in the AFAST Study Area and analysis in the Final AFAST EIS/OEIS indicate that military readiness activities are not expected to result in any sonar – induced mortalities to marine mammals. Natural and manmade sources of mortality other than sonar and underwater detonations that may contribute to stranding events are discussed in the Final AFAST EIS/OEIS (Section 3.6.3 and described in detail in Appendix E, Cetacean Stranding Report of the AFAST EIS/OEIS). The actual cause of a particular stranding may not be immediately apparent when there is little evidence of physical trauma, especially in the case of disease or age-related mortalities. These events require careful scientific investigation by a collaborative team of subject matter experts to determine actual cause of death.

Evidence from five beaked whale strandings which have occurred over approximately a decade suggests that the exposure of beaked whales to mid-frequency sonar in the presence of certain conditions (*e.g.*, multiple units using tactical sonar, steep bathymetry, constricted channels, strong surface ducts, *etc*.) may result in strandings, potentially leading to mortality. Although these physical factors believed to contribute to the likelihood of beaked whale strandings are not present, in their aggregate, in the AFAST Study Area, scientific uncertainty exists regarding what other factors, or combination of factors, may contribute to beaked whale strandings.

Summary of Effects to Marine Mammals

In conclusion, under the AFAST selected alternative, no significant impacts are predicted to marine mammals in territorial waters due to sonar activities. In addition, there would be no significant harm in non-territorial waters to marine mammals due to sonar activities. The Navy has completed consultation with NMFS in accordance with Section 7 of the ESA for ESA-listed marine mammals (with the exception of manatees) located in the AFAST Study Area. The Navy has completed consultation with NMFS in accordance with the MMPA for marine mammals located in the AFAST Study Area.

Aggregate Environmental Consequences

The potential impacts to marine mammals due to range complex activities (other than sonar activities) are presented in Section 3.7 of this EIS/OEIS. Although it is possible a single animal may be significantly affected when considering all events in the training complex, no significant effects are predicted by the analysis and no significant impacts to populations of marine mammals are anticipated when the potential impacts due to sonar activities are included with the potential impacts due to range complex activities. Therefore, there would be no significant impact to marine mammals in territorial waters. In addition, there would be no significant harm to marine mammal populations in non-territorial waters.

3.19.2.6 Sea Turtles

Summary of Environmental Consequences due to AFAST

The Final AFAST EIS/OEIS evaluates potential direct and indirect effects to sea turtles as a result of exposure to in-water sound and non-acoustic interactions during sonar activities in Section 4.5.

Acoustic Effects

Assessing whether a sound may disturb or injure a sea turtle involves understanding the characteristics of the acoustic sources, the presence of sea turtles in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those animals. Little is known about the role of sound and hearing in sea turtles; however, their greatest sensitivity appears to be at frequencies below the frequencies used by sonar systems during Atlantic fleet sonar activities. Use of these systems, therefore, is not expected to acoustically affect sea turtles. Sea turtles are, however, expected to be physiologically or behaviorally affected by use of explosive source sonobuoys. Effects to sea turtles were analyzed in the Final AFAST EIS/OEIS using the same method and criteria presented for small explosive impacts (single explosions) to sea turtles in the VACAPES Range Complex EIS/OEIS (Section 3.8).

Table 3.19-5 shows that no acoustic exposures resulting in a physiological effect are anticipated in the VACAPES Study Area. In the case of single explosions, behavioral effects are expected to be limited to short-term startle effects.

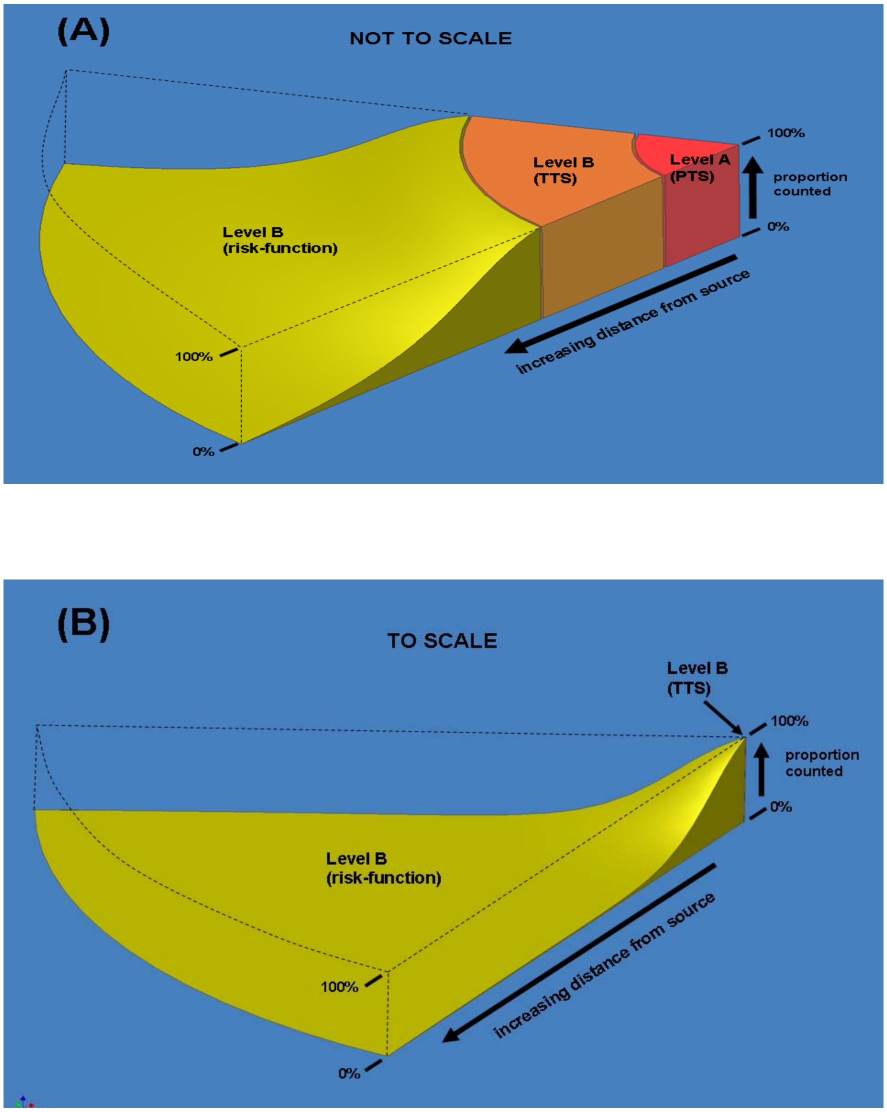


Figure 3.19-3 Summary of the Acoustic Effect Framework Used in This OEIS/EIS

(A) General relationships between PTS, TTS, and risk function harassment zones. Image is not scaled, which allows each zone to be visible. (B) Scaled representation of harassment zone areas. Scaled distances were based on a single, 1-second ping with source level of 235 dB re 1 µPa.

TABLE 3.19-5
ESTIMATED SEA TURTLE ACOUSTIC EXPOSURES FROM EXPLOSIVE SOURCE SONOBUOYS

Species	Mortality	PTS	TTS
Loggerhead sea turtle	0	0	1
Kemp's ridley sea turtle[1]	0	0	0
Leatherback sea turtle	0	0	0
Hardshell sea turtles[2]	0	0	0

1. This category does not include Kemp's ridley sea turtles in the Gulf of Mexico. They are included in the hardshell sea turtle class.
2. This category includes green, hawksbill, and unidentified hardshell species for all regions. It also includes Kemp's ridley sea turtles in the Gulf of Mexico, and may include extralimital occurrences of olive ridley turtles along the Atlantic coast.

Non-acoustic Effects

The Final AFAST EIS/OEIS also examined the potential non-acoustic effects to sea turtles during sonar activities, including interactions with vessels (Section 4.5.3.1) and interactions with other components of sonar activities, such as entanglement in expended materials (Section 4.5.3.2) and direct animal strike by a deployed item, such as torpedoes, sonobuoys, or training targets (Section 4.5.3.3). As discussed in Section 3.8.3.1 of the VACAPES Range Complex EIS/OEIS, although the potential for vessel strike exists, the Navy employs protective measures to reduce the likelihood of vessel strikes. The characteristics of materials expended during sonar activities make them unlikely to be a source of entanglement or ingestion for sea turtles. Due to the large area over which sonar training materials could be deployed from the air, the likelihood of striking an animal that may be near the surface is negligible. In addition, there are no known instances in which an animal has been struck by an exercise torpedo, as torpedoes are designed to home on mechanical signatures or active sonar returns from vessel hulls.

Summary of Effects to Sea Turtles

In conclusion, under the AFAST selected alternative, although there could be potential impacts to individuals, there would be no significant impact to sea turtles in territorial waters due to sonar activities. In addition, there would be no significant harm in non-territorial waters to sea turtles due to sonar activities. The Navy has completed consultation with NMFS in accordance with Section 7 of the ESA for ESA listed sea turtles due to sonar activities in the AFAST Study Area.

Aggregate Environmental Consequences

The potential impacts to sea turtles due to range complex activities (other than sonar activities) are presented in Section 3.8 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no significant impact to sea turtles in territorial waters. In addition, there will be no significant harm to sea turtles in non-territorial waters.

3.19.2.7 Fish and Essential Fish Habitat

Summary of Environmental Consequences due to AFAST

Effects to Essential Fish Habitat

Potential effects to EFH are analyzed in Section 4.6 of the Final AFAST EIS/OEIS. The potential stressors examined were effects of expended materials or byproducts and the effects due to small explosive forces. As previously discussed in Bathymetry and Sediments (Section 3.19.2.1), Military Expended Materials (Section 3.19.2.2), and Water Resources (Section 3.19.2.3), under the AFAST selected alternative,, there would be no significant impact to the physical environment due to expended materials and byproducts of sonar activities. Detonation of explosive sonobuoys would occur in relatively deeper waters where the sea bottom habitat structure would not be affected.

Effects to Fish: Sonar Exposure

Potential effects to fish due to exposure to active sonar are discussed in Section 4.7.1 of the Final AFAST EIS/OEIS.

Studies have indicated that acoustic communication and orientation of fish may be restricted by sound regimes in their environment. However, most marine fish species are not expected to able to detect sounds in the mid-frequency range of the operational sonars used during Atlantic fleet sonar activities, and, therefore, the sound sources do not have the potential to mask key environmental sounds. The few fish species that have been shown to be able to detect mid-frequencies do not have their best sensitivities in the range of the operational sonars. Additionally, vocal marine fish largely communicate below the range of mid-frequency sonars.

There is no information available that suggests that exposure to non-impulsive acoustic sources results in significant fish mortality on a population level. Mortality has been shown to occur in the larval stage of one species; however, the level of mortality was considered insignificant in light of natural daily mortality rates. Experiments show that exposure to loud sound can result in significant threshold shifts in certain fish that are classified as hearing specialists (but not those classified as hearing generalists). Threshold shifts are temporary, and considering the best available data, no data exist that demonstrate any long-term negative effects on marine fish from underwater sound associated with sonar activities. Further, while fish may respond behaviorally to mid-frequency sources, this behavioral modification is only expected to be brief and not biologically significant.

Effects to Fish: Exposure to Small Explosives (Explosive Source Sonobuoy)

Potential effects to fish due to exposure to detonation of the explosive source sonobuoy are discussed in Section 4.7.2 of the Final AFAST EIS/OEIS.

Fish that are located in the water column in proximity to the source of detonation could be injured, killed, or disturbed by the impulsive sound of a sonobuoy detonation or possibly temporarily leave the area. The potential for injury depends on proximity, fish anatomy (presence of a swim bladder), fish size, fish shape, and orientation of the fish to the explosive source. The huge variations in the fish population, including numbers, species, sizes, and orientation and range from the detonation point, make it very difficult to accurately predict mortalities at any specific site of detonation.

Summary of Effects to EFH and Fish

Sonar activities would not reduce the quality or quantity of EFH, introduce significant contamination to the water column or bottom habitats, or result in physical disruption of EFH. The likelihood of significant effects to individual fish from active sonar is low. Most fish species experience large number of natural mortalities especially during early life-stages, and, therefore, any small level of mortality caused by sonar activities involving the explosive source sonobuoy would most likely be insignificant to the population as a whole. Therefore, under the AFAST selected alternative, there would be no significant impact to EFH or fish populations as a result of active sonar activities in territorial waters. In addition, there would be no significant harm to EFH or fish populations from active sonar activities in non-territorial waters.

Aggregate Environmental Consequences

The potential impacts to EFH and fish due to range complex activities (other than sonar activities) are presented in Section 3.9 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no impact to EFH and fish in territorial waters. In addition, there would be no significant harm to EFH and fish in non-territorial waters.

3.19.2.8 Seabirds and Migratory Birds

Summary of Environmental Consequences due to AFAST

Potential effects to seabirds due to exposure to sonar or explosive source sonobuoy detonations are discussed in Section 4.8 of the Final AFAST EIS/OEIS. Little is known about the general hearing or underwater hearing capabilities of sea birds. It was concluded effects were unlikely even if some diving birds were able to hear a signal for the following reasons:

- There is no evidence seabirds use underwater sound.
- Seabirds spend a small fraction of time submerged.
- Seabirds could rapidly fly away from the area and disperse to other areas if disturbed.

Since sonobuoys are only detonated more than 12 NM from shore, only birds traveling far from shore have the potential to be exposed to a detonation; however; the likelihood of a seabird diving near a sonobuoy at the time of detonation is negligible. Therefore, under the AFAST selected alternative, there would be no significant impact to sea birds as a result of active sonar activities in territorial waters. In addition, there would be no significant harm to sea birds from active sonar activities in non-territorial waters.

Aggregate Environmental Consequences

The potential impacts to sea birds due to range complex activities (other than sonar activities) are presented in Section 3.10 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there will be no significant impact to sea birds in territorial waters. In addition, there would be no significant harm to sea birds in non-territorial waters.

3.19.2.9 Cultural Resources

Summary of Environmental Consequences due to AFAST

The potential impacts to cultural resources due to sonar activities are discussed in Section 4.19 of the Final AFAST EIS/OEIS. Sound in the water is not expected to affect cultural resources, and the explosions associated with the explosive source sonobuoy would occur within the water column and would not reach the ocean floor. Although shipwrecks are located in multiple locations throughout the AFAST Study Area, the likelihood of expended materials causing a disturbance is low. Therefore, under the AFAST selected alternative, there would be no significant impact to cultural resources as a result of active sonar activities in territorial waters. In addition, there would be no significant harm to cultural resources from active sonar activities in non-territorial waters.

Aggregate Environmental Consequences

The potential impacts to cultural resources due to range complex activities (other than sonar activities) are presented in Section 3.12 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be less than significant impact to cultural resources in territorial waters. In addition, there would be less than significant harm to cultural resources in non-territorial waters.

3.19.2.10 Transportation

Summary of Environmental Consequences due to AFAST

The potential impacts to airspace management are discussed in Section 4.12 of the Final AFAST EIS/OEIS. Because no new or modified activities are proposed within the airspace of the AFAST Study Area, there would be no effects to airspace management due to sonar activities.

The potential impacts to commercial shipping are discussed in Section 4.16 of the Final AFAST EIS/OEIS. No significant effects to commercial shipping have been reported in the past due to sonar activities.

Therefore, under the AFAST selected alternative, there would be no significant impact to transportation as a result of active sonar activities in territorial waters. In addition, there would be no significant harm to transportation from active sonar activities in non-territorial waters.

Aggregate Environmental Consequences

The potential impacts to transportation due to range complex activities (other than sonar activities) are presented in Section 3.13 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no significant impact to transportation in territorial waters. In addition, there would be no significant harm to transportation in non-territorial waters.

3.19.2.11 Regional Economy

Summary of Environmental Consequences due to AFAST

The potential impacts to commercial fishing are discussed in Section 4.15 of the Final AFAST EIS/OEIS. The Navy does not routinely close areas for active sonar activities. In addition, the largest portion commercial fishing occurs in state waters, where active sonar activities would not occur, with the exception of limited maintenance and navigational use. Furthermore, no significant impacts to fish are anticipated due to sonar activities. Therefore, under the AFAST selected alternative, no significant impact to commercial fishing is anticipated due to sonar activities.

Aggregate Environmental Consequences

The potential impacts to regional economy due to range complex activities (other than sonar activities) are presented in Section 3.15 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no significant impact to the regional economy in territorial waters. In addition, there would be no significant harm to the regional economy in non-territorial waters.

3.19.2.12 Recreation

Summary of Environmental Consequences due to AFAST

The potential effects to recreational boating are discussed in Section 4.14 of the Final AFAST EIS/OEIS. The potential effects to recreational fishing are discussed in Section 4.15 of the Final AFAST EIS/OEIS. The Navy does not routinely close areas for active sonar activities; therefore, under the AFAST selected alternative, there would be no significant impacts to recreational boating or fishing due to sonar activities. Furthermore, as previously discussed, no potential impacts to fish are anticipated due to active sonar activities.

The potential effects to scuba diving are discussed in Section 4.17 of the Final AFAST EIS/OEIS. Under the AFAST selected alternative, no significant impacts to diving are anticipated due to sonar activities.

The potential effects to marine mammal watching are discussed in Section 4.18 of the Final AFAST EIS/OEIS. Because these activities typically occur near-shore, and the Navy does not routinely close areas for sonar activities, under the AFAST selected alternative, there would be no significant impact to marine mammal watching due to sonar activities.

Aggregate Environmental Consequences

The potential impacts to recreation due to range complex activities (other than sonar activities) are presented in Section 3.16 of this EIS/OEIS. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, there would be no significant impact to recreation in territorial waters. In addition, there would be no significant harm to recreation in non-territorial waters.

3.19.3 Mitigation Measures for Atlantic Fleet Active Sonar Activities

The AFAST FEIS/OEIS and Record of Decision (ROD) provides a detailed discussion of mitigation measures employed during sonar activities, specifically during: active sonar activities (AFAST EIS/OEIS Section 5.1), use of explosive source sonobuoys (AFAST EIS/OEIS Section 5.2), and vessel transit (AFAST EIS/OEIS Section 5.3). In addition, the AFAST FEIS/OEIS and ROD presents a discussion of other measures that have been considered and rejected after consideration of: known science; likely effectiveness; personnel safety; practicality of implementation; and impact on the effectiveness of the military readiness activity. All mitigation measures incorporated into this FEIS/OEIS, including those from AFAST, are discussed in chapter 5. Specifically, AFAST mitigations related to active sonar and the use of explosive source sonobouys are presented below.

3.19.3.1 AFAST Mitigation Measures Related to Acoustic Effects

As discussed in the NMFS MMPA regulations for AFAST active sonar activities, ESA Biological Opinion, and the AFAST ROD, the Navy would implement various mitigation measures to maximize the ability of operators to recognize instances when marine mammals are in the vicinity. These measures include the following:

1. Training personnel in lookout/watchstander duties;
2. Stationing at least three people on watch with binoculars at all times;
3. Stationing at least two additional people on watch during ASW exercises when MFA sonar is being used;
4. Requiring all personnel engaged in passive acoustic sonar operation to monitor for marine mammal vocalizations;
5. Using all available sensor and optical systems, such as night vision goggles during MFA and HFA active sonar activities;
6. Using only passive capability of sonobuoys when marine mammals are detected within 183 meters (200 yards);
7. Limiting ship or submarine active transmission levels to at least 6 dB below normal operating levels when marine mammals are detected by any means within 914 meters (1,000 yards) of the sonar dome (the bow);
8. Limiting ship or submarine active transmission levels to at least 10 dB below normal operating levels when marine mammals are detected by any means within 457 meters (500 yards) of the sonar dome, or ceasing ship or submarine active transmissions when a marine mammal is detected by any means within 183 meters (200 yards) of the sonar dome;
9. If the need for such power-down arises, following power-down requirements as though the system is operating at 235 dB, the normal operating level (i.e., power-down would be to 229 dB);

10. Operating sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives;

11. Requiring helicopters to observe or survey the vicinity of an ASW activity for ten minutes before first deployment of active (dipping) sonar in the water; prohibiting dipping sonar within 183 meters (200 yd) of a marine mammal and ceasing pinging if a marine mammal closes to within 183 meters (200 yd) after pinging has begun;

12. Coordinating with the local NMFS Stranding Coordinator; and submitting a report containing a discussion of the nature of any observed effects based on both modeled results of real-time events and sightings of marine mammals.

Special Conditions Applicable for Bow-Riding Dolphins

If, after conducting an initial maneuver to avoid close quarters with dolphins, the ship concludes that dolphins are deliberately closing in on the ship to ride the vessel's bow wave, no further mitigation actions would be necessary because dolphins are out of the main transmission axis of the active sonar while in the shallow-wave area of the vessel bow.

The Navy and NMFS worked together to identify additional practicable and effective mitigation measures to address the following three issues of concern:

(1) general minimization of marine mammal impacts;

(2) minimization of impacts within the southeastern North Atlantic right whales critical habitat; and

(3) the potential relationship between the operation of mid and/or high-frequency active sonar and marine mammal strandings.

Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the following general goals:

- avoidance or minimization of injury or death of marine mammals wherever possible;
- a reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of mid- or high-frequency active sonar, underwater detonations, or other activities expected to result in the take of marine mammals (this goal may contribute to the first goal above, or by reducing harassment takes only);
- a reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of mid- or high-frequency active sonar, underwater detonations, or other activities expected to result in the take of marine mammals (this goal may contribute to the first goal listed above or by reducing harassment takes only);
- a reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of MFA or HFA sonar, underwater detonations, or other activities expected to result in the take of marine mammals (this goal may contribute to (1), above, or to reducing the severity of harassment takes only);
- a reduction in adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time;
- and for monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation (shut-down zone, etc.).

NMFS and the Navy had extensive discussions regarding mitigation as part of consultation on the proposed and final rules, in which several mitigation options and their respective practicability were explored. Ultimately, NMFS and the Navy developed the following measures which the Navy and NMFS believe supports (or contributes) to the goals mentioned above:

Planning Awareness Areas (PAAs): The Navy has designated several Planning Awareness Areas (PAAs) based on areas of high productivity that have been correlated with high concentrations of marine mammals (such as persistent oceanographic features like upwellings associated with the Gulf Stream front where it is deflected off the east coast near the Outer Banks), and areas of steep bathymetric contours that are frequented by deep diving marine mammals such as beaked whales and sperm whales. In developing the PAAs, USFF was able to consider these factors because of geographic flexibility in conducting ASW training. USFF is not tied to a specific range support structure for the majority of the training for AFAST.

Additionally, the topography and bathymetry along the East Coast and in the Gulf of Mexico is unique in that there is a wide continental shelf leading to the shelf break, affording a wider range of training opportunities. The Navy will avoid planning major exercises in the specified PAAs where feasible. Should national security require the conduct of more than four major exercises (COMPTUEX, JTFEX, SEASWITI, or similar scale event) in these areas (meaning all or a portion of the exercise) per year, the Navy will provide NMFS with prior notification and include the information in any associated after-action or monitoring reports. To the extent operationally feasible, the Navy plans to conduct no more than one of the four major exercises (COMPTUEX, JTFEX, SEASWITI, or similar scale event) per year in the Gulf of Mexico. Based on operational requirements, the exercise area for this one exercise may include the De Soto Canyon. If national security needs require more than one major exercise to be conducted in the PAAs, which includes portions of the DeSoto Canyon, the Navy would provide NMFS with prior notification and include the information in any associated after-action or monitoring reports. The PAAs will be included in the Navy's Protective Measures Assessment Protocol (PMAP) (implemented by the Navy for use in the protection of the marine environment) for unit level situational awareness (i.e., exercises other than COMPTUEX, JTFEX, or SEASWITI). The goal of PMAP is to raise awareness in the fleet and ensure common sense and informed oversight is injected into planning processes for testing and training evolutions.

Helicopter Dipping Sonar in North Atlantic right whale Critical Habitat: Helicopter Dipping Sonar is one of the two activity types that have been identified as planned to occur in the southern North Atlantic right whale critical habitat. Historically, only maintenance of helicopter dipping sonars occurs within a portion of the North Atlantic right whale critical habitat. Tactical training with helicopter dipping sonar does not typically occur in the North Atlantic right whale critical habitat area at any time of the year. The critical habitat area is used on occasion for post maintenance operational checks and equipment testing due to its proximity to shore. Unless otherwise dictated by national security needs, the Navy will minimize helicopter dipping sonar maintenance within the southeast North Atlantic right whale critical habitat from November 15 to April 15.

Object Detection Exercises in North Atlantic Right Whale Critical Habitat: Object detection training requirements are another type of activity that has been identified as planned to occur in the southern North Atlantic right whale critical habitat. The Navy recognizes the significance of the North Atlantic right whale calving area and has explored ways of affecting the least practicable impact (which includes a consideration of practicality of implementation and impacts to training fidelity) to right whales. Navy units will incorporate data from the Early Warning System (EWS) into exercise pre-planning efforts. USFF contributes more than $150,000 annually for aerial surveys that support the EWS, a communication network that assists afloat commands to avoid interactions with right whales. Fleet Air Control Surveillance Facility (FACSFAC) JAX houses the Whale Fusion Center, which disseminates the latest right whale sighting information to Navy ships, submarines, and aircraft. Through the Fusion Center, FACSFAC JAX coordinates ship and aircraft movement into the right whale critical habitat and the surrounding operating areas based on season, water temperature, weather conditions, and frequency of whale sightings and provides right whale reports to ships, submarines and aircraft, including coast guard vessels and civilian shipping. The Navy proposes:

- To reduce the time spent conducting object detection exercises in the North Atlantic right whale critical habitat during the time of November 15 to April 15; and
- Prior to conducting surface ship object detection exercises in the southeast North Atlantic right whale critical habitat during the time of November 15 to April 15, ships will contact the FACSFAC JAX to obtain the latest right whale sighting information. FACSFAC JAX will advise ships of all reported whale sightings in the vicinity of the critical habitat and Associated Area of Concern. To the extent operationally feasible, ships will avoid conducting training in the vicinity of recently sighted right whales. Ships will maneuver to maintain at least 457 meters (500 yards) separation from any observed whale, consistent with the safety of the ship.

3.19.3.2 Mitigation Measures Related to Explosive Source Sonobuoys (AN/SSQ-110A)

As discussed in the NMFS MMPA regulations for AFAST active sonar activities, ESA Biological Opinion, and the AFAST Record of Decision dated 23 Jan 2009, the Navy would implement the following mitigation measures for explosive source sonobuoys (AN/SSQ-110A) as well as for the follow on Advanced Extended Echo Ranging (AEER) system:

1. Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern;
2. Crews will conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post (source/receiver sonobuoy pair) detonation;
3. If a post (source/receiver sonobuoy pair) will be deployed within 914 meters (1,000 yards) of observed marine mammal activity, crews will deploy the receiver only and monitor while conducting a visual search;
4. When operationally feasible, crews will conduct continuous visual and aural monitoring of marine mammal activity, including monitoring of their aircraft sensors from first sensor placement to checking off-station and of radio frequency range of these sensors; aural detection of marine mammal cues the aircrew to increase the diligence of their visual surveillance;
5. If marine mammals are visually detected within 914 meter (1,000 yards) of the explosive source sonobuoy (AN/SSQ-110A) intended for use, then that payload shall not be detonated;
6. Aircrews will ensure a 914-meter (1,000-yard) safety zone, visually clear of marine mammals, is maintained;
7. Aircrews shall only leave posts with unexploded charges in the event of a sonobuoy malfunction, an aircraft system malfunction, or when an aircraft must immediately depart the area due to issues such as fuel constraints, inclement weather, and in-flight emergencies;
8. Aircrews will ensure all payloads are accounted for;
9. Marine mammal monitoring shall continue until out of their aircraft sensor range.

CHAPTER 4 :OTHER CONSIDERATIONS

4.1 CONSISTENCY WITH OTHER FEDERAL, STATE, AND LOCAL PLANS, POLICIES, AND REGULATIONS

Based on evaluation with respect to consistency and statutory obligations, the Department of the Navy's (DoN) alternatives, including the Proposed Action ("Proposed Action") for the VACAPES Range Complex Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) does not conflict with the objectives or requirements of federal, state, regional, or local plans, policies, or legal requirements. Table 4.1-1 provides a summary of environmental compliance requirements that may apply.

TABLE 4.1-1
SUMMARY OF ENVIRONMENTAL COMPLIANCE FOR THE PROPOSED ACTION

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
National Environmental Policy Act (NEPA) of 1969 (42 USC §§ 4321. *et seq.)* Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR §§ 1500-1508) DoN Procedures for Implementing NEPA (32 CFR Part 775)	DoN	The EIS portion of this document has been prepared in accordance with NEPA, CEQ regulations, and Navy NEPA procedures. Public participation and review is being conducted in compliance with NEPA. The Proposed Action would not likely result in significant impacts.
Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions	DoN	EO 12114 requires environmental consideration for actions that may affect the environment outside of U.S. Territorial Waters. The OEIS aspects of this document satisfy this requirement. The Proposed Action would not likely result in significant harm to the environment.

TABLE 4.1-1
SUMMARY OF ENVIRONMENTAL COMPLIANCE FOR THE PROPOSED ACTION (Continued)

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
Clean Air Act (CAA) (42 USC Part 7401 *et seq.*)	DoN USEPA Virginia DEQ Maryland DOE North Carolina DENR Delaware DNREC	Counties in Maryland, North Carolina, and Virginia's Eastern Shore bordering the Proposed Action Study Area are designated in "attainment," and thus the General Conformity Rule is not applicable to these areas. Hampton Roads Air Quality Control Region, VA is an attainment area with a maintenance plan for the 8-hour ozone standard and. where the Proposed Action occurs adjacent to Sussex County, Delaware (moderate nonattainment), Records of Non-Applicability have been prepared for each area (Appendix L).
Clean Water Act (CWA) (33 USC §§ 1344, *et seq.*)	USEPA	No permit under the CWA, whether under Section 401, 402, or 404 (b) (1), is required
Rivers and Harbors Act (33 USC §§ 401, *et seq.*)	U.S. Army Corps of Engineers (USACE)	Section 10 permits will be required for Mine Warfare training Areas in the Lower Chesapeake Bay and VACAPES OPAREA. The Navy has initiated the consultation process with USACE.
Coastal Zone Management Act (CZMA) (16 CFR §§ 1451, *et seq.*)	Virginia DEQ, North Carolina DENR Maryland MDE Delaware DNREC	The Navy has determined that the Proposed Action is consistent to the maximum extent practicable and is preparing a Federal Consistency Determination (CCD) in accordance with the CZMA. (Appendix G)
Magnuson-Stevens Fishery Conservation and Management Act (16 USC §§ 1801-1802)	National Marine Fisheries Service (NMFS)	The Proposed Action would not likely adversely affect Essential Fish Habitat (EFH) and would not likely decrease the available area or quality of EFH.

TABLE 4.1-1
SUMMARY OF ENVIRONMENTAL COMPLIANCE FOR THE PROPOSED ACTION (Continued)

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
Endangered Species Act (ESA) (16 USC §§ 1531, *et seq.*)	DoN U.S. Fish and Wildlife Service (USFWS) NMFS	The EIS/OEIS analyzes potential effects to species listed under the ESA. The Navy will complete consultation under Section 7 of the ESA with NMFS on the potential that the Proposed Action may affect listed species. The Navy has completed consultation with USFWS on the potential that the Proposed Action may affect listed species.
Marine Mammal Protection Act (MMPA) (16 USC §§ 1431, *et seq.*)	NMFS	This EIS/OEIS analyzes potential effects to marine mammals, some of which are species-listed under the ESA. As noted, potential effects on listed species are the subject of consultations with NMFS. The Navyhas prepared a request for a Letter of Authorization from the NMFS regarding effects on marine mammals.
The National Marine Sanctuaries Act (16 USC §§ 1431, *et. seq.*)	National Oceanic and Atmospheric Administration	The Proposed Action would have no effect on sanctuary resources in the offshore environment of NC, VA, DE or MD. Review of agency actions under Section 304 is not required.
National Historic Preservation Act (NHPA) (16 USC§§ 470. *et seq.*)	DoN Delaware Division of Historical and Cultural Affairs Maryland Historical Trust Virginia Department of Historic Resources North Carolina State Historic Preservation Office	The Navy complies with the consultation and other requirements of the NHPA. The Proposed Action would not likely have a significant impact on protected resources.
Act to Prevent Pollution from Ships (APPS) (33 U.S.C. §§ 1901, *et seq.*)	DoN	The Navy complies with the discharge regulations set fourth under the requirements of the APPS.

TABLE 4.1-1
SUMMARY OF ENVIRONMENTAL COMPLIANCE FOR THE PROPOSED ACTION (Continued)

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	DoN	The Proposed Action would not likely result in disproportionately high and adverse human health or environmental effects on minority or low income populations.
EO 13045, Protection of Children from Environmental Health Risks and Safety Risks	DoN	The Proposed Action would not likely result in disproportionate risks to children from environmental health risks or safety risks.
EO 13112 Invasive Species	DoN	EO 13112 requires Agencies to identify actions that may affect the status of invasive species and take measures to avoid introduction and spread of these species. This EIS/OEIS satisfies the requirement of EO 13112 with regard to the Proposed Action.
EO 11990 Protection of Wetlands	DoN	The Proposed Action would not likely have a significant impact on wetlands.
EO 12962 Recreational Fisheries	DoN	EO 12962 requires Agencies to fulfill certain duties with regard to promoting the health and access of the public to recreational fishing areas. The Proposed Action complies with these duties.
EO 13158, Marine Protected Areas	DoN	EO 13158 requires Agencies to identify any actions that affect the natural or cultural resources that are protected by an MPA. Agencies shall avoid harm to the natural and cultural resources that are protected by an MPA. This EIS/OEIS satisfies the requirement of EO 13158 with regard to the Proposed Action.
Migratory Bird Treaty Act (16 USC §§ 703-712)	USFWS	The Proposed Action would not likely have a significant impact on migratory birds, and would comply with applicable requirements of the MBTA

4.2 REQUIRED PERMITS AND APPROVALS

All required permits and approvals have been obtained. The decisions and supporting data can be found in the appendices.

4.2.1 COASTAL ZONE MANAGEMENT ACT COMPLIANCE

The CZMA of 1972 (16 United States Code [U.S.C.] Section [§] 1451) encourages coastal states to be proactive in managing coastal zone uses and resources. CZMA established a voluntary coastal planning program; participating states submit a Coastal Management Plan (CMP) to National Oceanographic and Atmospheric Administration (NOAA) for approval. Under CZMA, federal actions are required to be consistent, to the maximum extent practicable, with the enforceable policies of approved CMPs.

CZMA defines the coastal zone (16 U.S.C. Part 1453) as extending, "to the outer limit of State title and ownership under the Submerged Lands Act" (i.e., 3 nautical miles [nm] from the shoreline). The coastal zone extends inland only to the extent necessary to control the shoreline. Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of, or which is held in trust by, the federal government (16 U.S.C. Part 1453).

Review of federal agency activities is conducted through the submittal of either a Consistency Determination or a Negative Determination. A federal agency shall submit a Consistency Determination when it determines that its activity may have either a direct or an indirect effect on a state's coastal zone or resources. In accordance with 15 CFR § 930.39, the consistency determination shall include a brief statement indicating whether the proposed activity will be undertaken in a manner consistent to the maximum extent practicable with the enforceable policies of the management program and should be based upon an evaluation of the relevant enforceable policies of the management program. A federal agency may submit a Negative Determination to a coastal state when the federal agency has determined that its activities would not have an effect on the state's coastal zone or its resources or when conducting the same or similar activities for which Consistency Determinations have been prepared in the past.

Pursuant to 15 CFR § 930.41, the state has 60 days from the receipt of the Consistency Determination in which to concur with or object to the Consistency Determination, or to request an extension under 15 CFR § 930.41(b). Federal agencies shall approve one request for an extension period of 15 days or less.

In accordance with the CZMA, the Navy has reviewed the enforceable policies of each state's CZMP relevant to the study area. Based on the limitations discussed in this EIS, the enforceable policies of each state's CZMP, and pursuant to 15 CFR § 930.39, the Navy has prepared Consistency Determinations for all affected states. Specific information regarding CZMA can be found in Appendix K. CCDs or Negative Determinations were written for each state adjacent to the EIS/OEIS Study Area and are in Appendix G.

4.3 RELATIONSHIP BETWEEN SHORT-TERM USE OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

NEPA requires analysis of the relationship between a project's short-term impacts on the environment and the effects those impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This means that choosing one option may reduce future flexibility in pursuing other options, or that committing a resource to a certain use may often eliminate the possibility for other uses of that resource.

With respect to marine mammals, the Navy, in partnership with the National Marine Fisheries Service (NMFS), is committed to furthering understanding of these creatures and developing ways to lessen or eliminate the impacts that Navy training activities may have on these animals.

The Proposed Action would result in both short- and long-term environmental effects. However, the Proposed Action would not likely be expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety, or the general welfare of the public. The Navy is committed to sustainable range management, including co-use of the VACAPES Range Complex with the general public and commercial interests. This commitment to co-use enhances the long-term productivity of the range areas surrounding VACAPES Range Complex.

4.4 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

NEPA requires that environmental analysis include identification of "…any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented." Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effects that the uses of those resources would have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (*e.g.,* energy or minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (*e.g.,* the disturbance of a cultural site).

For the alternatives, including the Proposed Action, most resource commitments are neither irreversible nor irretrievable. Most impacts are short-term and temporary or long lasting, but negligible. There are several culturally significant shipwrecks in the area proposed for training activities; however, these sites are well-documented and the Navy makes every effort to avoid these areas whenever possible. No habitat associated with threatened or endangered species would be lost as result of implementation of the Proposed Action. Since there would be no building or facility construction, the consumption of materials typically associated with such construction (concrete, metal, sand, fuel, *etc.*) would not likely occur. Energy typically associated with construction activities would not likely be expended and irretrievably lost. Implementation of the Proposed Action would require fuels used by aircraft, ships, and ground-based vehicles. Since fixed- and rotary-wing flight and ship activities could increase, relative, total fuel use would increase. Therefore, total fuel consumption would increase and this nonrenewable resource would be considered irretrievably lost.

4.5 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF ALTERNATIVES AND MITIGATION MEASURES

Increased training and testing operations on the VACAPES Range Complex would result in an increase in energy demand over the No Action Alternative. This would result in an increase in fossil fuel consumption, mainly from aircraft, vessels, and power supply. Although the required electricity demands of increased intensity of range complex usage would be met by the existing electrical generation infrastructure within the VACAPES Range Complex, the alternatives would result in a net cumulative negative impact on the energy supply.

Energy requirements would be subject to any established energy conservation practices onboard each vessel. No additional power generation capacity other than the potential use of generators would be required for any of the operations. The use of energy sources has been minimized wherever possible without compromising safety, training, or testing operations.

At the present time, the Navy, under the direction of the Energy Policy Act (EPAct) of 1992 and EO 13149, is actively testing and introducing several different types of alternate fuels (bio-diesel B100/B20, clean natural gas, fuel ethanol E85, fuel cells, *etc.*) to further reduce the impacts of its activities on the environment and non-renewable resources.

4.6 NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL OF VARIOUS ALTERNATIVES AND MITIGATION MEASURES

Resources that will be permanently and continually consumed by project implementation include water, electricity, natural gas, and fossil fuels; however, the amount and rate of consumption of these resources would not likely result in significant environmental impacts or the unnecessary, inefficient, or wasteful use of resources. Nuclear-powered vessels are beneficial because they decrease the use of fossil fuels. With respect to operational activities, project mitigation measures would ensure that all natural resources are conserved or recycled to the maximum extent feasible. It is also possible that new technologies or systems will emerge, or will become more cost effective or user-friendly, and will further reduce the Navy's reliance on nonrenewable natural resources. However, even with implementation of conservation measures, consumption of natural resources would generally increase with implementation of the alternatives.

Aircraft operations within the VACAPES OPAREAs are the single largest airborne noise source. Noise levels in excess of 90 dBA can occur. Sustainable range management practices that protect and conserve natural and cultural resources are in place. Sustainable range management practices are in place that protect and conserve natural and cultural resources, as well as and preserve access to training areas for current and future training requirements, while addressing potential encroachments that threaten to impact range capabilities.

4.7 URBAN QUALITY, HISTORIC AND CULTURAL RESOURCES, AND THE DESIGN OF THE BUILT ENVIRONMENT

There are no urban areas under consideration in this EIS/OEIS and therefore no urban quality issues exist. Likewise, there is no new construction being proposed. Historic and cultural resources are addressed in Section 3.12.

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CHAPTER 5 : MITIGATION MEASURES

5.1 INTRODUCTION

Effective training in the VACAPES Range Complex dictates that ship, submarine, and aircraft participants utilize their sensors and exercise weapons to their optimum capabilities as required by the mission. As discussed in Chapter 3, the Navy recognizes that the proposed action has the potential to impact some marine resources in the vicinity of training. This chapter describes the Navy's overall mitigation approach as well as specific mitigation measures that would be implemented to protect marine mammals, sea turtles, and other resources during training activities. Some of these measures are generally applicable and others are designed to apply to certain geographic areas and/or for specific types of Navy training.

Due to the nature of the proposed action analyzed in this document, mitigation measures for many elements of the action have been established through previous environmental analyses, consultation, and/or permitting processes.

As noted above, this chapter describes the overall approach to mitigation for the proposed action as well as specific mitigation measures to be implemented. Section 5.2 describes the Navy's overall mitigation approach. The Navy's Monitoring and Reporting Requirements are presented in Section 5.3 and research efforts are presented in Section 5.4. Mitigation measures performed by Navy personnel on a regular and routine basis are discussed in Section 5.5 and are known as "Standard Operating Procedures." Section 5.6 presents special mitigation measures associated with vessel transit during North Atlantic right whale migration. Section 5.7 presents measures for specific training events. Section 5.8 presents coordination and reporting requirements. Section 5.9 provides alternative mitigation that was considered but eliminated. Section 5.10 discusses the effectiveness of visual observation including the detection probability and efficacy of mitigation measures. Measures for activities that are part of the proposed action, but are analyzed in separate environmental documents that are incorporated by reference are not necessarily included in this chapter. Mitigation measures specific to sonar use are addressed fully in the AFAST EIS/OEIS (DoN, 2008a) and are presented in sections 5.7.17 and 5.7.18.

5.2 APPROACH

Mitigation of impacts is defined in the CEQ regulations (40 CFR 1508.20) to include avoidance, minimization, rectification, reduction/elimination over time, and compensation. Given the nature of the proposed action and alternatives and potential impacts analyzed here, the Navy believes that a comprehensive approach to mitigation for the VACAPES Range Complex requires focus on: (1) mitigation by avoidance, in which adverse impacts are avoided altogether by altering the location, design, or other aspect of an activity, and (2) minimization of impacts when avoidance is not feasible. An important complement to the *avoidance* and *minimization* of impacts is *monitoring* to track compliance with take authorizations, impacts on protected resources, and effectiveness of mitigation measures. Taken together, these three elements – avoidance, minimization, and monitoring - comprise the Navy's integrated approach to addressing potential environmental impacts.

Avoidance. Avoidance of geographic areas of particular sensitivity has been integrated into the proposed action and alternatives where feasible. Mitigation measures discussed later in this chapter involve avoidance of sensitive areas. Planning for training activities takes into consideration whether and how training locations could be planned to avoid sensitive areas (e.g. those known to have a high density of protected species or the presence of a protected species of particular concern). Consideration is also given to avoiding smaller scale habitats (e.g. *Sargassum* rafts, a known sea turtle habitat) as they are encountered during an activity. Those avoidance measures that require an ongoing evaluation of conditions or awareness during an activity are listed later in this chapter.

Minimization. In some cases, avoiding environmentally sensitive locations altogether is not possible. In these instances, mitigation measures have been designed to minimize the potential for impact on the resources of concern. These minimization measures are also listed in this chapter.

Monitoring. A well-designed monitoring program can provide important feedback for validating assumptions made in analyses and allow for adaptive management. Since monitoring will be a requirement for compliance with the final rule issued for this proposed action under the Marine Mammal Protection Act (MMPA), details of the monitoring program will be developed in coordination with NMFS through those regulatory processes. A description of the monitoring program framework is provided in Section 5.3.

It is important to note that discussions with resource agencies as part of consultation and permitting processes may result in changes to the mitigation as described in this document. Such changes will be reflected in this final EIS/OEIS as well as in documents that result from other regulatory processes (*e.g*., ESA Biological Opinion).

It should be noted that several of these mitigation measures align with mitigation measures for unit-level training that the Navy has had in place since 2004. In addition, the Navy coordinated with the NMFS to further develop measures for protection of marine mammals as part of the National Defense Exemption. The National Defense Exemption from Requirements of the MMPA for Certain DoD Military Readiness Activities That Employ Mid-Frequency Act Sonar or Improved Extended Echo Ranging Sonobuoys is dated January 23, 2007. This exemption is pursuant to Title 16, Section 1371 (f) of the United States Code. This exemption was applicable to mid-frequency active (MFA) sonar systems, operating within the frequency range of 1 kHz to 10 kHz, and Improved Extended Echo Ranging (IEER) sonobuoys. The exemption was in effect for a period of two years from the date of enactment (January 23, 2007) and was authorized until "the Department of Navy is granted authorization under the MMPA for one or both of these categories of actions as associated with a specified proposed activity, whichever is earliest" (DoN, 2007a).

The final suite of measures developed in Navy's application for a Marine Mammal Protection Act (MMPA) Letter of Authorization (LOA) is analyzed in this final EIS/OEIS. In addition to the National Environmental Policy Act (NEPA) process, the public had an opportunity to provide input to NMFS through the MMPA process, both during the comment period following NMFS' Notice of Receipt of the application for a MMPA LOA, and during the comment period following NMFS' publication of the proposed rule (published 12 December 2008). In order to make the findings necessary to issue the MMPA authorization, it may be necessary for NMFS to require additional mitigation or monitoring measures beyond those addressed in this Final EIS/OEIS. If additional mitigation or monitoring measures are required, they will be included in the Record of Decision.

5.3 MONITORING AND REPORTING MEASURES

5.3.1 Integrated Comprehensive Monitoring Plan

The Navy is committed to demonstrating environmental stewardship while executing its National Defense mission and is responsible for compliance with a suite of federal environmental and natural resources laws and regulations that apply to the marine environment. As part of those responsibilities, an assessment of the long-term and/or population-level effects of Navy training activities, as well as the efficacy of mitigation measures, is necessary. To address this need, the Navy is developing an Integrated Comprehensive Monitoring Plan (ICMP) to assess the effects of training activities on marine species and investigate population-level trends in marine species distribution, abundance, and habitat use in various range complexes and geographic locations where Navy training occurs (see Figure 5.3-1). Although the ICMP is intended to apply to all Navy training, use of MFA Sonar in training and RDT&E will comprise a major component of the overall program.

The ICMP will establish the overarching structure and coordination that will facilitate the collection and synthesis of monitoring data from Navy training and research and development projects. The Program will compile data from range-specific monitoring efforts as well as research and development (R&D) studies that are fully or partially Navy-funded. Monitoring methods across the ranges will include methods such as vessel and aerial surveys, tagging, and passive acoustic monitoring.

The primary objectives of the ICMP are to:

- Monitor Navy training exercises, particularly those involving active sonar and underwater detonations, for compliance with the terms and conditions of ESA Section 7 consultations and/or MMPA authorizations;
- Minimize exposure of protected species to sound levels from active sonar or sound pressure levels from underwater detonations currently considered to result in harassment;
- Collect data to support estimating the number of individuals exposed to sound levels above current regulatory thresholds;
- Assess the efficacy of the Navy's current marine species mitigation;
- Assess the practicality and effectiveness of potential future mitigation tools and techniques;
- Document trends in species distribution and abundance in Navy training areas through focused longitudinal monitoring efforts; and
- Add to the knowledge base on potential behavioral and physiological effects to marine species from active sonar and underwater detonations.

The ICMP will provide a comprehensive structure and serve as the basis for establishing monitoring plans for individual range complexes and specific training activities as well as geographically based longitudinal monitoring programs at select locations. Specific training exercise plans will focus on short-term monitoring and mitigation for individual training activities. Each training event will be evaluated to determine if it represents an appropriate monitoring opportunity within the ICMP framework. Due to the scale (spatial, temporal, and operational) of various training activities, not every event will present optimum opportunity for concentrated monitoring and, as a result, various levels of effort and resources will be associated with individual exercises. The overall approach of the ICMP is to target the majority of available monitoring resources on a limited number of opportunities with best potential for high quality data collection rather than attempting to apply a thin blanket of monitoring over the entirety of Navy training.

Data collection methods will be standardized across the program to the extent possible to provide the best opportunity for pooling data from multiple regions. Some methods may be universally applicable; however, some may be utilized only in specific locations where conditions are most appropriate. For example, in Hawaii, there is significant baseline data on odontocetes from tagging, which can be used to provide context for tagging data collected during training events. The Navy's overall monitoring approach will seek to leverage and build on existing research efforts whenever possible.

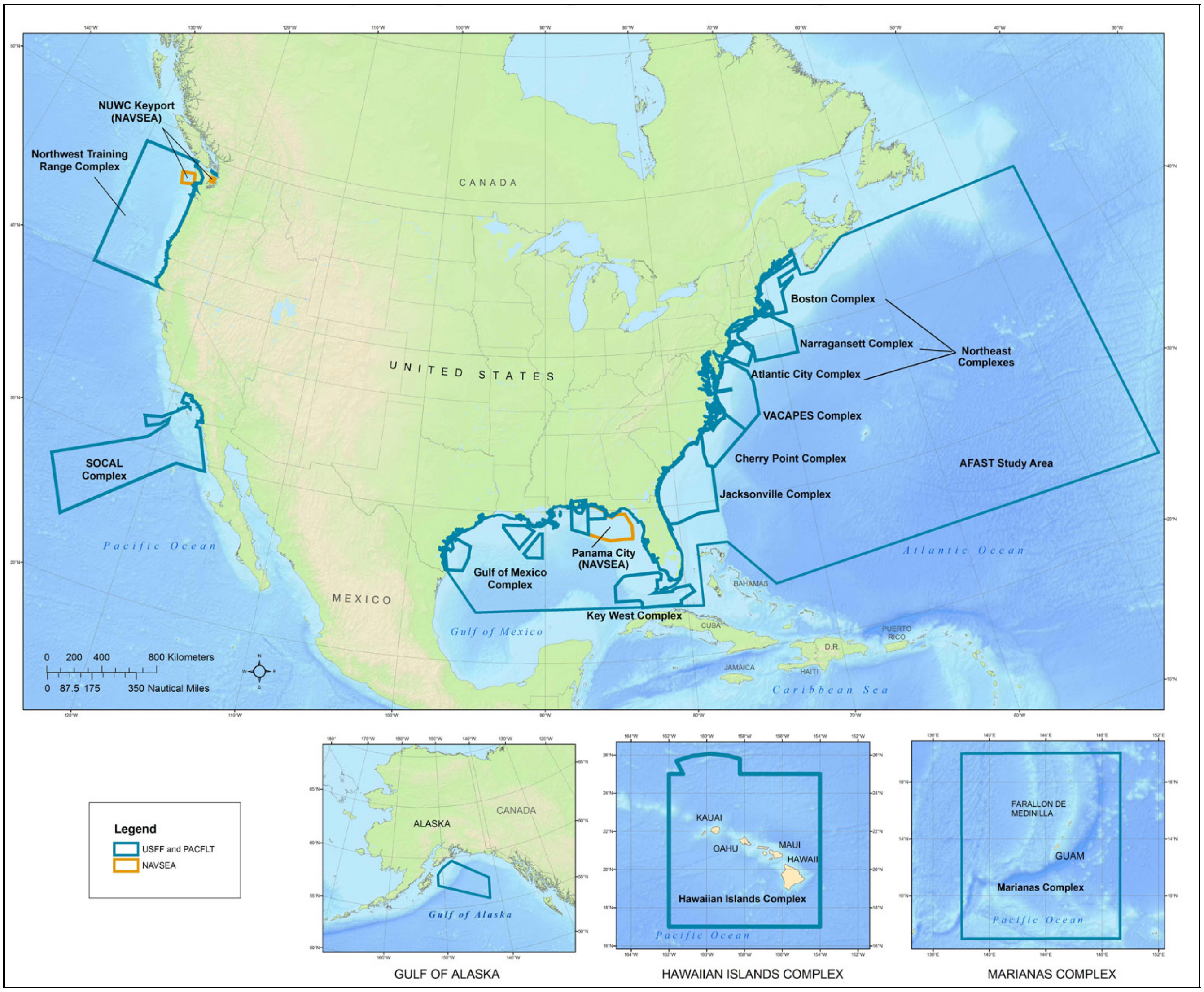

Figure 5.3-1 Navy-Wide Area Map of Areas Where Data Collection is Expected to Occur

By using a combination of monitoring techniques or tools appropriate for the species of concern, the type of training activities conducted, sea state conditions, and the appropriate spatial extent, the detection, localization, and observation of marine species can be optimized, and return on the monitoring investment can be maximized in terms of data collection and mitigation effectiveness evaluation. The ICMP will evaluate the range of potential monitoring techniques that can be tailored to any Navy range or exercise and the appropriate species of concern. The primary tools available for monitoring generally include the following:

- Visual Observations – Surface vessel and aerial survey platforms can provide data on both long term population trends (abundance and distribution) as well as occurrence immediately before, during, and after training events. In addition, visual observation has the potential to collect information related to behavioral response of marine species to Navy training activities. Both Navy personnel (lookouts) and independent visual observers (Navy biologists) will be used from a variety of platforms (both Navy and third-party) for monitoring as appropriate and when logistically feasible.
- Passive Acoustic Monitoring – Autonomous Acoustic Recorders (moored buoys), High Frequency Acoustic Recording Packages (HARPS), sonobuoys, passive acoustic towed arrays, shipboard passive sonar, and Navy Instrumented Acoustic Ranges can provide data on presence/absence as well as localization, identification, and tracking in some cases. Passive acoustic observations are particularly important for species that are difficult to detect visually or when conditions limit the effectiveness of visual monitoring. Instrumented Navy ranges present a unique opportunity to take advantage of infrastructure that would otherwise not be available for monitoring such a large area. The Marine Mammal Monitoring on Navy Ranges (M3R) program takes advantage of this opportunity and may support long-term data collection at specific fixed sites.
- Tagging is an important tool for examining the movement patterns and diving behavior of cetaceans. Sensors can be used that measure location, swim velocity, orientation, vocalizations, as well as record received sound levels. Tagging with sophisticated digital acoustic recording tags (D-tags) may also allow direct monitoring of behaviors not readily apparent to surface observers. D-tags were recently deployed as part of a behavioral response study (BRS-07) initiated at the Atlantic Undersea Test and Evaluation Center (AUTEC) range in the Bahamas to begin identifying behavioral mechanisms related to anthropogenic sound exposure.
- Photo identification and tagging of animals – Photo identification contributes to understanding of movement patterns and stock structure that is important to determine how potential effects may relate to individual stocks or populations.
- Oceanographic and environmental data collection – Physical and environmental data related to habitat parameters are necessary for analyzing distribution patterns, developing predictive habitat and density models, and better understanding habitat use.

Because data concerning physiological and behavioral effects, as well as long-term modifications of habitat use, are extremely limited at this time, the ICMP will also incorporate several geographically fixed longitudinal monitoring sites to assess potential effects to marine mammals, both at the individual and population level. One example of this geographically fixed monitoring approach is the program recently initiated for the proposed Undersea Warfare Training Range (USWTR) in the Atlantic. The Navy contracted with a consortium of researchers from Duke University, the University of North Carolina at Wilmington, the University of St. Andrews, and the NMFS Northeast Fisheries Science Center to conduct a pilot study analysis and subsequently develop a survey and monitoring plan that prescribes the recommended approach for data collection, including surveys (aerial/shipboard, frequency, spatial extent, *etc*.), passive acoustic monitoring, photo identification and data analysis (standard line-transect, spatial modeling, *etc*.) necessary to establish a fine-scale seasonal baseline of protected species distribution and abundance.

This baseline study will provide the foundation for establishing a monitoring program designed to provide meaningful data on potential long term effects to marine species that may be chronically exposed to training activities on the USWTR. The baseline data collection portion of the program began in June 2007 at the Onslow Bay alternative site and includes coordinated aerial, shipboard, and passive acoustic surveys as well as deployment of HARPs to supplement the traditional visual surveys. A similar program is currently being initiated at the Jacksonville preferred site. Similar efforts may be developed for other Navy ranges to support the overall ICMP objectives.

In addition to the specific monitoring initiative outlined above, the ICMP framework proposes to continue or initiate studies of behavioral response, abundance, distribution, habitat utilization, *etc*. for species of concern using a variety of methods, which may include visual surveys, passive and acoustic monitoring, radar, and data logging tags (to record data on acoustics, diving and foraging behavior, and movements). This work will help to build the collective knowledgebase on the geographic and temporal extent of key habitats and provide baseline information to account for natural perturbations such as El Niño or La Niña events as well as establish baseline information to determine the spatial and temporal extent of reactions to Navy operations, or indirect effects from changes in prey availability and distribution. Both the Office of Naval Research and Chief of Naval Operations are heavily involved in supporting a variety of ongoing research efforts (summarized below), including the recent BRS-07 conducted at AUTEC during the summer of 2007.

The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during or within 24 hours after completion of explosive training activities.

5.3.2 Monitoring Summary

The monitoring methods proposed for use during training events in the VACAPES Range Complex include a combination of individual elements designed to allow a comprehensive assessment include:

(1) Vessel and aerial surveys

(i) Visual surveillance of 2 events per year. The primary goal will be to survey two different types of explosive events with one of them being a multiple detonation event.

(ii) For surveyed training events, aerial or vessel surveys will be used 1– 2 days prior to, during if reasonably safe, and 1–5 days post detonation. The variation in the number of days after allows for the detection of animals that gradually return to an area, if they indeed do change their distribution in response to underwater detonation events.

(iii) Surveys will include any specified exclusion zone around a particular detonation point plus 2000 yards beyond the exclusion zone. For vessel-based surveys a passive acoustic system (hydrophone or towed array) could be used to determine if marine mammals are in the area before and/or after a detonation event. Depending on animals sighted, it may be possible to conduct focal surveys of animals outside of the exclusion zone (detonations could be delayed if marine mammals are observed within the exclusion zone) to record behavioral responses to the detonations.

(iv) When conducting a particular survey, the survey team will collect:

(A) species identification and group size;

(B) location and relative distance from the detonation site;

(C) the behavior of marine mammals including standard environmental and oceanographic parameters;

(D) date, time and visual conditions associated with each observation;

(E) direction of travel relative to the detonation site; and

(F) duration of the observation.

(v) An aerial survey team will conduct pre- and post-aerial surveys, taking local oceanographic currents into account, of the exercise area.

(2) Passive acoustic monitoring

(i) When practicable, a towed hydrophone array should be used whenever shipboard surveys are being conducted. The towed array would be deployed during daylight hours for each of the days the ship is at sea.

(ii) A towed hydrophone array is towed from the boat and can detect and localize marine mammals that vocalize and would be used to supplement the ship-based systematic line-transect surveys (particularly for species such as beaked whales that are rarely seen).

(iii) The array would need to detect low frequency vocalizations (< 1,000 Hz) for baleen whales and relatively high frequency vocalizations (up to 30 kHz) for odontocetes such as sperm whales. The use of two simultaneously deployed arrays can also allow more accurate localization and determination of diving patterns.

(3) Marine mammal observers on Navy platforms

(i) Marine mammal observers (MMOs) will be placed on a Navy platform during one of the exercises being monitored per year.

(ii) Qualifications must include expertise in species identification of regional marine mammal species and experience collecting behavioral data. Experience as a NMFS marine mammal observer is preferred, but not required. Navy biologists and contracted biologists will be used; contracted MMOs must have appropriate security clearance to board Navy platforms.

(iii) MMOs will not be placed aboard Navy platforms for every Navy training event or major exercise, but during specifically identified opportunities deemed appropriate for data collection efforts. The events selected for MMO participation will take into account safety, logistics, and operational concerns.

(iv) MMOs will observe from the same height above water as the lookouts.

(v) The MMOs will not be part of the Navy's formal reporting chain of command during their data collection efforts; Navy lookouts will continue to serve as the primary reporting means within the Navy chain of command for marine mammal sightings. The only exception is that if an animal is observed within the shutdown zone that has not been observed by the lookout, the MMO will inform the lookout of the sighting for the lookout to take the appropriate action through the chain of command.

(vi) The MMOs will collect species identification, behavior, direction of travel relative to the Navy platform, and distance first observed. All MMO sighting will be conducted according to a standard operating procedure.

The Navy would submit a report annually on September 1 describing the implementation and results (through June 1 of the same year) of the monitoring required above. Standard marine species sighting forms would be provided by the Navy and data collection methods will be standardized across ranges to allow for comparison in different geographic locations.

VACAPES Range Complex Comprehensive Report – The Navy will submit to NMFS a draft report that summarizes all of the marine mammal observations and data gathered during explosive exercises through June 1, 2012. This report will be submitted to NMFS at the end of the fourth year of the rule (November 2012).

The Navy will respond to NMFS comments on the draft comprehensive report if submitted within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or three months after the submittal of the draft if NMFS does not comment by then.

To implement the aforementioned monitoring measures, the Navy is developing an Integrated Comprehensive Monitoring Program (ICMP) for marine species in order to assess the effects of training activities on marine species and investigate population-level trends in marine species distribution, abundance, and habitat use in various range complexes and geographic locations where Navy training occurs. Although the ICMP is intended to apply to all Navy training, use of mid-frequency active (MFA) sonar in training, testing, and research, development, test, and evaluation (RDT&E) will comprise a major component of the overall program.

The ICMP will establish the overarching structure and coordination that will facilitate the collection and synthesis of monitoring data from Navy training and research and development projects. The Program will compile data from range-specific monitoring efforts as well as research and development (R&D) studies that are fully or partially Navy funded. Monitoring methods across the ranges will include methods such as vessel and aerial surveys, tagging, and passive acoustic monitoring. The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during or within 24 hours after completion of explosives training activities.

The Navy, with guidance and support from NMFS, will convene a Monitoring Workshop, including marine mammal and acoustic experts as well as other interested parties, in 2011. The Monitoring Workshop participants will review the monitoring results from the previous two years of monitoring pursuant to the VACAPES Range Complex rule as well as monitoring results from other Navy rules and LOAs. The Monitoring Workshop participants would provide their individual recommendations to the Navy and NMFS on the monitoring plan(s) after also considering the current science (including Navy research and development) and working within the framework of available resources and feasibility of implementation. NMFS and the Navy would then analyze the input from the Monitoring Workshop participants and determine the best way forward from a national perspective. Subsequent to the Monitoring Workshop, modifications would be applied to monitoring plans as appropriate.

5.3.3 Reporting

In order to issue an Incidental Take Authorization (ITA) for an activity, Section 101(a)(5)(A) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking''. Effective reporting is critical to ensure compliance with the terms and conditions of an LOA, and to provide NMFS and the Navy with data of the highest quality based on the required monitoring. As NMFS noted in its proposed rule, additional detail has been added to the reporting requirements since they were outlined in the proposed rule. The updated reporting requirements are all included below. A subset of the information provided in the monitoring reports may be classified and not releasable to the public. NMFS will work with the Navy to develop tables that allow for efficient submission of the information required below.

General Notification of Injured or Dead Marine Mammals

Navy personnel will ensure that NMFS (regional stranding coordinator) is notified immediately (or as soon as operational security allows) if an injured or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy training exercise utilizing Mid-frequency Active Sonar (MFAS), High Frequency Active Sonar (HFAS), or underwater explosive detonations. The Navy will provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).

Annual VACAPES Monitoring Plan Report

The Navy will submit a report annually on September 1 describing the implementation and results (through June 1 of the same year) of the VACAPES Monitoring Plan, described above. Data collection methods will be standardized across range complexes to allow for comparison in different geographic locations. Although additional information will also be gathered, the marine mammal observers (MMOs) collecting marine mammal data pursuant to the VACAPES Monitoring Plan shall, at a minimum, provide the same marine mammal observation data required in the MFAS/HFAS major Training Exercises section of the Annual VACAPES Exercise Report referenced below. The VACAPES Monitoring Plan Report may be provided to NMFS within a larger report that includes the required Monitoring Plan Reports from multiple Range Complexes.

Annual VACAPES Exercise Report

The Navy will submit an Annual VACAPES Exercise Report on September 1 of every year. This report shall contain the subsections and information indicated below.

Major Training Exercises

This section shall contain the following information for Major Training Exercises (MTE) conducted in the VACAPES Range Complex:

(a) Exercise Information (for each MTE):

(i) Exercise designator.

(ii) Date that exercise began and ended.

(iii) Location.

(iv) Number and types of active sources used in the exercise.

(v) Number and types of passive acoustic sources used in exercise.

(vi) Number and types of vessels, aircraft, etc., participating in exercise.

(vii) Total hours of observation by lookouts (watchstanders).

(viii) Total hours of all active sonar source operation.

(ix) Total hours of each active sonar source (along with explanation of how hours are calculated for sources typically quantified in alternate way (buoys, torpedoes, etc.)).

(x) Wave height (high, low, and average during exercise).

(b) Individual marine mammal sighting information (for each sighting in each MTE).

(i) Location of sighting.

(ii) Species (if not possible—indication of whale/dolphin/pinniped).

(iii) Number of individuals.

(iv) Calves observed (y/n).

(v) Initial Detection Sensor.

(vi) Indication of specific type of platform observation made from (including, for example, what type of surface vessel, *i.e.*, FFG, DDG, or CG)

(vii) Length of time observers maintained visual contact with marine mammal(s).

(viii) Wave height (in feet).

(ix) Visibility.

(x) Sonar source in use (y/n).

(xi) Indication of whether animal is <200yd, 200–500yd, 500–1000yd, 1000–2000yd, or >2000yd from sonar source in (x) above.

(xiii) Mitigation Implementation—whether operation of sonar sensor was delayed, or sonar was powered or shut down, and how long the delay was.

(xiv) If source in use (x) is hull-mounted, true bearing of animal from ship, true direction of ship's travel, and estimation of animal's motion relative to ship (opening, closing, parallel)

(xv) Observed behavior—Lookouts (Watchstanders) shall report, in plain language and without trying to categorize in any way, the observed behavior of the animals (such as animal closing to bow ride, paralleling course/ speed, floating on surface and not swimming, etc.)

(c) An evaluation (based on data gathered during all of the MTEs) of the effectiveness of mitigation measures designed to avoid exposing marine mammals to mid-frequency sonar. This evaluation shall identify the specific observations that support any conclusions the Navy reaches about the effectiveness of the mitigation.

5.3.4 Adaptive Management

The regulations under which the Navy's LOA are issued will contain an adaptive management component (NMFS, 2009). This gives NMFS the ability to consider the results of the previous years' monitoring, research, and/or the results of stranding investigations when prescribing mitigation or monitoring requirements in subsequent years. In the event that NMFS concludes that there is a high likelihood that MFAS or explosive detonations were a cause of a Uncommon Stranding Event ([USE] as defined in 50 CFR § 216.291), NMFS will review the analysis of the environmental and operational circumstances surrounding the USE. In subsequent LOAs, based on this review and through the adaptive management component of the regulations, NMFS may require the mitigation measures be modified or supplemented if the new data suggest that modifications would either have a reasonable likelihood of reducing the chance of future USEs resulting from a similar confluence of events or would increase the effectiveness of the stranding investigations. Further based on this review and the adaptive management component of the regulations, NMFS may modify or add to the existing monitoring requirements if the data suggest that the addition of a particular measure would likely fill a specifically important data or management gap.

5.4 RESEARCH EFFORTS

The Navy provides a significant amount of funding and support to marine research through a variety of organizations. From FY04 to FY08, the Navy provided over $94 million to universities, research institutions, federal laboratories, private companies, and independent researchers around the world for marine life research. During this same time period, the DoD contributed nearly $6 million for a total of $100 million in marine life research projects. These projects include basic science efforts, such as baseline surveys, and do not include monitoring surveys or environmental planning document preparation (DoN, 2008b). In FY08, the Navy spent over $26 million and the DoD almost $1 million towards this effort (DoN, 2008b). Currently, the Navy has budgeted nearly $22 million and the DoD has budgeted a half a million dollars for continued marine mammal research in FY09 (DoN, 2008b). Major topics of Navy-supported research include the following:

- Better understanding of marine species distribution and important habitat areas,
- Developing methods to detect and monitor marine species before and during training,
- Understanding the effects of sound on marine mammals, sea turtles, fish, and birds, and
- Developing tools to model and estimate potential effects of sound.

This research is directly applicable to Atlantic Fleet training activities, particularly with respect to the investigations of the potential effects of underwater noise sources on marine mammals and other protected species. Proposed training activities employ sonar and underwater explosives, which introduce sound into the marine environment.

The Marine Life Sciences Division of the Office of Naval Research currently coordinates six programs that examine the marine environment and are devoted solely to studying the effects of noise and/or the implementation of technology tools that will assist the Navy in studying and tracking marine mammals. The six programs are as follows:

1. Environmental Consequences of Underwater Sound,
2. Non-Auditory Biological Effects of Sound on Marine Mammals,
3. Effects of Sound on the Marine Environment,
4. Sensors and Models for Marine Environmental Monitoring,
5. Effects of Sound on Hearing of Marine Animals, and
6. Passive Acoustic Detection, Classification, and Tracking of Marine Mammals.

The Navy has also developed the technical reports referenced within this document, which include the Marine Resource Assessments and the Navy OPAREA Density Estimates (NODE) reports (DoN, 2007b). Furthermore, research cruises by the NMFS and by academic institutions have received funding from the U.S. Navy. For instance, the ONR contributed financially to the Sperm Whale Seismic Survey (SWSS) in the Gulf of Mexico, coordinated by Texas A&M. The goals of the SWSS are to examine effects of the oil and gas industry on sperm whales and what mitigations would be employed to minimize adverse effects to the species. All of this research helps in understanding the marine environment and the effects that may arise from the use of underwater noise in the Gulf of Mexico and western North Atlantic Ocean.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods on instrumented ranges. However, acoustic detection, identification, localization, and tracking of individual animals still requires a significant amount of research effort to be considered a reliable method for marine mammal monitoring. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential mitigation and monitoring tool.

Recently, a workshop was held to discuss the research required to understand the impact of tactical mid-frequency sonar transmission on fish, fisheries and fisheries habitat. Workshop participants included personnel from the Navy, academic universities, and NOAA Fisheries Service, who were selected based on their expertise in acoustics, fish hearing and fisheries biology. The objective of the workshop was to describe the range of scientific concerns regarding the effects of Navy training activities using tactical mid-frequency active sonar on fish and fisheries resources and to distill these concerns into a long-term research and development plan. The priorities of the workshop included larval fish effects, hearing capabilities, small pelagic and soniferous fish behavior and potential effects to fisheries.

Overall, the Navy will continue to fund ongoing research, and is planning to coordinate long term monitoring/studies of marine mammals on various established ranges and operating areas. The Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include mitigation and monitoring programs; data sharing with NMFS,through literature for research and development efforts; and future research as described previously.

5.5 STANDARD OPERATING PROCEDURES (GENERAL MARITIME MEASURES)

The mitigation measures presented below are taken by Navy personnel on a regular and routine basis. These are routine measures and are considered "Standard Operating Procedures."

5.5.1 Personnel Training – Lookouts

The use of shipboard lookouts is a critical component of all Navy standard operating procedures. Navy shipboard lookouts (also referred to as "watchstanders") are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the Officer of the Deck (OOD) (e.g., trash, a periscope, marine mammals, sea turtles) and all disturbances (e.g., surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

All personnel serving as lookouts on Navy ships and submarines are now required to complete Marine Species Awareness Training (MSAT) as part of the lookout training program. MSAT includes instruction on the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments, general observation at sea, and detecting/identifying marine mammals. MSAT has been reviewed by NMFS and acknowledged as suitable training.

1. All bridge personnel, Commanding Officers, Executive Officers, officers standing watch on the bridge, maritime patrol aircraft aircrews, and Mine Warfare (MIW) helicopter crews will complete MSAT.
2. Navy lookouts will undertake extensive training to qualify as a lookout in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).
3. Lookout training will include on-the-job instruction under the supervision of a qualified, experienced lookout. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).
4. Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure to facilitate implementation of protective measures if marine species are spotted.
5. Surface lookouts would scan the water from the ship to the horizon and be responsible for all contacts in their sector. In searching the assigned sector, the lookout would always start at the forward part of the sector and search aft (toward the back). To search and scan, the lookout would hold the binoculars steady so the horizon is in the top third of the field of vision and direct the eyes just below the horizon. The lookout would scan for approximately five seconds in as many small steps as possible across the field seen through the binoculars. They would search the entire sector in approximately five-degree steps, pausing between steps for approximately five seconds to scan the field of view. At the end of the sector search, the glasses would be lowered to allow the

eyes to rest for a few seconds, and then the lookout would search back across the sector with the naked eye.

6. At night, to increase effectiveness, lookouts would not continuously sweep the horizon with their eyes. Instead, lookouts would scan the horizon in a series of movements that would allow their eyes to come to periodic rests as they scan the sector. When visually searching at night, they would look a little to one side and out of the corners of their eyes, paying attention to the things on the outer edges of their field of vision. Lookouts will also have night vision devices available for use.

5.5.2 Operating Procedures and Collision Avoidance

1. Prior to major exercises, a Letter of Instruction, Naval Message or Environmental Annex to the Operational Order will be issued to further disseminate the personnel training requirement and general marine species mitigation measures.
2. Commanding Officers will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
3. While underway, surface vessels will have at least two lookouts with binoculars; surfaced submarines will have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts will watch for and report to the OOD the presence of marine mammals and sea turtles.
4. On surface vessels equipped with a mid-frequency active sonar, pedestal mounted "Big Eyes" (20x110) binoculars will be properly installed and in good working order to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel.
5. Personnel on lookout will employ visual search procedures employing a scanning method in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).
6. After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).
7. While in transit, naval vessels will be alert at all times, use extreme caution, and proceed at a "safe speed" so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.
8. When whales have been sighted in the area, Navy vessels will increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction and are dictated by environmental and other conditions (*e.g.*, safety, weather).
9. Naval vessels will maneuver to keep at least 1,500 ft (460 m) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged operations, launching and recovering aircraft or landing craft, minesweeping operations, replenishment while underway and towing operations that severely restrict a vessel's ability to deviate course. Vessels will take reasonable steps to alert other vessels in the vicinity of the whale.
10. Where feasible and consistent with mission and safety, vessels will avoid closing to within 200-yd (183 m) of sea turtles and marine mammals other than whales (whales addressed above).
11. Floating weeds, algal mats, Sargassum rafts, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.

12. Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.
13. All vessels will maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a major training exercise.

5.6 MITIGATION MEASURES APPLICABLE TO VESSEL TRANSIT DURING NORTH ATLANTIC RIGHT WHALE MIGRATION

In 1999, a Mandatory Ship Reporting System was implemented by the U.S. Coast Guard, which requires vessels larger than 300 gross registered tons (DoN ships are exempt) to report their location, course, speed, and destination upon entering the nursery and feeding areas of the right whale. At the same time, ships receive information on locations of right whale sightings, in order to avoid collisions with the animals. In the southeastern United States, the reporting system is from November 15 through April 15 of each year; the geographical boundaries include coastal waters within roughly 46 kilometers (km) (25 nautical miles [nm]) of shore along a 167 km (90 nm) stretch of the Atlantic coast in Florida and Georgia. In the northeastern United States, the reporting system is year-round and the geographical boundaries include the waters of Cape Cod Bay, Massachusetts Bay, and the Great South Channel east and southeast of Massachusetts; it includes all of Stellwagen Bank National Marine Sanctuary.

Mid-Atlantic, Offshore of the Eastern United States

For purposes of these measures, the mid-Atlantic is defined broadly to include ports south and east of Block Island Sound southward to South Carolina. The procedure described below would be established as mitigation measures for Navy vessel transits during North Atlantic right whale migratory seasons near ports located off the western North Atlantic, offshore of the eastern United States. The mitigation measures would apply to all Navy vessel transits, including those vessels that would transit to and from East Coast ports and operating areas (OPAREAs). Seasonal migration of North Atlantic right whales is generally described by NMFS as occuring from October 15th through April 30th, when right whales migrate between feeding grounds farther north and calving grounds farther south. The Navy mitigation measures have been established in accordance with rolling dates identified by NMFS consistent with these seasonal patterns.

NMFS has identifed ports located in the western Atlantic Ocean, offshore of the southeastern United States, where vessel transit during North Atlantic right whale migration is of highest concern for potential ship strike. The ports include the Hampton Roads entrance to the Chesapeake Bay, which includes the concentration of Atlantic Fleet vessels in Norfolk, Virginia. Navy vessels are required to use extreme caution and operate at a slow, safe speed consistent with mission and safety during the months indicated in Table 5.6-1 and within a 20 nm (37 km) arc (except as noted) of the specified reference points.

During the indicated months, Navy vessels would practice increased vigilance with respect to avoidance of vessel-whale interactions along the mid-Atlantic coast, including transits to and from any mid-Atlantic ports not specifically identified above. All surface(d) units transiting within 56 km (30 nm) of the coast in the mid-Atlantic would ensure at least two watchstanders are posted, including at least one lookout that has completed required MSAT training. Furthermore, Navy vessels would not knowingly approach any whale head on and would maneuver to keep at least 500 yards (457 m) away from any observed whale, consistent with vessel safety.

TABLE 5.6-1
NORTH ATLANTIC RIGHT WHALE MIGRATION PORT REFERENCES

Region	Months	Port Reference Points
South and East of Block Island	Sep–Oct and Mar–Apr	20 nm seaward of line between 41-4.49N 071-51.15W and 41-18.58N 070-50.23W
New York / New Jersey	Sep–Oct and Feb-Apr	40-30.64N 073-57.76W
Delaware Bay (Philadelphia)	Oct–Dec and Feb–Mar	38-52.13N 075-1.93W
Chesapeake Bay (Hampton Roads and Baltimore)	Nov-Dec and Feb–Apr	37-1.11N 075-57.56W
North Carolina	Dec–Apr	34-41.54N 076-40.20W
South Carolina	Oct–Apr	33-11.84N 079-8.99W 32-43.39N 079-48.72W

5.7 MEASURES FOR SPECIFIC TRAINING EVENTS

These actions are standard operating procedures that are in place currently and will be used in the future for all activities being analyzed under the Preferred Alternative.

5.7.1 Surface-to-Surface Gunnery (up to and including 5-inch explosive rounds)

1. Lookouts will visually survey for floating weeds, algal mats, and *Sargassum* rafts, which may be inhabited by immature sea turtles, in the target area. Intended target area shall not be within 600 yards (548 m) of known or observed floating weeds, algal mats, *Sargassum* rafts, or coral reefs.
2. If applicable, target-towing vessels shall maintain a trained lookout for marine mammals and sea turtles. If a marine mammal or sea turtle is sighted in the vicinity, the tow vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.
3. A 600 yard (548 m) radius buffer zone will be established around the intended target.
4. From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
5. The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within the target area and the buffer zone.

5.7.2 Surface-to-Surface Gunnery (up to and including 5-inch non-explosive rounds)

1. Lookouts will visually survey for floating weeds, algal mats, and *Sargassum* rafts which may be inhabited by immature sea turtles in the target area. Intended target area shall not be within 200 yards (182 m) of known or observed floating weeds, algal mats, *Sargassum* rafts, or coral reefs.
2. A 200 yard (182 m) radius buffer zone will be established around the intended target.
3. From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
4. If applicable, target-towing vessels shall maintain a trained lookout for marine mammals and sea turtles. If a marine mammal or sea turtle is sighted in the vicinity, the tow vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.
5. The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within the target area and the buffer zone.

5.7.3 Firing Exercise (FIREX) Using the Integrated Maritime Portable Acoustic Scoring System (IMPASS) (5-in. explosive rounds)

Note: This exercise is also known as Firing Exercise II (FIREX II) and Naval Surface Fire Support (NSFS).

1. FIREX using IMPASS will only be conducted in Areas 1C1/2, 7C/D, 8C/D and 5C/D of the VACAPES Range Complex.
2. Pre-exercise monitoring of the target area will be conducted with “Big Eyes” prior to the event, during deployment of the IMPASS sonobuoy array, and during return to the firing position. Ships will maintain a lookout dedicated to visually searching for marine mammals and sea turtles 180° along the ship track line and 360° at each buoy drop-off location.
3. “Big Eyes” on the ship will be used to monitor a 600 yd (548 m) buffer zone around the target area for marine mammals/sea turtles during naval-gunfire events. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.
4. Ships will not fire on the target if any marine mammals or sea turtles are detected within or approaching the 600 yd (548 m) buffer until the area is cleared. If marine mammals or sea turtles are present, operations would be suspended. Visual observation will occur for approximately 45 minutes, or until the animal has been observed to have cleared the area and is heading away from the buffer zone.
5. Post-exercise monitoring of the entire effect range will take place with “Big Eyes” and the naked eye during the retrieval of the IMPASS sonobuoy array following each firing exercise.
6. FIREX with IMPASS will take place during daylight hours only.
7. FIREX with IMPASS will only be used in Beaufort Sea State three (3)[17] or less due to equipment limitations.
8. The visibility must be such that the fall of shot is visible from the firing ship during the exercise.
9. No firing will occur if marine mammals are detected within 70 yd (64 m) of the vessel.

Historically FIREX using IMPASS occurs in preferred areas W-386 7C/D, 8C/D, W-72 (1C1/2) and secondary areas W-386 (5C/D) (see Figure 2.2-10). The locations were established to be far enough from shore to reduce civilian encounters (e.g., diving and recreational fishing), while remaining a reasonable day’s distance from the homeport of Norfolk, Virginia of participating ships. Surface ships conducting FIREX with IMPASS do not have strict distance from land restrictions like aircraft that embark from shore-based facilities.

5.7.4 Surface-to-Air Gunnery (up to and including 5-inch explosive rounds)

1. Vessels will orient the geometry of gunnery exercises to prevent debris from falling in the area of sighted marine mammals, sea turtles, algal mats, *Sargassum* rafts, and coral reefs.
2. Vessels will expedite recovery of any parachute deploying aerial targets to reduce the potential for entanglement of marine mammals and sea turtles.
3. If applicable, target towing aircraft shall maintain visual observation. If a marine mammal or sea turtle is sighted within the vicinity of the exercise, the tow aircraft will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

[17] The Beaufort Scale of Wind Force was developed as a means for sailors to gauge wind speeds through visual observations of the sea state. The scale runs from 0 for calm to force 12 for Hurricane. In addition, this specific measure results from technological limitations of the sonobouy array in higher sea states and is not intended as a measure for minimizing potential effects on the marine environment.

5.7.5 Surface-to-Air Gunnery (up to and including 5-inch non-explosive rounds)

1. Vessels will orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sighted marine mammals, sea turtles, algal mats, *Sargassum* rafts and coral reefs.
2. Vessels will expedite the recovery of any parachute deploying aerial targets to reduce the potential for entanglement of marine mammals and sea turtles.
3. If applicable, target towing aircraft shall maintain visual observation. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow aircraft will immediately notify the firing vessel in order to stop gunnery firing until the area is clear.

5.7.6 Small Arms Training – (such as 9 mm, .45 cal pistol, 12GA Shotgun, 5.56 mm, 7.62 mm, and .50 cal)

1. Lookouts will visually survey for floating weeds, algal mats, *Sargassum* rafts, marine mammals, and sea turtles. Weapons will not be fired in the direction of known or observed floating weeds, algal mats, *Sargassum* rafts, marine mammals, sea turtles or coral reefs.

5.7.7 Air-to-Surface At-Sea Bombing Exercises (250-lbs to 2,000-lbs explosive bombs)

This activity occurs in 7D and part of 8C in the VACAPES Study Area. The location was established to be far enough from shore to reduce civilian encounters (e.g., diving and recreational fishing), while remaining within 150 nm from shore-based facilities (the established flight distance restriction for F/A-18 jets during unit level training events).

1. Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The pre-exercise survey of the impact area will be made by flying at 1,500 ft altitude or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
2. A buffer zone of 5,100-yd (4,663 m) radius will be established around the intended target zone. The exercises will be conducted only if the buffer zone is clear of sighted marine mammals and sea turtles.
3. If surface vessels are involved, lookouts will survey for *Sargassum* rafts. Ordnance shall not be targeted to impact within 5,100 yards (4663 m) of known or observed *Sargassum* rafts or coral reefs.
4. At-sea BOMBEXs using live ordnance will occur during daylight hours only.

5.7.8 Air-to-Surface At-Sea Bombing Exercises (non-explosive munitions)

1. If surface vessels are involved, trained lookouts will survey for *Sargassum* rafts, which may be inhabited by immature sea turtles, and for sea turtles and marine mammals. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed *Sargassum* Rafts, sea turtles, marine mammals or coral reefs.
2. A 1,000 yd (914 m) radius buffer zone will be established around the intended target.
3. Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The pre-exercise survey of the impact area will be made by flying at 1,500 feet or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
4. The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

5.7.9 Air-to-Surface Gunnery (such as .05 cal, 20 mm and 25 mm explosive or non-explosive rounds)

1. If surface vessels are involved, lookouts will visually survey for *Sargassum* rafts, which may be inhabited by immature sea turtles, in the target area. Impact should not occur within 200 yds (182 m) of known or observed floating weeds, algal mats, *Sargassum* rafts, or coral reefs.
2. A 200 yd (182 m) radius buffer zone will be established around the intended target.
3. If surface vessels are involved, lookout(s) will visually survey the buffer zone for marine mammals and sea turtles prior to and during the exercise.
4. Aerial surveillance of the buffer zone for marine mammals and sea turtles will be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 feet to 1,500 feet is optimum. Aircraft crew/pilot will maintain visual watch during exercises. Firing through cloud cover is prohibited; aircraft must be able to actually see ordnance impact areas.
5. The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.
6. If applicable, target towing control craft shall maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the towing control craft will immediately notify the firing vessel in order to stop gunnery firing until the area is clear.

5.7.10 Air-to-Surface Missile Exercises (explosive)

1. Ordnance shall not be targeted to impact within 1,800 yd (1,646 m) of known or observed *Sargassum* rafts, which may be inhabited by immature sea turtles, or coral reefs.
2. Aircraft will visually survey the target area for marine mammals and sea turtles. Visual inspection of the target area will be made by flying at 1,500 ft altitude or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Explosive ordnance shall not be targeted to impact within 1,800 yd (1,646 m) of sighted marine mammals and sea turtles.

This activity occurs within W-386 (Air-E, F, I, J, and Air-K) and W-72A. These locations were established to be far enough from shore to reduce civilian encounters (e.g., diving and recreational fishing), while remaining within 60 nm from shore-based facilities (the established flight distance restriction for helicopters during unit level training events).

5.7.11 Air-to-Surface Missile Exercises (non-explosive munitions)

1. Ordnance shall not be targeted to impact within 1,800 yards (1646 m) of known or observed Sargassum rafts, which may be inhabited by immature sea turtles, or coral reefs.
2. Aircraft will visually survey the target area for marine mammals and sea turtles. Visual inspection of the target area will be made by flying at 1,500 feet or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Ordnance shall not be targeted to impact within 1,800 yards (1646 m) of sighted marine mammals and sea turtles.
3. This activity will only occur in W-386 (Air-K)..

5.7.12 Air-to-Air Missile Exercises (explosive and non-explosive)

1. The geometry of missile exercises will be oriented in order to minimize the potential for debris to fall within 1,000 yards (914 m) of sighted marine mammals, sea turtles, algal mats, *Sargassum* rafts, and coral reefs.

5.7.13 Mine Neutralization Training Involving Underwater Detonations (up to and including 20-lbs NEW charges)

Mine neutralization involving underwater detonations occurs in shallow water (0-120 ft or 0-36 m) and is executed by divers using scuba. NMFS issued a Biological Opinion in 2002 for underwater detonations of up to and including 20-lb explosive charges related to MINEX training (NMFS, 2002). These exercises utilize small boats that deploy from shore-based facilities. Often times these small boats are rigid-hulled inflatable boats (RHIBs) which are designed for shallow water and have limited seaworthiness necessitating a nearshore location. The exercise is a one-day event that occurs only during daylight hours therefore the distance from shore is limited.

1. Observers will survey the buffer zone, a 700 yd (640 m) radius from detonation location, for marine mammals and sea turtles from all participating vessels during the entire operation. A survey of the buffer zone (minimum of 3 parallel tracklines 219 yd (200 m) apart) using support craft will be conducted at the detonation location 30 minutes prior through 30 minutes post detonation. During late July through October, an additional surface observer will be added to more carefully look for hatchling turtles in the buffer zone. Aerial survey support will be utilized whenever assets are available.
2. Detonation operations will be conducted during daylight hours.
3. If a sea turtle or marine mammal is sighted within the buffer zone, the animal will be allowed to leave of its own volition. The Navy will suspend detonation exercises and ensure the area is clear for a full 30 minutes prior to detonation.
4. Divers placing the charges on mines and dive support vessel personnel will survey the area for sea turtles and marine mammals and will report any sightings to the surface observers. These animals will be allowed to leave of their own volition and the buffer zone will be clear for 30 minutes prior to detonation.
5. No detonations will take place within 3.2 nm of an estuarine inlet (*e.g.*, Chesapeake Bay).
6. No detonations will take place within 1.6 nm of shoreline.
7. No detonations will take place within 1,000 ft of any known artificial reef, shipwreck, or live hard-bottom community.
8. Personnel will record any protected species observations during the exercise as well as measures taken if species are detected within the buffer zone.

Historically this activity has occurred in shallow water portions of W-50 in the VACAPES Study Area per the 2002 NMFS BO. This location is just offshore from NAS Oceana Dam Neck Annex, a restricted-access Naval Installation and overlaps an established Surface Danger Zone for live ordnance use, therefore civilian encounters are minimized. This location has a low bathymetric relief and a sand-silt bottom. This activity will only occur in W-50.

5.7.14 Mine Countermeasures – Minesweeping Using Equipment Towed by Helicopters

1. Use trained lookouts to survey for *Sargassum* rafts, sea turtles and marine mammals prior to and during the exercise.
2. Establish a 250 yd (229 m) buffer zone around the towed equipment. Exercise will not be conducted if marine mammals or sea turtles are detected within the buffer zone.
3. Helicopters will not fly within 1 nm from the Chesapeake Bay Bridge Tunnel in VACAPES Range Complex.

5.7.15 Inert Mine Shape Deployment

1. Known shipwrecks will be avoided when deploying inert mine shapes.
2. Known artificial and oyster reefs will be avoided when deploying inert mine shapes.

5.7.16 Anchorage of Ships

1. These requirements are not applicable if going to an assigned anchorage.
2. Avoid *Sargassum* rafts.
3. Ships will not anchor in the vicinity of coral reefs, except in designated anchorages or for safety of ship: vicinity is defined as the anchor swing circle encompassing a portion of a coral reef.
4. Ships will not anchor in areas of known shipwrecks.

5.7.17 Mitigation Measures Related to Acoustic Effects (Taken From the AFAST FEIS)

The AFAST Record of Decision, dated 23 Jan 2009, provides detailed discussion of mitigation measures to be employed during activities analyzed in the AFAST FEIS/OEIS. As discussed in the NMFS MMPA regulations for AFAST active sonar activities, ESA Biological opinion, and the AFAST Record of Decision dated 23 Jan 2009, the Navy would implement various mitigation measures to maximize the ability of operators to recognize instances when marine mammals are in the vicinity. These measures include the following:

1. Training personnel in lookout/watchstander duties;

2. Stationing at least three people on watch with binoculars at all times;

3. Stationing at least two additional people on watch during ASW exercises when MFA sonar is being used;

4. Requiring all personnel engaged in passive acoustic sonar operation to monitor for marine mammal vocalizations;

5. Using all available sensor and optical systems, such as night vision goggles during MFA and HFA active sonar activities;

6. Using only passive capability of sonobuoys when marine mammals are detected within 183 meters (200 yards);

7. Limiting ship or submarine active transmission levels to at least 6 dB below normal operating levels when marine mammals are detected by any means within 914 meters (1,000 yards) of the sonar dome (the bow);

8. Limiting ship or submarine active transmission levels to at least 10 dB below normal operating levels when marine mammals are detected by any means within 457 meters (500 yards) of the sonar dome, or ceasing ship or submarine active transmissions when a marine mammal is detected by any means within 183 meters (200 yards) of the sonar dome;

9. If the need for such power-down arises, following power-down requirements as though the system is operating at 235 dB, the normal operating level (i.e., power-down would be to 229 dB);

10. Operating sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives;

11. Requiring helicopters to observe or survey the vicinity of an ASW activity for ten minutes before first deployment of active (dipping) sonar in the water; prohibiting dipping sonar within 183 meters (200 yd) of a marine mammal and ceasing pinging if a marine mammal closes to within 183 meters (200 yd) after pinging has begun;

12. Coordinating with the local NMFS Stranding Coordinator; and submitting a report containing a discussion of the nature of any observed effects based on both modeled results of real-time events and sightings of marine mammals.

Special Conditions Applicable for Bow-Riding Dolphins

If, after conducting an initial maneuver to avoid close quarters with dolphins, the ship concludes that dolphins are deliberately closing in on the ship to ride the vessel's bow wave, no further mitigation actions would be necessary because dolphins are out of the main transmission axis of the active sonar while in the shallow-wave area of the vessel bow.

The Navy and NMFS worked together to identify additional practicable and effective mitigation measures to address the following three issues of concern:

(1) general minimization of marine mammal impacts;

(2) minimization of impacts within the southeastern North Atlantic right whales critical habitat; and

(3) the potential relationship between the operation of mid and/or high-frequency active sonar and marine mammal strandings.

Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the following general goals:

- avoidance or minimization of injury or death of marine mammals wherever possible;
- a reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of mid- or high-frequency active sonar, underwater detonations, or other activities expected to result in the take of marine mammals (this goal may contribute to the first goal above, or by reducing harassment takes only);
- a reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of mid- or high-frequency active sonar, underwater detonations, or other activities expected to result in the take of marine mammals (this goal may contribute to the first goal listed above or by reducing harassment takes only);
- a reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of MFA or HFA sonar, underwater detonations, or other activities expected to result in the take of marine mammals (this goal may contribute to (1), above, or to reducing the severity of harassment takes only);
- a reduction in adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time;
- and for monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation (shut-down zone, etc.).

NMFS and the Navy had extensive discussions regarding mitigation as part of consultation on the proposed and final rules, in which several mitigation options and their respective practicability were explored. Ultimately, NMFS and the Navy developed the following measures which the Navy and NMFS believe supports (or contributes) to the goals mentioned above:

Planning Awareness Areas (PAAs): The Navy has designated several Planning Awareness Areas (PAAs) based on areas of high productivity that have been correlated with high concentrations of marine mammals (such as persistent oceanographic features like upwellings associated with the Gulf Stream front where it is deflected off the east coast near the Outer Banks), and areas of steep bathymetric contours that are frequented by deep diving marine mammals such as beaked whales and sperm whales. In developing the PAAs, USFF was able to consider these factors because of geographic flexibility in conducting ASW training. USFF is not tied to a specific range support structure for the majority of the training for AFAST.

Additionally, the topography and bathymetry along the East Coast and in the Gulf of Mexico is unique in that there is a wide continental shelf leading to the shelf break, affording a wider range of training opportunities. The Navy will avoid planning major exercises in the specified PAAs where feasible. Should national security require the conduct of more than four major exercises (COMPTUEX, JTFEX, SEASWITI, or similar scale event) in these areas (meaning all or a portion of the exercise) per year, the Navy will provide NMFS with prior notification and include the information in any associated after-action or monitoring reports. To the extent operationally feasible, the Navy plans to conduct no more than one of the four major exercises (COMPTUEX, JTFEX, SEASWITI, or similar scale event) per year in the Gulf of Mexico. Based on operational requirements, the exercise area for this one exercise may include the De Soto Canyon. If national security needs require more than one major exercise to be conducted in the PAAs, which includes portions of the DeSoto Canyon, the Navy would provide NMFS with prior notification and include the information in any associated after-action or monitoring reports. The PAAs will be included in the Navy's Protective Measures Assessment Protocol (PMAP) (implemented by the Navy for use in the protection of the marine environment) for unit level situational awareness (i.e., exercises other than COMPTUEX, JTFEX, or SEASWITI). The goal of PMAP is to raise awareness in the fleet and ensure common sense and informed oversight is injected into planning processes for testing and training evolutions.

Helicopter Dipping Sonar in North Atlantic right whale Critical Habitat: Helicopter Dipping Sonar is one of the two activity types that have been identified as planned to occur in the southern North Atlantic right whale critical habitat. Historically, only maintenance of helicopter dipping sonars occurs within a portion of the North Atlantic right whale critical habitat. Tactical training with helicopter dipping sonar does not typically occur in the North Atlantic right whale critical habitat area at any time of the year. The critical habitat area is used on occasion for post maintenance operational checks and equipment testing due to its proximity to shore. Unless otherwise dictated by national security needs, the Navy will minimize helicopter dipping sonar maintenance within the southeast North Atlantic right whale critical habitat from November 15 to April 15.

Object Detection Exercises in North Atlantic Right Whale Critical Habitat: Object detection training requirements are another type of activity that has been identified as planned to occur in the southern North Atlantic right whale critical habitat. The Navy recognizes the significance of the North Atlantic right whale calving area and has explored ways of affecting the least practicable impact (which includes a consideration of practicality of implementation and impacts to training fidelity) to right whales. Navy units will incorporate data from the Early Warning System (EWS) into exercise pre-planning efforts. USFF contributes more than $150,000 annually for aerial surveys that support the EWS, a communication network that assists afloat commands to avoid interactions with right whales. Fleet Air Control Surveillance Facility (FACSFAC) JAX houses the Whale Fusion Center, which disseminates the latest right whale sighting information to Navy ships, submarines, and aircraft. Through the Fusion Center, FACSFAC JAX coordinates ship and aircraft movement into the right whale critical habitat and the surrounding operating areas based on season, water temperature, weather conditions, and frequency of whale sightings and provides right whale reports to ships, submarines and aircraft, including coast guard vessels and civilian shipping. The Navy proposes:

- To reduce the time spent conducting object detection exercises in the North Atlantic right whale critical habitat during the time of November 15 to April 15; and
- Prior to conducting surface ship object detection exercises in the southeast North Atlantic right whale critical habitat during the time of November 15 to April 15, ships will contact the FACSFAC JAX to obtain the latest right whale sighting information. FACSFAC JAX will advise ships of all reported whale sightings in the vicinity of the critical habitat and Associated Area of Concern. To the extent operationally feasible, ships will avoid conducting training in the vicinity of recently sighted right whales. Ships will maneuver to maintain at least 457 meters (500 yards) separation from any observed whale, consistent with the safety of the ship.

5.7.18 Mitigation Measures Related to Explosive Source Sonobuoys (AN/SSQ-110A) (Taken from the AFAST FEIS)

As discussed in the NMFS MMPA regulations for AFAST active sonar activities, ESA Biological Opinion, and the AFAST Record of Decision dated 23 Jan 2009, the Navy would implement the following mitigation measures for explosive source sonobuoys (AN/SSQ-110A) as well as for the follow on Advanced Extended Echo Ranging (AEER) system:

1. Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern;

2. Crews will conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post (source/receiver sonobuoy pair) detonation;

3. If a post (source/receiver sonobuoy pair) will be deployed within 914 meters (1,000 yards) of observed marine mammal activity, crews will deploy the receiver only and monitor while conducting a visual search;

4. When operationally feasible, crews will conduct continuous visual and aural monitoring of marine mammal activity, including monitoring of their aircraft sensors from first sensor placement to checking off-station and of radio frequency range of these sensors; aural detection of marine mammal cues the aircrew to increase the diligence of their visual surveillance;

5. If marine mammals are visually detected within 914 meter (1,000 yards) of the explosive source sonobuoy (AN/SSQ-110A) intended for use, then that payload shall not be detonated;

6. Aircrews will ensure a 914-meter (1,000-yard) safety zone, visually clear of marine mammals, is maintained;

7. Aircrews shall only leave posts with unexploded charges in the event of a sonobuoy malfunction, an aircraft system malfunction, or when an aircraft must immediately depart the area due to issues such as fuel constraints, inclement weather, and in-flight emergencies;

8. Aircrews will ensure all payloads are accounted for;

9. Marine mammal monitoring shall continue until out of their aircraft sensor range.

5.8 COORDINATION AND REPORTING REQUIREMENTS

The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during or within 24 hours after completion of training activities. Additionally, the Navy will follow internal chain of command reporting procedures as promulgated through Navy instructions and orders.

5.9 MEASURES CONSIDERED BUT ELIMINATED

As described in Chapter 3, the vast majority of estimated exposures to marine mammals during proposed activities would not cause injury. Potential effects on marine mammals would be further reduced with the implementation of mitigation measures described above. Therefore, the Navy concludes the proposed action and mitigation measures would achieve the least practicable adverse impact on species or stocks of marine mammals. A determination of "least practicable adverse impacts" includes consideration, in consultation with NMFS, of personnel safety, practicality of implementation, and impact of the effectiveness of the military training activity. Therefore, the following additional mitigation measures were analyzed and eliminated from further consideration because:

- they would result in impacts to training effectiveness, which would ultimately degrade military readiness;
- they present personnel safety concerns; or,
- they are impractical and provide no known protective benefit.

Reduction in training. The requirements for training have been developed iteratively over many years to ensure sailors have achieved levels of readiness that ensure they are prepared to properly respond to the many contingencies that may occur during deployment and actual combat. These training requirements are designed to provide the experience needed to ensure sailors are properly trained and proficient for operational success. There is not extra training built into the training plan, as this would not be an efficient use of resources (*e.g.* fuel, time). Therefore, any reduction of training would not allow sailors to achieve satisfactory levels of readiness needed to accomplish their mission.

Establish and implement a set vessel speed. Navy personnel are already required to use extreme caution and operate at a slow, safe speed consistent with mission and safety. Further, during periods of North Atlantic right whale migration, ships exercise heightened lookout vigilance and adjust speeds as necessary as an added measure to avoid this critically endangered species. Ships and submarines need to be able to react to changing tactical situations during training as they would in actual combat. Placing arbitrary speed restrictions would not allow them to properly react to these situations. By training differently than what would be needed in an actual combat scenario there would be a decrease in training effectiveness and a reduction in crew's abilities.

Restrict training to certain geographic areas, during certain seasons, and during certain conditions (*e.g.* low visibility, nighttime). Implementation of blanket restrictions on training as mitigation measures would dramatically reduce the realism of training with potentially severe national security consequences, and would afford at best only highly speculative benefits to marine species populations. Personnel must train under the full range of conditions that they might encounter during deployment and in combat, and be in a state of readiness that allow them to identify and respond to changing environmental conditions 24 hours per day. On-the-job training in combat is the worst possible way of training personnel and places personnel and the success of the military mission at significant risk. Nonetheless, the Navy has considered limitations during certain specific training events in all East Coast Range Complexes where feasible and when such limitations would not interfere with training missions and goals, and when other related training events provide the necessary exposure of personnel to the full spectrum of environmental conditions they may encounter during deployment and combat (particularly Unit Level Training events involving explosive ordnance, and seasonal restrictions related to North Atlantic right whale calving season and migration).

Visual monitoring using third-party observers from aircraft and vessels in addition to existing Navy-trained lookouts. Under the Integrated Comprehensive Monitoring Program for Marine Mammals described in Section 5.3, third-party lookouts would be used during exercises selected for data sampling. However, using third-party lookouts for all training events the Navy conducts in order to supplement Navy lookout observations and/or provide a "check" of Navy-trained lookouts would present logistical and security problems for the Navy.

- **Security.** Security clearances would need to be obtained for a large number of observers in order to cover all training events, since the exact time and location of all Navy training events is classified as SECRET.
- **Space.** Some training events span one or more 24-hour periods, with operations that are occurring underway continuously in that timeframe, therefore enough third-party personnel would be needed in order to man the observation decks or aircraft during that timeframe. There are severe space limitations onboard ships for berthing third-party crews, and there are no additional seats in aircraft that are involved in exercises. Overnight berthing of contractors and visitors are onboard ships is currently accomplished only after significant planning and juggling of bunks, space and Navy crew work shifts.
- **Scheduling.** Scheduling civilian vessels and/or aircraft to coincide with all training events would impact training effectiveness since exercise event timetables cannot be precisely fixed and are instead based on the free-flow development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the unceasing progress of the exercise and impact the effectiveness of the training activity.
- **Safety.** Surveying during training events also raises safety concerns with multiple vessels and slow, low-flying civilian aircraft operating in the same seaspace and airspace as military vessels and aircraft engaged in combat training activities. In addition, most of the training events take place far from land, limiting both the time available for civilian aircraft to be in the exercise area and presenting a concern should aircraft mechanical problems arise.

Expansion of Exclusion Area Delineated for Use with Explosive Detonations. Currently, the Navy uses certain exclusion zones for different explosive types, which means that an area of a certain size around an explosive must be clear of marine mammals for a certain amount of time prior to the detonation of that explosive. For a few of the larger charges (MK-84s and MK-48s), the distance to the isopleth within which NMFS expects TTS would likely occur is larger than the distance that the Navy must ensure is clear prior to the initiation of some of the exercise types that utilize those larger charges (i.e., an animal could be within the distance from a source where TTS may occur, but outside of the distance that the Navy is required to 'clear' prior to detonation. NMFS considered requiring an enlarged exclusion zone for use with these larger charges.

Monitoring of Explosive Exclusion Area During Exercises. For some explosive detonations, the Navy's current mitigation requires clearance of an area prior to the initiation of an explosive exercise, but does not require continued monitoring of the area throughout the exercise. Under this measure, NMFS considered a requirement for Navy to continue monitoring the exclusion zone throughout the exercise and to take appropriate mitigation measures during the exercise should a marine mammal be spotted within that zone.

5.10 DETECTION PROBABILITY AND MITIGATION EFFICACY

5.10.1 Factors Affecting Detection Probability

The probability of visually detecting a marine animal is dependent upon two things. First, the animal and the observer must be in the same place at the same time. If the animal is not present, it cannot be seen (availability bias) (Marsh and Sinclair, 1989). Second, when the animal is in a position to be detected by an observer and the observer in a position to detect the animal, the observer must perceive the animal (perception bias) (Marsh and Sinclair, 1989). The factors affecting the detection of the animal may be probabilistically quantified as *g(0)*. That is, *g(0)* represents the chance that the animal will be available for detection (i.e., on the surface and in the observer's field of view) and that the observer will perceive the animal. A *g(0)* value of 1 indicates that 100 percent of the animals are detected; it is rare that this assumption holds true, as both perception and availability bias impact the overall value of *g(0)* for any given species.

Various factors are involved in estimating *g(0)*, including: sightability/detectability of the animal (species-specific behavior and appearance, school size, blow characteristics, dive characteristics, and dive interval); viewing conditions (sea state, wind speed, wind direction, sea swell, and glare); and observer (experience, fatigue, and concentration) and platform characteristics (pitch, roll, yaw, speed, and height above water). Thomsen *et al*. (2005) provide a complete and recent discussion of *g(0)*, factors that affect the detectability of the animals, and ideas on how to account for detection bias. Table 5.10-1 provides a range of values for *g(0)* for cetacean species in the VACAPES Study Area. It is important to note that *g(0)* as it is used here does not relate to the ability to identify an animal on any order, only that the animal will be detected.

5.10.1.1 Marine Mammals

There are many variables that play into how easily a marine mammal may be detected by an observer at the surface [i.e., the g(*0*) value for that species]. As discussed previously, some of these variables affect (or are affected by) the observer, the platform, and the conditions under which the observations are being made. Many of the variables, however, are directly related to the animal, its external appearance, its behavior and its life history. The size of the animal, its surface behavior, its dive behavior, and the overall gregariousness of the species all impact the ability of the observer to detect an individual at the surface.

The following is a much generalized discussion of the behavior and external appearance of the marine mammals with the potential to occur in the East Coast Range Complexes as these characters relate to the detectability of each species. The species are grouped loosely based on either taxonomic relatedness or commonalities in size and behavior (or both). Not all statements may hold true for all species in a grouping and outstanding exceptions are mentioned where applicable. The information presented in this section may be found in Jefferson *et al.* (2008) and sources within unless otherwise noted.

<u>Cetaceans</u>

Large Whales

Species of large whales found in the VACAPES Study Area include all the baleen whales and the sperm whale. Baleen whales are generally large (adult size ranging from 9 to 27 m [30 to 89 ft]), often making them immediately detectable. Many species of baleen whales have a prominent blow ranging from 3 m (10 ft) to as much as 12 m (39 ft) above the surface. However, there are at least two species (Bryde's whale and common minke whale) that often have no visible blow. Baleen whales tend to travel singly or in small groups ranging from pairs to groups of five; the exception to this is the fin whale, which is known to travel in pods of seven or more individuals. However, all species of baleen whales are known to form larger-scale aggregations in areas of high localized productivity or on breeding grounds. Baleen whales may or may not fluke at the surface before they dive; some species fluke regularly (humpback whale, North Atlantic right whale), some fluke variably (blue whale, fin whale) and some rarely fluke (sei whale, common minke whale, and Bryde's whale). Baleen whales may remain at the surface for extended periods of time as they forage or socialize. North Atlantic right whales are known to form surface-active groups (SAG) and humpback whales to corral prey at the surface. Dive behavior varies amongst species, as well. Many species will dive and remain at depth for as long as 30 minutes. Some will adjust their diving behavior according to the presence of vessels (North Atlantic right whale, humpback whale, fin whale). Sei whales are known to sink just below the surface and remain there between breaths. Baleen whales have *g(0)* values ranging from 0.11 to 1.00 (Table 5.10-1).

Sperm whales also belong to the large whales, with adult males reaching as much as 18 m (50 ft) in total length. Sperm whales at the surface would likely be easy to detect. They are large, have a prominent, 5 m (16 ft) blow, and may remain at the surface for long periods of time. They are known to raft (i.e., loll at the surface) and to form SAGs when socializing. Sperm whales may travel or congregate in large groups of as many as 50 individuals. They also engage in conspicuous surface behavior such as fluking, breaching and tail-slapping. However, sperm whales are long, deep divers and may remain submerged for over an hour. Sperm whales vocalize frequently (Teloni, 2005) and would probably be detected acoustically. Sperm whales have *g(0)* values ranging from 0.19 to 1.00 (Table 5.10-1).

Cryptic Species

Cryptic cetacean species are those that are known to be difficult to detect on the surface or that actively avoid vessels. These include beaked whales (family Ziphiidae), dwarf and pygmy sperm whales (*Kogia* spp.), and harbor porpoises.

Beaked whales are notoriously difficult to detect at sea. Beaked whales may occur in a variety of group sizes, ranging from single individuals to groups of as many as 100 (MacLeod and D'Amico, 2006). For beaked whale species occurring in the East Coast Range Complexes, group sizes may range from 1 to 22 individuals. Beaked whale diving behavior in general consists of long, deep dives that may last for nearly 90 minutes followed by a series of shallower dives and intermittent surfacings (Tyack *et al*., 2006; Baird *et al*., 2007). However, individuals may remain at the surface for an extended period of time (perhaps an hour or more) or make shorter dives (MacLeod and D'Amico, 2006). Detection of beaked whales is further complicated because beaked whales often dive and surface in a synchronous pattern (MacLeod and D'Amcio, 2006) and they travel below the surface of the water. Beaked whales are odontocetes and use acoustic signals for communication and foraging. They are known to produce sounds ranging from low to high frequency (MacLeod and D'Amico, 2006). However, many of the sounds that have been recorded for beaked whales fall at or outside the upper range of human hearing (greater than 20 kHz), making acoustic detection less likely for these species than for species with a lower peak frequency. Beaked whales have *g(0)* values ranging from 0.13 to 1.00 (Table 5.10-1).

Dwarf and pygmy sperm whales (referred to broadly as *Kogia* spp.) are small cetaceans (3 to 4 m [10 to 13 ft] adult length) that are not seen commonly at sea. *Kogia* spp. are some of the most commonly stranded species in some areas, which suggests that sightings are not indicative of their overall abundance. This supports the idea that they are cryptic, perhaps engaging in inconspicuous surface behavior or actively avoiding vessels. When *Kogia* spp. are sighted, they are seen in groups of no more than five to six individuals. They have no visible blow, do not fluke when they dive, and are known to log (i.e., lie motionless) at the surface. When they do dive, they often will sink out of sight with no prominent behavioral display. There is little acoustic information on *Kogia* spp.; what is available suggests that *Kogia* spp. emit ultrasonic clicks with a peak frequency of 125 kHz (Marten, 2000), well outside of what is audible to the human ear. *Kogia* spp. are not likely to be detected acoustically. *Kogia* spp. have *g(0)* values ranging from 0.19 to 0.79 (Table 5.10-1).

Harbor porpoises are better known than beaked whales and *Kogia* spp., but are considered to be cryptic because they are difficult to detect in all but the best of conditions (i.e., no swell, no whitecaps). Harbor porpoises travel singly or in small groups (less than six individuals), but may aggregate into groups of several hundred. They are inconspicuous at the surface, rarely lifting their heads above the surface and often lying motionless. They are small and may actively avoid vessels. Harbor porpoises have *g(0)* values ranging from 0.08 to 0.85 (Table 5.10-1).

Delphinids

There are 18 species of the family Delphinidae that may occur in the East Coast Range Complexes. There are a variety of factors that make these species some of the most likely to be detected at sea by observers. Many species of delphinids engage in very conspicuous surface behavior, including leaping, spinning, bow riding, and traveling along the surface in large groups. Delphinid group sizes may range from 10 to 10,000 individuals, depending upon the species and the geographic region. Species such as pilot whales, rough-toothed dolphins, white-beaked dolphins, white-sided dolphins, bottlenose dolphins, Stenellid dolphins, common dolphins, and Fraser's dolphins are known to either actively approach and investigate vessels, or bow ride along moving vessels. Fraser's dolphins and common dolphins form huge groups that travel quickly along the surface, churning up the water and making them visible from a great distance. Delphinids may dive for as little as a minute to over thirty minutes, depending upon the species. Some species of delphinids are very vocal and may be easily detected acoustically if they are foraging or socializing. There are records of some species of Delphinids (spinner dolphins, pantropical spotted dolphins, common dolphins) actively avoiding vessels in the Eastern Tropical Pacific (ETP). This behavior is probably a response to the high levels of mortality associated with tuna fisheries in the ETP and has not been noted elsewhere in the world. Delphinids have *g(0)* values ranging from 0.19 to 1.00, with many species having much higher values (Table 5.10-1).

Miscellaneous

Beluga whales may occur in the East Coast Range Complexes and would probably be detected by observers. Belugas have an extremely conspicuous coloration (all white) and reach up to 5 m (16 ft) in total length. They travel in groups ranging from 15 individuals to thousands. They dive for lengths of up to 25 minutes, but are one of the most vocal cetaceans and would likely be detected acoustically. There are no *g(0)* values available for beluga whales.

Pinnipeds

There are no sea lions in North Atlantic waters. Seals are more difficult to detect at sea than cetaceans. They are much smaller, often solitary and generally do not engage in conspicuous surface behavior. There is not a lot of information regarding seal behavior at sea. Some species, such as harbor seals, are known to approach and observe human activities on land or on stationary vessels. Harbor seals and gray seals are solitary at sea. Harp seals appear to be an exception, traveling in large groups at the surface and churning up whitewater like dolphins. Gray seals are known to rest vertically at the surface with only the head exposed. Pinnipeds may be long divers; gray seals may dive for as long as 30 minutes and hooded seals for up to 60 minutes. The only *g(0)* values available for pinnipeds occurring in the East Coast Range Complexes are for the harbor seal. They have a *g(0)* value of 0.28 (Table 5.10-1).

TABLE 5.10-1
RANGE OF ESTIMATES FOR G(0) FOR MARINE MAMMAL SPECIES FOUND ON THE ATLANTIC COAST

g(0)[1]	Location	Platform	Source
Threatened/Endangered Cetacean Species			
Right whale (*Eubalaena* spp.)			
0.29-1.00	U.S. Atlantic Coast	Shipboard	(Palka, 2006)
0.11-0.71	U.S. Atlantic Coast	Aerial	(Hain *et al.*, 1999)
0.19-0.29	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.95	U.S. West Coast	Aerial	(Forney *et al.*, 1995)
Humpback (*Megaptera novaeangliae*)			
0.19-0.21	U.S. Atlantic Coast	Shipboard	(Palka, 2005a)
0.90-1.00	U.S. West Coast	Shipboard	(Barlow, 1995; Calambokidis and Barlow, 2004)
0.95	U.S. West Coast	Aerial	(Forney *et al.*, 1995)
0.26	Hawaii	Aerial	(Mobley *et al.*, 2001)
Blue whale (*Balaenoptera musculus*)			
0.41	U.S. West Coast	Aerial	(Barlow et al., 1997; Carretta, *et al.*, 2000)
0.9-1.00	U.S. West Coast	Shipboard	(Barlow and Taylor, 2001)
0.92	U.S. West Coast	Shipboard	(Barlow and Forney, 2007; Forney, 2007)
Sei whale (*Balaenoptera borealis*)			
0.92	U.S. West Coast	Shipboard	(Barlow and Forney, 2007; Forney, 2007)
Fin whale (*Balaenoptera physalus*)			
0.32-0.94	U.S. Atlantic Coast	Shipboard	(Blaylock *et al.*, 1995; Palka, 2006)
0.19-0.29	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.90-1.00	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.95-0.98	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney et al. 1995)
0.90-1.00	Hawaii	Shipboard	(Barlow, 2003b)

TABLE 5.10-1
RANGE OF ESTIMATES FOR G(0) FOR MARINE MAMMAL SPECIES FOUND ON THE ATLANTIC COAST (Continued)

g(0)[1]	Location	Platform	Source
Sperm whale (*Physeter macrocephalus*)			
0.28-0.57	U.S. Atlantic Coast	Shipboard	(Palka, 2005a; Palka, 2006)
0.19-0.29	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.53-1.00	U.S. West Coast	Shipboard	(Barlow, 1995; Barlow and Gerrodette, 1996; Barlow and Sexton, 1996; Barlow, 2003a; Barlow and Taylor, 2005)
0.95-0.98	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney et al., 1995)
0.87	Hawaii	Shipboard	(Barlow, 2003b, 2006)
0.32	Antarctic	Shipboard	(Kasamatsu and Joyce, 1995)
Non-Threatened/Non-Endangered Cetacean Species			
Minke whale (*Balaenoptera acutorostrata*)			
0.31-0.70	U.S. Atlantic Coast	Shipboard	(Blaylock *et al*., 1995; Palka, 2006)
0.19-0.29	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.25-0.90	Eastern North Atlantic	Shipboard	(Butterworth and Borchers,,1988; Øien, 1990; Schweder *et al*., 1991; Schweder and Høst, 1992; Schweder *et al*., 1992; Schweder *et al*., 1997; Skaug and Schweder, 1999; Skaug *et al*., 2004)
0.84	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.95-0.98	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney *et al*., 1995)
0.63-0.83	Antarctic	Shipboard	(Doi *et al*., 1982; IWC, 1982, 1983)
Bryde's whale (*Balaenoptera edeni*)			
0.90-1.00	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.90	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Beluga (*Delphinapterus leucas*)			
None available.			
***Kogia* spp.**			
0.29-0.55	U.S. Atlantic Coast	Shipboard	(Palka, 2006)

TABLE 5.10-1
RANGE OF ESTIMATES FOR G(0) FOR MARINE MAMMAL SPECIES FOUND ON THE ATLANTIC COAST (Continued)

g(0)[1]	Location	Platform	Source
0.19-0.79	U.S. West Coast	Shipboard	(Barlow, 1995; Barlow and Sexton, 1996; Barlow, 1999, 2003a)
0.35	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Ziphiidae (Beaked Whales)			
0.46-0.51	U.S. Atlantic Coast	Shipboard	(Palka, 2005a; Palka 2006)
0.19-0.21	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.13-1.00	U.S. West Coast	Shipboard	(Barlow, 1995; Barlow and Sexton, 1996; Barlow, 1999; Carretta *et al*., 2001; Barlow, 2003a; Barlow, *et al*. 2006)
0.23-0.45	Hawaii	Shipboard	(Barlow, 2003b, 2006)*
0.27	Antarctic	Shipboard	(Kasamatsu and Joyce, 1995)
0.95-0.98	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney *et al*., 1995)
Bottlenose dolphin (*Tursiops truncatus*)			
0.62-0.99	U.S. Atlantic Coast	Shipboard	(Palka, 2005a; Palka, 2006)
0.58-0.77	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.74-1.00	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.67-0.96	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney *et al*., 1995)
0.74-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Spinner dolphin (*Stenella longirostris*)			
0.61-0.76	U.S. Atlantic Coast	Shipboard	(Palka, 2006)
0.77-1.0	U.S. West Coast	Shipboard	(Barlow, 2003a)
0.77-1.0	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Clymene dolphin (*Stenella clymene*)			
None available.			
Pantropical spotted dolphin (*Stenella attenuate*)			
0.37-0.94	U.S. Atlantic Coast	Shipboard	(Palka, 2006)*
0.77-1.00	U.S. West Coast	Shipboard	(Barlow, 2003a)
0.76-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Atlantic spotted dolphin (*Stenella frontalis*			
0.37-0.94	U.S. Atlantic Coast	Shipboard	(Palka, 2006)**
Striped dolphin (*Stenella coeruleoalba*)			
0.61-0.77	U.S. Atlantic Coast	Shipboard	(Palka, 2005a; Palka, 2006)

TABLE 5.10-1
RANGE OF ESTIMATES FOR G(0) FOR MARINE MAMMAL SPECIES FOUND ON THE ATLANTIC COAST (Continued)

g(0)[1]	Location	Platform	Source
0.77-1.00	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.76-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Common dolphin (*Delphinus delphis*)			
0.52-0.95	U.S. Atlantic Coast	Shipboard	(Palka, 2005a; Palka, 2006)
0.58-0.77	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.79-0.81	Eastern North Atlantic	Shipboard	(Cañadas *et al*., 2004)
0.77-1.0	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.67-0.96	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney *et al*., 1995)
Rough-toothed dolphin (*Steno bredanensis*)			
0.74-1.00	U.S. West Coast	Shipboard	(Barlow, 2003a)
0.74-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Fraser's dolphin (*Lagenodelphis hosei*)			
0.76-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
White-sided dolphin (*Lagenorhynchus acutus and L. obliquidens*)			
0.27-0.38	U.S. Atlantic Coast	Shipboard	(Palka, 2006)
0.58-0.77	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.77-1.00	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.67-0.96	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney *et al.*, 1995)
White-beaked dolphin (*Lagenorhynchus albirostris*)			
None available.			
Risso's dolphin (*Grampus griseus*)			
0.51-0.84	U.S. Atlantic Coast	Shipboard	(Palka, 2005a; Palka 2006)
0.58-0.77	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.74-1.00	U.S. West Coast	Shipboard	(Barlow, 1995, 2003a)
0.67-0.96	U.S. West Coast	Aerial	(Forney and Barlow, 1993; Forney *et al*., 1995)
0.74-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
False killer whale (*Pseudorca crassidens*)			
0.74-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Pygmy killer whale (*Feresa attenuata*)			
0.74-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)

TABLE 5.10-1
RANGE OF ESTIMATES FOR G(0) FOR MARINE MAMMAL SPECIES FOUND ON THE ATLANTIC COAST (Continued)

g(0)[1]	Location	Platform	Source
Killer whale (*Orcinus orca*)			
0.90	U.S. West Coast	Shipboard	(Barlow, 2003a)
0.95-0.98	U.S. West Coast	Aerial	(Forney *et al*., 1995)
0.90	Hawaii	Shipboard	(Barlow, 2003b, 2006)
0.96	Antarctic	Shipboard	(Kasamatsu and Joyce, 1995)
Melon-headed whale (*Peponocephala electra*)			
0.74-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
Pilot whale (*Globicephala* spp.)			
0.48-0.67	U.S. Atlantic Coast	Shipboard	(Palka, 2005a; Palka 2006)
0.19-0.29	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.74-1.00	U.S. West Coast	Shipboard	(Barlow, 2003a)
0.74-1.00	Hawaii	Shipboard	(Barlow, 2003b, 2006)
0.93	Antarctic	Shipboard	(Kasamatsu and Joyce, 1995)
Harbor porpoise (*Phocoena phocoena*)			
0.35-0.73	U.S. Atlantic Coast	Shipboard	(Palka, 1995; Palka, 1996; Palka, 2006)
0.24-0.49	U.S. Atlantic Coast	Aerial	(Palka, 2005b)
0.41-0.71	Eastern North Atlantic	Aerial	(Grünkorn *et al*. 2005)
0.08-0.85	U.S. West Coast	Aerial	(Barlow *et al*. ,1988; Calambokidis *et al*., 1993a; Forney *et al.* 1995; Laake *et al.,* 1997; Carretta *et al*., 2001; Carretta *et al*., 2007)
0.54-0.79	U.S. West Coast	Shipboard	(Calambokidis *et al*., 1993b; Barlow 1995; Carretta *et al*., 2001)
Non-Threatened/Non-Endangered Pinniped Species			
Harbor seal (*Phoca vitulina*)			
.28	U.S. West Coast	Aerial	(Barlow *et al*., 1997; Carretta *et al*. 2000)

*These numbers were either determined by the source or applied by the source for abundance/density estimation analyses in the particular geographic location.

[1] A *g(0)* value of 1.00 indicates that 100 percent of the animals are detected; it is rare that this assumption holds true. Departures of *g(0)* from 1.00 can be attributed to either perception bias or availability bias.

In general, large whales are fairly easy to detect due to their large size and prominent blow (Taylor *et al*., 2007). Also relatively easy to detect are large groups of individuals, particularly gregarious delphinids that may be visible from a great distance due to the disturbance they make when moving across the surface of the water. Less easy to detect are marine mammals that spend a great deal of time at depth or whose presence on the surface is solitary and inconspicuous (Taylor *et al.*, 2007).

Most information on pinnipeds is gleaned from studies done while individuals are hauled-out on land or on ice. Systematic at-sea sightings information is limited, so a *g(0)* value is available only for harbor seal (Carretta *et al*., 2000). Pinnipeds have a low profile, no dorsal appendage and small body size in comparison with most cetaceans, limiting accurate visual detection to sea states of less than Beaufort 2 (Carretta *et al*., 2000).

5.10.1.2 Sea Turtles

The detection probability of sea turtles is generally lower than that of cetaceans. Sea turtles often spend over 90 percent of their time underwater (e.g., Byles, 1988; Renaud and Carpenter, 1994; Mansfield and Musick, 2003) and are not visible more than one or two meters below the surface (Mansfield, 2006). Shoop and Kenney (1992) postulated that, due to the dive behavior of sea turtles, marine surveys underestimate the total number of animals in a given area by as much as an order of magnitude. This suggests that standard visual observation efforts may be less effective in detecting sea turtles than they are in detecting cetaceans. Sea turtles also are much smaller than cetaceans, so the effective distance from which they can be seen (from both surface and aerial platforms) is smaller (300 m [984 ft] for turtles versus over a kilometer for large whales or gregarious delphinids; Musick *et al.*, 1984). Shipboard surveys designed for sighting marine mammals are adequate for detecting large sea turtles (e.g., adult leatherbacks), but usually not the smaller-sized turtles (e.g., juveniles, *Lepidochelys* spp.). Pelagic juveniles may be especially difficult to detect. Aerial detection may be more effective in spotting sea turtles on the surface, particularly in calm seas and clear water, but it is possible that the smallest age classes are not detected even in good conditions (Marsh and Saalfeld, 1989). Visual detection of sea turtles, especially small turtles, is further complicated by their startle behavior in the presence of ships. Turtles on the surface may react to the presence of a vessel (dive) before it is detected by shipboard or aerial observers (Kenney, 2005). However, sea turtle reaction time is reduced in proportion to increasing vessel speeds (Hazel *et al*., 2007).

There have been few dedicated surveys for sea turtles. There is no information available on specific *g(0)* values for turtles. Most of these studies have used mathematical models to calculate the proportion of surfaced turtles to submerged turtles based on the proportion of time sea turtles are expected to spend at the surface (obtained from tracking or tagging data). Byles (1988) found that for every loggerhead observed on the surface in Chesapeake Bay, approximately 19 were present, but unobservable. Mansfield (2006) found that sea turtles spent more time at the surface during the spring than during the summer within the Chesapeake Bay. Therefore, the 1:19 (at surface/ under the surface) ratio would change depending on the season. However, sea turtles only spend a portion of the year in Chesapeake Bay and their surfacing behavior may be different than that of year-round residents in other locations. Not only are there no specific estimates of *g(0)* for turtles, but it is likely that the value shifts significantly depending on species, age class, season and geographic region.

Visual mitigation efforts for sea turtles will probably detect only those individuals that are very large or that spend a significant portion of their time at the surface. Sea turtles will not be detected acoustically.

CHAPTER 6 : CUMULATIVE IMPACTS

6.1 APPROACH

The Navy's past experience in preparing cumulative impacts analyses under the National Environmental Policy Act of 1969 (NEPA) was utilized in determining the scope and format of the cumulative impacts analyses presented within this chapter of the Virginia Capes (VACAPES) Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS).

The approach taken in the analysis of cumulative impacts follows the objectives of NEPA and CEQ regulations and guidance. CEQ regulations (40 Code of Federal Regulations [CFR] §§ 1500-1508) provide the implementing procedures for NEPA. The regulations define cumulative impacts as:

> "'Cumulative impact' is the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7)."

> "To determine the scope of environmental impact statements, agencies shall consider …cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement."

In addition, the CEQ has published guidance addressing implementation of cumulative impact analysis under NEPA. The CEQ guidance publication entitled *Considering Cumulative Impacts Under the National Environmental Policy Act, January 1997* states that the analyses should:

> "…determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and future actions… identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Based on the guidance provided within this CEQ publication, the Navy has determined the following types of potential cumulative impacts need to be analyzed:

- "additive" (the total loss of a resource from more than one incident),
- "countervailing" (adverse impacts that are compensated for by beneficial effects), and
- "synergistic" (when the total effect is greater than the sum of the effects taken independently).

However, the analysis of cumulative impacts may go beyond the scope of project-specific direct and indirect impacts to include expanded geographic and time boundaries and a focus on broad resource sustainability. The true geographic range of an action's effect may not be limited to an arbitrary political or administrative boundary. Similarly, the impacts of an action may continue beyond the time the action ceases. This "big picture" approach is becoming increasingly important as growing evidence suggests that the most significant impacts result not from the direct impacts of a particular action, but from the combination of individual, often minor, impacts of multiple actions over time. The underlying issue is whether or not a resource can adequately recover from the impact of an action before the environment is exposed to a subsequent action or actions.

The proposed action is to support and conduct current and emerging training and Research, Development, Testing, and Evaluation (RDT&E) operations in the VACAPES Range Complex. This Range Complex consists of targets and instrumented areas, airspace, and surface and subsurface operating areas (OPAREAs). The activities analyzed in this document include current and future proposed Navy training and RDT&E operations within Navy-controlled OPAREAs, airspace, and ranges, and Navy-funded range capabilities enhancements

The proposed action would not make radical changes to the VACAPES Range Complex facilities, operations, training, or RDT&E capacities. Rather, the actions proposed in the No Action Alternative, Alternative 1, and Alternative 2 are incremental increases that would result in relatively small-scale, but critical, enhancements that are necessary if the Navy is to maintain a state of military readiness commensurate with its national defense mission.

6.1.1 Assumptions Used in the Analysis

The cumulative impacts analysis in this chapter differs from the analysis conducted for the alternatives detailed in Chapter 3 because the cumulative impacts analysis considers an expanded geographic area and extended timeframe. Therefore, the cumulative impacts analysis includes additional impacts on the physical, biological, and human environments associated with VACAPES Range Complex activities.

In accordance with NEPA, the cumulative impacts analysis takes into consideration combined impacts of past, present, and reasonably foreseeable future activities. Therefore, the baseline utilized in the alternatives analysis presented in Chapter 3 of this EIS/OEIS could not be used in the cumulative impacts analysis. The baseline associated with the cumulative impact analysis had to take into account the effects of both past and present activities. In accordance with the NEPA, the cumulative impacts analysis must take into consideration the incremental contribution of the proposed action to the existing baseline. However, as activities increase within the Study Area, the baseline will change. Thus, the baseline for the cumulative impacts analysis must include past, present, and reasonably foreseeable future activities.

The incremental contribution of the proposed action in each area is relatively small and would most likely continue to reduce in size as non-military activities increase within the Study Area. Overall, it is more difficult to analyze cumulative impacts versus project-specific impacts. The Navy recognizes the need to identify and quantify the factors causing environmental change and the threshold triggers associated with the environmental response.

6.1.2 Summary and Significance of Past Cetacean Stranding Events Related to Military Use of Sonar

With the exception of historic whaling in the 19th and early part of the 20th century, during the past few decades there has been an increase in marine mammal mortalities associated with a variety of human activities (Geraci *et al*., 1999; NMFS, 2007a). These include fisheries interactions (bycatch and directed catch), pollution (marine debris, toxic compounds), habitat modification (degradation, prey reduction), vessel strikes (Laist *et al*., 2001), and gunshots. In addition, during the past 10 years, naval sonar has been putatively linked to only 5 stranding events worldwide, with a total of 51 stranded animals and 37 mortalities. The 37 mortalities equate to an average of fewer than 4 marine mammal mortalities per year over the past 10 years.

These five strandings are unique from other strandings because in these cases, unique conditions may have existed in the active sonar activity area that, in their aggregate, may have contributed to the marine mammal strandings. For example, the stranding of whales occurred over a short period of time, stranded individuals were spatially co-located, traumas in stranded animals were consistent between events, and active sonar was known or suspected to be in use. Moreover, in several of these strandings, activities involved multiple ships operating in the same area over extended periods of time in close proximity. Furthermore, operations occurred across a relatively short horizontal distance, in areas surrounded by landmasses, and of at least 3,281 feet (ft) (1,000 meters [m]) in depth near a shoreline with a rapid change in bathymetry. However, these conditions are not present in the majority of other documented marine mammal strandings, and current science suggests that multiple factors, both natural and man-made, may each be acting alone or in combination to cause marine mammals to strand.

Overall, the number of deaths during stranding events associated with mid-frequency active sonar exposure is small in comparison to the number of marine mammals killed annually through fishing by-catch and whaling operations. For example, the mean annual bycatch from 1990 through 1999 was 3,029 marine mammals (Read *et al*., 2006). Bycatch data from 1990 through 1994 was extrapolated by Read *et al.,* (2006) to consider global impacts; when this was done, approximately 308,000 marine mammal deaths have resulted annually. Waring *et al*., (2008) provided a mean annual mortality of 702 to Western North Atlantic cetaceans (excluding pinnipeds) by observed fisheries in 2001 through 2005. In addition to by-catch, some countries still engage in whaling operations for research and commercial purposes. Such operations led to the death of almost 1,500 marine mammals in 2006 (DoN, 2008a). Thus, the overall contribution of cetaceans' stranding resulting in death associated with exposure to naval mid-frequency sonar is relatively small when compared to all the other non-military activity related to marine mammal stranding and effects, as shown in Figure 6.1-1.

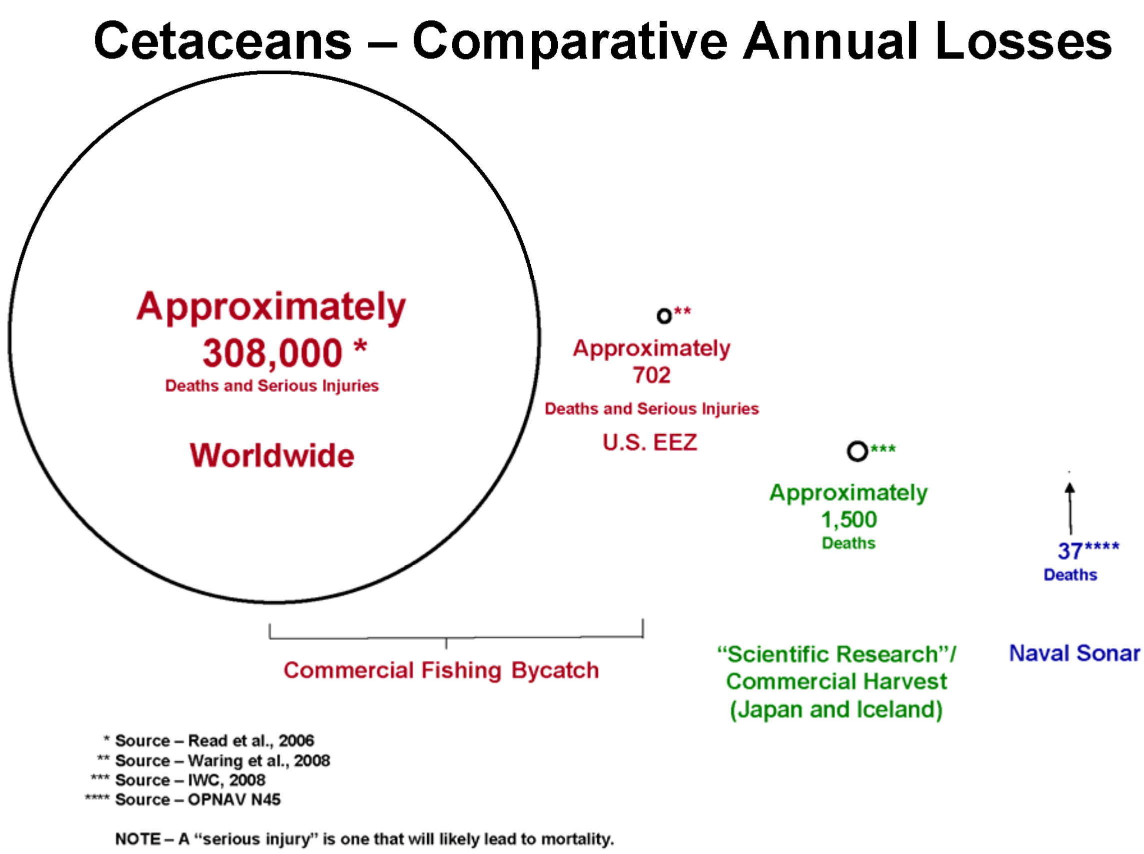

Figure 6.1-1 Annual Comparison of Cetacean Death by Activity

The Navy has made the protection of marine mammals a top priority. The Navy has led the way in marine mammal research, and in conjunction with the National Oceanic and Atmospheric Administration (NOAA), has developed 29 mandatory science-based mitigation measures that allow the Navy to conduct active sonar activities with the utmost care for the ocean environment. Refer to Chapter 5, Mitigation Measures, for additional information.

6.1.3 Organization of Chapter 6

Presenting past, present and reasonably foreseeable future actions and their potential impacts can be very confusing. The following organization may help the reader understand how the data are presented. Past and present actions are presented in Section 6.2. Actions for civilian commercial and recreational activities are presented in Section 6.2.1; other federal and state agency activities are presented in Section 6.2.2; scientific research efforts are discussed in Section 6.2.3; and military operations are in Section 6.2.4. Reasonably foreseeable future actions are presented in Section 6.3. This section is further divided into military operations (Section 6.3.1) and other federal and state agency actions (Section 6.3.2). Section 6.4 is a discussion of cumulative impacts relative to the proposed action. Each resource area in Chapter 3 is discussed in this section and impacts referenced in Sections 6.2 and 6.3 are incorporated, if relevant. Finally, Section 6.5 is a summary of cumulative impacts by resource area.

6.2 PAST AND PRESENT ACTIONS

Various types of past and present actions not related to the proposed action have the potential to affect the resources identified in Chapter 3. The overview of these actions in this section emphasizes components of the activities that are relevant to the effects analysis in Chapter 3. Geographic distribution, intensity, duration, and the historical effects of similar activities are considered when determining whether a particular activity may contribute cumulatively and significantly to the impacts on resource areas identified in Chapter 3. The past and present actions discussed in this section are based upon the best data available to the public as of December 1, 2008.

6.2.1 Commercial and Recreational Activities

The fishing industry affects resources, including marine mammals and sea turtles. The mean annual mortality of Western North Atlantic marine mammals as a result of by-catch is estimated at 2,615 (*i.e.,* 702 cetaceans and 1,913 pinnipeds) (Waring *et al*., 2008). Adverse effects to protected marine species are possible due to gillnet, longline, trawlgear, and pot fisheries. Additionally, commercial fisheries may incidentally entangle and drown or injure cetaceans by lost and expended fishing gear (*e.g*., Northridge and Hofman, 1999). For example, entanglement in fixed fishing gear, in particular in sink gillnets and a variety of pot and trap fisheries, is one of the most important factors depressing the growth rate of the North Atlantic right whale population (Kenney, 2002). Additionally, fisheries may indirectly compete with cetaceans by reducing the amount of primary food source accessible to cetaceans, thereby negatively affecting their numbers (Trites *et al*., 1997). Southeastern shrimp trawl and summer flounder/scup/black sea bass fisheries are considered to be most likely to adversely affect sea turtles; however, shrimp trawling has the greatest effect. However, the use of "turtle-excluder devices" (TED) in the shrimp fishery was estimated to reduce sea turtle bycatch by approximately 97 percent (NOAA, 2004). As an example of the success of TEDs, in South Carolina waters, mortality was reduced by approximately 44 percent in the law's first four years (Gibbons, 2008).

Fisheries are classified first, according to the total effect of all fisheries on each marine mammal stock and second, by addressing the effect of individual fisheries on each stock. This classification method includes consideration of the rate, in numbers of animals per year, of incidental mortalities and serious injuries of marine mammals due to commercial fishing operations relative to the potential biological removal level for each stock. The potential biological removal level is the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (NMFS, 2007b). Category I fisheries are the most detrimental to marine mammals and are defined as having an annual mortality and serious injury of a stock in a given fishery of greater than or equal to 50 percent of the potential biological removal level (NMFS, 2007b). Table 6.2-1 shows the Category I commercial fisheries in the Atlantic Ocean and Gulf of Mexico and the marine mammal species affected.

Along the Atlantic and Gulf Coast, almost 2.8 billion pounds of fish were commercially caught with a value of over $2.1 billion (NMFS, 2007c). In addition, over 12 million Americans participate in saltwater recreational fishing along the Atlantic and Gulf Coast (NMFS, 2007c). In the past ten years, the number of participants has increased 54 percent and the number of recreational fishing trips has increased to 82 million trips (NMFS, 2007c). Nationwide, recreational saltwater recreational fishing generated over $30 billion in sales in 2000 and supported about 350,000 jobs (Steinbeck *et al.*, 2004).

TABLE 6.2-1
CATEGORY I COMMERCIAL FISHERIES
IN THE ATLANTIC OCEAN AND GULF OF MEXICO

Fishery Description	Estimated Number of Vessels/ Persons	Marine Mammal Species Incidentally Killed/Injured		
Gillnet Fisheries	>1,011	Fin whale Humpback whale Long-finned pilot whale Minke whale Atlantic Ocean right whale Short-finned pilot whale	Bottlenose dolphin Common dolphin Harbor porpoise Risso's dolphin White-sided dolphin	Gray seal Harbor seal Harp seal Hooded seal
Longline Fisheries	94*	Cuvier's beaked whale Long-finned pilot whale Mesoplodon beaked whale Northern bottlenose whale Pygmy sperm whale Short-finned pilot whale	Atlantic spotted dolphin Bottlenose dolphin Common dolphin Pantropical spotted dolphin Risso's dolphin	----
Trap/Pot Fisheries	13,000	Fin whale Humpback whale Minke whale Atlantic Ocean right whale	----	Harbor seal

NMFS, 2007b
*Some Caribbean fisheries are included in this number

6.2.1.1 Commercial and Recreational Fisheries – Atlantic Ocean, Offshore of the Southeastern United States

In 2006, commercial fishing off the southeastern U.S. Atlantic coast brought in 540 million pounds of fish with a value of $249 million (NMFS, 2007d). Examples of fish caught include menhaden, flounder, mackerel, crab, sea scallops, and shrimp. Recreational anglers brought in approximately 71 million pounds of fish in 2006 (NMFS, 2007d).

6.2.1.2 Cruise Ship/Passenger Ship Operations

Norfolk, VA is a cruise terminal for several cruise ship operations. Norfolk was recently named "Best Up-and-Coming U.S. Homeport" by *Porthole Cruise Magazine*. The terminal is expected to serve over 100,000 cruise passengers to its new state-of-the-art facility, the Half Moone Cruise and Celebration Center. In addition to bringing the obvious economic benefits to the region, they also add volume to ocean traffic and contribute noise to the ocean. They also contribute to the loading of debris in the ocean environment. Several laws govern the disposal of solid waste from cruise ships including International Convention for the Prevention of Pollution from Ships and Act to Prevent Pollution from Ships (prohibits the at-sea disposal of plastic waste), Marine Plastic Pollution Research and Control Act of 1987 (prohibits discharging garbage within three nm of shore, certain types of garbage between 3-25 nm offshore, and discharging plastic anywhere), and the Clean Water Act (prohibits discharging pollutants from a point source into waters of the US) to name a few.

6.2.1.3 Marine Ecotourism (Whale-Watching and Dolphin-Watching)

Migrating baleen whales may be affected by whale-watching activities off the East Coast as well as in the Caribbean (Hoyt, 1995). Effects of whale-watching on cetaceans may be measured in a short time-scale (*i.e.*, startle reaction) or as a long-term effect on reproduction or survivability (IFAW, 1995). There is little evidence to show that short-term effects have any relation to possible long-term effects on cetacean individuals, groups, or populations (IFAW, 1995). Whale-watching could have an effect on whales by distracting them, displacing them from rich food patches, or by dispersing food patches with wake or propeller wash.

6.2.2 Federal and State Activities (other than Military Operations)

6.2.2.1 National Aeronautics and Space Administration (NASA) Activities

NASA's main operational centers on the East Coast are located at Kennedy Space Center and Cape Canaveral Air Force Station in Florida and Wallops Flight Facility (WFF)/Goddard Space Flight Center in Virginia. Activities at the Florida sites in 2007 and 2008 include five space shuttle launches, and four Delta II rocket launches (NASA, 2007a). Operations at Wallops Flight Facility/Goddard Space Flight Center include many research-oriented activities such as the launching of sounding rockets and scientific balloons (NASA, 2007b).

WFF is located on the Delmarva Peninsula in Virginia and is part of the NASA Goddard Space Flight Center. The WFF is compromised of the Main Base, Mainland, and Wallops Island. WFF is a multifaceted research and development facility with particular expertise in launching and utilizing sub-orbital rockets. It has been used as an aeronautics research center since 1945; WFF currently maintains three runways, an active launch range, communications and radar tracking systems, and approximately 556 buildings. The island covers an area of approximately 10.2 mi^2 (26.3 km^2).

An EA was completed in 2003 which proposed to make available for use the AQM-37 at Wallops Island (NASA, 2003). The AQM-37 is an air-launched, preprogrammed, nonrecoverable target with external command and control capabilities which can be used as an aerial target to test new and operational ship defense weapon systems. The purpose of the AQM-37 is to serve as a target for missile exercises being performed by the U.S. Navy and supported by WFF in the VACAPES OPAREA. This would be used to test the performance of shipboard weapons systems as well as provide simulated real-world targets for ship defense training exercises, allowing for the potential requirement of 20 target flights per year with a maximum of 30, which have been in place since 2003. After analyzing 14 environmental resources (land resources, water resources, air quality, noise, hazardous materials and waste, biological resources, population, recreation, employment and income, health and safety, cultural resources, environmental justice, transportation, and cumulative effects), NASA determined that there were no significant environmental impacts from the AQM-37 operations at WFF (NASA, 2003).

Finally, NASA Wallops Flight Facility participates in the development and testing of instruments for orbital flight by conducting observational Earth Science studies, supporting aerospace technology development, providing aircraft flight services for scientific investigations, operating the Wallops Test Range and managing the Orbital Tracking Station. The Test Range consists of a rocket launch range, aeronautical research airport and associated tracking, data acquisition and ordnance operations. Suborbital and orbital vehicles are launched from Wallops Island. No major launches are planned for Wallops Flight Facility/Goddard Space Flight Center (NASA, 2007a). Wallops Orbital Tracking Station provides around the clock tracking, command and data acquisition operations. The mission support set includes many of NASA's low Earth orbiting spacecraft and NASA cooperative spacecraft, plus Department of Defense, commercial and foreign spacecraft.

There is no additional publicly available information regarding past and present actions potentially occurring within the VACAPES Study Area for this facility.

6.2.2.2 Exploration, Extraction, and Production of Oil, Gas, and Alternative Energy on the Outer Continental Shelf

The Minerals Management Service (MMS), within the Department of the Interior, manages the mineral resources of the federal offshore lands of the Outer Continental Shelf (OCS). MMS leases OCS lands to commercial companies for the exploration, extraction, and production of mineral resources. The Atlantic OCS area is divided into four planning areas along the Atlantic seaboard: the Atlantic Ocean, Mid-Atlantic, South Atlantic, and the Straits of Florida (MMS, 2007a).

For the past 26 years leasing of specific portions of the Federal OCS has been prohibited via the annual Congressional appropriations process (e.g. Congress not appropriating funds for MMS to conduct leasing for the specified OCS areas). From 1982 to 1992, Congress supported annual moratoria in specific OCS areas off the coast of California, the North Atlantic, the Mid-Atlantic, the Eastern Gulf of Mexico and all of the North Aleutian Basin (EIA, 2005).

In 1990, President George H. W. Bush issued a Presidential Directive that enacted a blanket moratorium until 2000 on all unleased areas offshore Northern and Central California, Southern California except for 87 tracts, Washington, Oregon, the North Atlantic coast, and the Eastern Gulf of Mexico coast. Separate from the annual moratoria in appropriations legislation, this directive meant that no leasing or pre-leasing activities were allowed to occur in these areas during the entire period. In 1998, President Clinton extended the moratorium through 2012 (EIA, 2005).

On August 8, 2005, President George W. Bush signed into law the Energy Policy Act of 2005. This legislation has several provisions that pertain to natural gas and oil development including alternative energy related projects in offshore areas. Of note, the Act requires MMS to conduct a comprehensive inventory and analysis of the estimated natural gas and oil resources on the OCS. The inventory includes moratoria areas which were closed to natural gas and oil leasing. Several provisions in the Act provide increased incentives for natural gas and oil development in offshore areas in order to maintain and stimulate production. Finally, the Energy Policy Act of 2005 granted authority to MMS to manage and oversee alternative-energy related projects on the OCS. Prior to this provision, there was a gap in the law with respect to alternative energy projects (EIA, 2005).

In April 2007, MMS published the Proposed Final Program (PFP) Outer Continental Shelf Oil and Gas Leasing Program 2007-2012 in conjunction with the Final FEIS 2007-2012 OCS Oil and Gas Leasing Program (MMS, 2007b; 2007c). The FEIS evaluated the possible environmental effects of a proposed leasing program that includes the entire area offshore the coast of Virginia, the Gulf of Mexico, the North

Aleutian Basin, and the Chukchi Sea. With regard to the Gulf of Mexico, the MMS FEIS noted that offshore oil and gas activities have the potential to affect military activities, but that U.S. Department of Defense (DoD) and the U.S. Department of Interior (DOI) have cooperated on these issues for many years and have developed mitigation measures that minimize such conflicts. Whenever possible, close coordination between oil and gas operators and the military authorities for specific operational areas is encourages, and in some cases, is required under these lease stipulations. In some instances where the military requires unimpeded access to specific areas on the OCS, specific lease blocks have been deleted from one or more proposed lease sales.

As for the Mid-Atlantic/Virginia area, the Navy commented in 2006 on the Proposed Program for OCS Oil and Gas Leasing for 2007- 2012 and the accompanying DEIS that it had concerns about possible operational conflicts with energy activities in this area. However, the Navy supported the 22 nm (40 km) buffer and no obstruction zone and expressed it willingness to discuss possible alternatives to minimize conflicts between energy development and military operations. In the PFP published in April 2007, MMS decided on one special interest sale in 2011, but with a 50-mile buffer and a no obstruction zone from the mouth of the Chesapeake Bay off the coastline of Virginia. Also, MMS noted that the special lease sale in the Mid-Atlantic would only be held if the President chooses to modify the withdrawal and Congress discontinues the annual appropriations moratorium in the Mid-Atlantic.

In October 2007 MMS released a final programmatic EIS supporting the establishment of a program for authorizing alternative energy and alternate use (AEAU) activities on the OCS, as authorized by Section 388 of the Energy Policy Act of 2005 (EPAct), and codified in subsection 8(p) of the Outer Continental Shelf Lands Act (OCSLA) (MMS, 2007d). The final programmatic EIS examines the potential environmental effects of the program on the OCS and identifies policies and best management practices that may be adopted for the program. Under the program, MMS has jurisdiction over AEAU projects on the OCS including, but not limited to: offshore wind energy, wave energy, ocean current energy, offshore solar energy, and hydrogen generation. MMS will also have jurisdiction over other projects that make alternate use of existing oil and natural gas platforms in Federal waters on the OCS. Future AEAU activities on the OCS will be evaluated by the Navy on a case by case basis to determine if operational conflicts with Navy activities may exist in a specific area.

MMS issued the Record of Decision to establish the AEAU program by selecting the Preferred Alternative described in the Final programmatic Environmental Impact Statement. This decision establishes an AEAU program for issuance of leases, easements, and rights-of-way (ROWs) on the OCS for alternative energy activities and the alternate use of structures on the OCS. The Preferred Alternative also provides MMS the option to authorize, on a case-by-case basis, individual AEAU projects that are in the national interest prior to promulgation of the final rule. At the same time, the MMS stated it would vigorously pursue its efforts to complete a comprehensive program with regulations for authorizing and managing AEAU activities on the OCS. Upon promulgation of the final rule, MMS leases, easements, and ROWs for AEAU activities on the OCS would be issued subject to the rule’s provisions. On July 9, 2008, MMS issued the proposed regulations for establishing a program to grant leases, easements, and rights-of-ways for alternative energy on the OCS. MMS is working toward issuance of several leases for data gathering and technology testing. These leases will look at varied renewable energy sources in different portions of the OCS (MMS, 2008f).

On July 14, 2008, President Bush removed the executive prohibition on producing oil from the OCS that was in effect until 2012, as mentioned earlier, and requested that Congress take action to lift the restrictions in order to give states the option to recommend the opening of the OCS off their coasts to environmentally responsible exploration (The White House, 2008). In September 2008, the congressional ban on offshore drilling was allowed to expire (Washington Post, 2008).

Many Section 7 consultations have been completed on MMS activities. Until 2002, Biological Opinions (BOs) resulting from Section 7 consultations concluded that one take of sea turtles may occur annually due to vessel strikes. Biological Opinions issued on July 11, 2002 (lease sale 184), November 29, 2002 (multi-lease sales 185, 187, 190, 192, 194, 196, 200, and 201), and August 20, 2003 (lease sales 189 and 197), have concluded that in addition to vessel strikes to sea turtles, adverse effects may occur from seismic surveys and expended materials. Explosive removal of offshore structures may adversely affect sea turtles and marine mammals (USAF, 2005).

In April 2006, MMS applied for a Letter of Authorization (LOA) from NMFS to "take" by harassment a small number of marine mammals, incidental to explosive removal of offshore structures in the Gulf of Mexico (NMFS, 2006b). In this application it was estimated that Level A harassment takes would be five dolphins over the course of five years, and Level B harassment takes would be 457 dolphins and whales combined per year (NMFS, 2006b). However, it was stated that these numbers would be much lower in actuality due to the implementation of mitigation measures (NMFS, 2006b).

In April 2007, a final rule was printed in the Federal Register by MMS requiring the lessees to provide information on how they will conduct their proposed activities in a manner consistent with the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA) (MMS, 2007e). Each lessee would be required to employ monitoring systems and mitigation measures, submit biological environmental reports and environmental effects analyses, and obtain its own authorized incidental "take" permits from NMFS (MMS, 2007e).

6.2.2.3 MMS Regulated Activities – Atlantic Ocean, Offshore of the Southeastern United States

The southeastern Atlantic Coast is divided by MMS into three planning areas: Mid-Atlantic, South Atlantic, and Straits of Florida. These areas combined cover 208,477 nm^2 (715,970 km^2) from Delaware to the southern most tip of Florida. From 1959 until 2000, 307 blocks (2,484 nm^2 or 8,531 km^2) were leased (MMS, 2007f). There are currently no active leases and no activity in this area (MMS, 2007c). However, a special interest sale in the Mid-Atlantic region off the coast of Virginia has been proposed in late 2011 (MMS, 2007c).

6.2.2.4 Onshore and Offshore Liquefied Natural Gas (LNG) Facilities

Liquefied natural gas (LNG) is natural gas that has been cooled about -260 degrees Fahrenheit (°F) until the gas is in its liquid form. When natural gas is liquefied, it decreases to 1/600 its original volume, which makes it ideal for shipping (FERC, 2005). LNG is transported to LNG terminals by tankers equipped with insulated walls and systems to keep the LNG in liquid form. Once LNG is unloaded from ships at LNG terminals, it is stored as a liquid until it is warmed to convert it back to natural gas. The natural gas is then sent through pipelines for distribution (FERC, 2005).

LNG is odorless, colorless, non-toxic, and will not burn as a liquid. LNG vapors will not explode in a confined environment and are only flammable at concentrations of 5 to 15 percent with air (FERC, 2005). This makes LNG relatively harmless unless vapors are at flammable concentrations around an ignition source.

FERC, the USCG and the Maritime Administration (MARAD) regulate LNG facilities. LNG facilities that lie within state waters are regulated by FERC per the Energy Policy Act of 2005. The USCG and MARAD have jurisdiction over the LNG facilities within federal waters under the Federal Deepwater Ports Act of 1974 (FERC, 2006a).

6.2.2.5 Existing LNG Facilities, Mid-Atlantic

Dominion Cove Point LNG, LP – Cove Point, MD

The Cove Point terminal began service in 1978, but was forced to close in 1980. In 1995, it was reopened to liquefy, store, and distribute domestic natural gas, and in July 2003 received its first LNG imports. The terminal is owned by Dominion Corporation and is located on the Chesapeake Bay, approximately 60 mi (97 km) southeast of Washington, DC (CRS, 2003). The demand for natural gas in the United States is expected to grow by at least 20 percent over the next decade (Dominion, 2007a). As a response to this increased demand, the FERC authorized the expansion of Cove Point LNG's existing import terminal and pipeline, as well as the construction of new downstream pipeline and storage facilities as part of the Cove Point Expansion Project (FERC, 2006b). According to the Cove Point Expansion Project website, construction of the LNG facilities began in August of 2006. Pipeline facility construction began in 2007 and will continue through 2008. In the fall of 2008, it is expected to be ready for service (Dominion, 2007b).

6.2.2.6 Dredging Operations

The construction and maintenance of federal navigation channels are ongoing activities on the U.S. Atlantic coast. NMFS has identified dredging operations as an activity that may cause sea turtle mortality. Hopper dredges move faster than sea turtles and can entrain (or trap) them. NMFS has issued BOs with the U.S. Army Corps of Engineers (USACE) for the U.S. Atlantic coast and has concluded that the implementation of reasonable and prudent measures will result in no jeopardy to sea turtle species. Dredging activities also have the potential to affect the protected Gulf and shortnose sturgeons, particularly juveniles that may not be able to avoid entrainment. This potential effect has not been quantified. Dredging operations obviously affect the geology of an area, as the floor topography is altered and turbidity occurs.

An area on the mid Atlantic coast of the United States that utilizes maintenance dredging on a regular basis is the Hampton Roads region of southeastern Virginia. Hampton Roads, a natural tidal basin formed by the confluence of the James and Elizabeth Rivers, includes the waterways around Norfolk, Virginia Beach, Suffolk, Chesapeake, Portsmouth, Hampton, and Newport News, Virginia. A series of navigation channels (more than 10) lie in this area and require dredging to maintain their dimensions, which range from 350 to 1,000 ft (107 to 305 m) wide and 45 to 55 ft (14 to 17 m) deep (GlobalSecurity.org, 2005). The USACE Norfolk District has reported a total of 27 sea turtle takes between 2000 and 2006 due to dredging operations in the area of Hampton Roads (USACE, 2007a).

One southeastern Atlantic coast region in which maintenance dredging is necessary is within Cumberland Sound and NSB Kings Bay on the southeastern Georgia coast. Dredging in Kings Bay has occurred at least once a year since 1994. The USACE Jacksonville District has reported a total of 15 sea turtle takes between 2000 and 2007 due to dredging operations in the Kings Bay area (USACE, 2007b).

6.2.2.7 Commerce and Shipping Lanes

The waters off the U.S. Atlantic coast support a large volume of maritime traffic heading to and from foreign ports as well as traffic traveling north and south to various U.S. ports. Commercial shipping comprises a large portion of this traffic, and a number of commercial ports are located along the Atlantic U.S. coasts.

A number of commercial ports are located in Chesapeake Bay and Delaware Bay in the mid-Atlantic U.S. coast area. There also are a number of inland ports that are accessed through these bay systems (DoN, 2008a; 2008b). The VACAPES OPAREA is in the direct path of commercial shipping traffic traveling between the two major ports along the northeastern seaboard, New York and Boston, and Miami and other ports in the south (DoN, 2008a; 2008b).

Marine transportation is expected to grow. Surface vessel traffic is a major contributor to noise in all oceans, particularly at low frequencies. The effect on marine species is unknown, but it is possible that this persistent noise may affect marine mammals' use of sound for communication and hunting.

6.2.2.8 Ship Strikes

NMFS identified commercial and recreational traffic and recreational pursuits as potentially having adverse effects on sea turtles and cetaceans through propeller and boat strike damage (USAF, 2004). Private vessels participating in high-speed marine activities are particular threats. Ship strikes or ship collisions with whales are a recognized source of whale mortality worldwide. The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). Laist et al. (2001) identified 11 species known to be hit by ships. These species include fin whales, right whales, humpback whales, sperm whales, and gray whales. Of these, fin whales are hit most frequently. On the East Coast of North America, ship strikes remain a significant threat to some whale populations. For North Atlantic right whales, for example, ship strikes are believed to be a significant factor limiting the recovery of this species (Knowlton and Kraus, 2001).

A review of recent reports on ship strikes provides some insight regarding the types of whales, locations and vessels involved, but also reveals significant gaps in the data. The Large Whale Ship Strike Database report provides a summary of the 292 worldwide confirmed or possible whale/ship collisions from 1975 through 2002 (Jenson and Silber, 2004). The report also notes that these totals represent a minimum number of collisions, because the vast majorities go undetected or unreported. All types of ships can hit whales, and in most cases the animal is either seen too late, not observed until the collision occurs, or not detected. The ability of a ship to avoid a collision and to detect a collision depends on a variety of factors, including environmental conditions, ship design, size, and number of crew.

Smaller ships, such as Navy destroyers and Coast Guard cutters, have a number of advantages for avoiding ship strikes compared to most merchant vessels. For instance, naval and Coast Guard ships have their bridges positioned forward, offering good visibility ahead of the bow. Military crew sizes are also much larger than those of merchant ships, and they have dedicated lookouts posted during each watch. These vessels are generally twin screw and much more maneuverable than single screw commercial craft. Due to smaller ship size and higher deck manning, Navy and Coast Guard vessels are more likely to detect any strike that occurs, and these agencies' standard operating procedures include reporting of ship strikes. Overall, the percentage of Navy traffic relative to other large shipping traffic is very small (on the order of 2 percent).

NOAA continues to review all shipping activities and their relationship to cumulative effects, in particular on large whale species. According to the NOAA report (Jenson and Silber, 2004), the factors that contribute to ship strikes of whales are not clear, nor is it understood why some species appear more vulnerable than others. Nonetheless, the number of known ship strikes indicates that deaths and injuries from ships and shipping activities remain a threat to endangered large whale species, and to Atlantic Ocean right whales in particular (Jenson and Silber, 2004).

Maritime traffic also increases underwater noise. The amount of noise produced by a ship depends on its type, size, and operational mode. Large commercial vessels emit low frequency noise in ranges similar to those used by some large whales (mysticetes) in communication to each other (NMFS, 2006a). This communication between whales could be masked by vessel noise. Masking not only interferes with communication, but also with the animal's ability to detect and avoid approaching ships (NMFS, 2006a). Masking can be due to one individual ship or the constant drone in the ocean from increases in boat traffic. Boat traffic has steadily increased over the years; however, the number of large ships is predicted to double over the next two to three decades (Southall, 2005).

6.2.2.8.1 Implementation of Vessel Operational Measures to Reduce Ship Strikes to North Atlantic Right Whales

In August 2008, NMFS released a Final EIS to analyze the potential effects associated with the implementation of vessel operational measures in waters off the East Coast of the United States to reduce vessel collisions with the endangered North Atlantic right whale (NMFS, 2008a). The proposed action addresses the lack of recovery of the North Atlantic right whale population by reducing the probability and threat of ship strike related deaths and serious injuries to the species.

Due to regional differences in right whale distribution and behavior, oceanographic conditions, and ship traffic patterns, the proposed vessel operational measures would apply only in certain areas and at certain times of the year, or under certain conditions. To account for regional variations, the U.S. East Coast is divided into three regions: northeastern United States (NEUS), mid-Atlantic United States (MAUS), and southeastern United States (SEUS). All vessels 65 ft (19.8 m) and greater in overall length and subject to US jurisdiction would be required to abide by the operational measures, except for vessels owned or operated by, or under contract to the Federal government, and law enforcement vessels of a state, or political subdivision thereof, when engaged in enforcement or human safety missions. An additional exemption would apply for vessels to maintain safe maneuvering speed under certain conditions. The measures considered include the following:

- **Seasonal Management Areas (SMAs).** SMAs are predetermined and established areas within which seasonal speed restrictions apply.
- **Dynamic Management Areas (DMAs).** DMAs are temporary areas consisting of a circle around a confirmed right whale sighting. The radius of this circle expands incrementally with the number of whales sighted and a buffer is included beyond the core area to allow for whale movement. Speed restrictions apply within DMAs, which may be mandatory or voluntary and apply only when and where no SMA is in effect.
- **Routing Measures.** These consist of a set of routes designed to minimize the co-occurrence of right whales and ship traffic. Use of these routes is voluntary; therefore, they constitute a non-regulatory measure. However, mandatory speed restrictions would apply in the portions of the routes located within an active SMA. NMFS would monitor these routes and consider making them mandatory if use is low.

Within the proposed SMAs (when in effect) and DMAs (when in effect), NMFS' proposed restriction is 10 knots/hour (kn) (19 kilometers/hour [km/hr]); however, for comparison purposes, the FEIS also considers speed limits of 12 and 14 kn (22 and 26 km/hr). The following six alternatives were considered:

1. Alternative 1-No Action.
2. Alternative 2-Mandatory DMA.
3. Alternative 3-Speed restrictions in designated areas.
4. Alternative 4-Recommended shipping routes.
5. Alternative 5-Combination of Alternatives 1 through 4.
6. Alternative 6-Proposed Action and Preferred Alternative.
   - In the SEUS region, Southeast SMA and recommended routes.
   - In the MAUS region, separate SMAs (20 nm [37 km] SMAs option).
   - In the NEUS region, Cape Cod Bay SMA, Off Race Point SMA, and Great South Channel GSC SMA, as well as recommended routes.
   - In all three regions, Voluntary DMAs.

Not all vessel operation measures are considered for all regions. The specific measures considered for each of the regions of the VACAPES Study Area implementation are shown in Table 6.2-2.

TABLE 6.2-2
SUMMARY OF PROPOSED OPERATIONAL MEASURES BY REGION

Region	Proposed Measures	Period of Application	Alternative
Southeast	Southeast SMA off the coast of Georgia and Florida, bounded to the north by latitude 31º27'N, to the south by latitude 29º45'N, to the east by longitude 80º51.6'W, and to the west by the shoreline. **or** SMA including all waters within the Mandatory Ship Reporting System WHALESSOUTH reporting area and the presently designated right whale critical habitat **and/or** Recommended routes into and out of the ports of Jacksonville and Fernandina Beach, Florida, and Brunswick, Georgia.	November 15 to April 15 November 15 to April 15 Year-round	6 3 and 5 4, 5, and 6
Mid-Atlantic	Six Separate SMAs, including under one option a 56-km (30-NM)-wide rectangular SMA south and east of the mouth of Block Island Sound; SMAs with a 37 km (20 NM) radius around the entrances to the ports of New York/New Jersey, the Delaware Bay and Chesapeake Bay, and Morehead City and Beaufort, North Carolina; finally, a continuous SMA from the shore out to 37 km (20 NM) from Wilmington, NC, south to Brunswick, GA. Under another option, the 37 km (20 NM) SMAs would be 56 km (30 NM) in size. **or** One continuous 46 km (25 NM) SMA between Block Island Sound and Savannah, GA.	November 1 to April 30 October 1 to April 30	6 (20-NM SMAs Option) 3 and 5
Southeast and Mid-Atlantic	Mandatory DMAs throughout the EEZ Or Voluntary DMAs throughout the EEZ	Year-round Year –round	2 and 5 6

The EIS analyzed potential effects to the North Atlantic right whale, other marine species, physical environment, port areas and vessel operations, commercial fishing vessels, ferry vessels and ferry passengers, whale-watching vessels, charter vessels, environmental justice, and cultural resources. For the purposes of the cumulative impacts analysis in this EIS/OEIS, the Preferred Alternative, Alternative 6, will be discussed. It was determined that there would be a direct positive effect on right whale populations and indirect positive effects on marine mammals and sea turtles. In addition, implementation of Alternative 6 would result in negligible impacts on water quality in the NEUS had minor adverse impacts in the SEUS, as well as minor, direct positive effects to ocean noise. There would be only minimal impact on the financial revenues of port vessel operators, commercial fishing vessels, and charter vessels. There would be annual financial adverse effects to ferry vessels and ferry passengers and whale-watching vessels. There were no environmental justice concerns identified and no effects to cultural resources (NMFS, 2008a).

In addition, NMFS has promulgated a Final Rule to implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic right whale population effective December 9, 2008 through December 9, 2013, speed restrictions of no more than 10 kn (18.5 km/hr) will apply to all vessels 65 ft (19.8 m) or greater in overall length in certain locations and at certain times of the year along the east coast of the U.S. Atlantic seaboard (NMFS, 2008b). Also see 50 Code of Federal Regulations 224.105 (2008). The purpose of the regulations is to reduce the likelihood of deaths and serious injuries to North Atlantic right whales that result from collisions with ships. These restrictions are not mandatory for naval vessels as stated by NMFS since it was recognized that national security, navigational, and human safety missions of some federal agencies may be compromised by mandatory vessel speed restrictions. The Navy currently implements mitigation measures to address ship strikes; and, NMFS has stated that most of these measures are similar to, if not more stringent than, the measures considered in the Final Rule.(NMFS, 2008a, see Section 2.4.8. and Appendix A of the NMFS EIS).

6.2.2.9 Expended Materials

Expended materials include any man-made object expended, disposed of, or abandoned that enters the coastal or marine environment. It may enter directly from a ship, or indirectly when washed out to sea via rivers, streams, and storm drains. Types of expended materials include plastics, abandoned vessels, glass, metal, trash, and rubber. These materials can injure or kill marine life, interfere with navigation safety, create adverse economic impacts to shipping and coastal industries, and pose a threat to human health (NOAA, 2007).

During the 2007 International Coastal Cleanup Campaign event, worldwide volunteers discovered 235 animals entangled in expended materials. As shown in Table 6.2-3, expended fishing line was responsible for nearly half of all entanglements, followed closely by rope and fishing nets (OC, 2007). This is an annual effort by the Ocean Conservancy and the summary of animals entangled in expended materials is published annually.

There are several events that promote cleaning up debris (trash and litter) along shorelines (ocean, lakes, and rivers) in and around the Study Area to include an annual Earth Day shoreline cleanup of the Anacostia and Potomac Rivers, the *Potomac River Watershed Clean-up* at the Dashiell Marina and 1.25 miles of Potomac River shoreline, the *Girl Scout Beach Clean-up*, and *Boy Scout Fall Ordeal.*

6.2.3 Scientific Research

Scientific research on protected species such as marine mammals and sea turtles and studies on the marine environment in general occur throughout the world. For targeted research on particular species regulated by NMFS and the USFWS, a scientific research and enhancement permit is required for any proposed research activity that involves the “take” of a marine species. Scientific Research and Enhancement Permits are required for research that results in the take of marine mammal species or involves any ESA-listed species that are not covered by the General Authorization. Permits cover a five-year period. The most recent permit was issued by NMFS in August 2007 for activities being conducted by NMFS’s Office of Science and Technology. The permit authorizes research on marine mammals in waters to the east of Andros Island, Bahamas. Activities include the attachment of tags to and photography of

TABLE 6.2-3
SUMMARY OF ANIMALS ENTANGLED IN EXPENDED MATERIALS

Debris	Invertebrates	Fish	Reptiles	Birds	Mammals	Amphibians	Total	
Balloon/ribbon/string	0	0	0	4	1	0	5	2.1%
Beverage Can	1	1	0	0	0	0	2	0.9%
Building Materials	2	0	0	0	2	0	4	1.7%
Crab/Lobster/Fish Traps	2	1	0	0	0	0	3	1.3%
Fishing Line	22	32	5	43	8	0	110	46.8%
Fishing Nets	13	12	0	6	4	0	35	14.9%
Glass Bottles	3	2	1	0	2	0	8	3.4%
Miscellaneous	2	0	2	5	1	0	10	4.3%
Plastic Bags	2	3	0	12	5	0	22	9.4%
Plastic Container	0	0	0	0	1	0	1	0.4%
Rope	1	9	2	6	5	1	24	10.2%
Six-Pack Holders	0	2	0	1	0	0	3	1.3%
Tire	0	1	1	0	0	0	2	0.9%
Wire	1	0	0	4	1	0	6	2.6%
Totals	**49**	**63**	**11**	**81**	**30**	**1**	**235**	**100.0%**
Total Percentage	**20.9%**	**26.8%**	**4.7%**	**34.5%**	**12.8%**	**0.4%**	**100.0%**	

Source: OC, 2007

cetaceans, and exposing them to sound, particularly from mid-frequency sonar. Additional permits authorized that are of particular interest in the VACAPES Study Area include a wide variety of research activities on right whales. NMFS is currently analyzing the cumulative effects of these authorizations in the proposed Programmatic EIS on Northern Right Whale Research.

The 1994 amendments to the MMPA authorized, under a General Authorization, the conduct of activities that involve low-impact harassment levels of marine mammals in the wild. Activities encompassed by the General Authorization for Scientific Research do not require a scientific research and enhancement permit. The activities covered under the General Authorization are limited to bona fide research that only involves Level B harassment of non-ESA-listed marine mammals and generally include, but are not limited to, photo-identification studies, behavioral observations, vessel surveys, and aerial surveys over water or land, as well as over pinniped rookeries if flown at altitudes greater than 1,000 ft (305 m) (DoN, 2008a). In addition to the General Authorization, NMFS also issues commercial and education photography permits. These permits allow for photography of non-listed marine mammals that result at a maximum in Level B harassment. Additional activities authorized include those related to imports for public display of marine mammals, as well as import and export of marine mammal parts.

6.2.3.1 Environmental Contamination and Biotoxins

Insufficient information is available to determine how, at what levels, or in what combinations, environmental contaminants may impact cetaceans (MMC, 2003). There is growing evidence that high contaminant burdens are associated with several physiological abnormalities, including skeletal deformations, developmental impacts, reproductive and immunological disorders, and hormonal alterations (Reijnders and Aguilar, 2002). DeSwart *et al.* (1996) conducted a study where harbor seals were fed contaminated Baltic herring and their immune function was monitored over a two-and-a-half-year period. The results of this study showed that chronic exposure to environmental contaminants accumulated through the food chain had an adverse effect on the immune function of those harbor seals. This further suggests that environmental contaminates may have an adverse immunological effect on free-ranging seals in areas with similar contamination levels as that observed in this study (DeSwart *et al.*, 1996). Since no similar studies have been conducted with other marine mammal species, it may be reasonably concluded that similar impacts could occur in other marine mammals, such as cetaceans.

Several mortality activities (die-offs) have been reported for cetaceans. Biotoxins, viruses, bacteria, and El Nino activities have been implicated separately in recent mass mortality activities (Domingo *et al.*, 2002). A mass mortality activity for humpback whales, apparently associated with biotoxins, occurred along the beaches of Massachusetts in 1987 through 1988. Geraci *et al.* (1989) concluded that the whales died from saxitoxin poisoning after consumption of Atlantic mackerel containing the toxin. During the summer of 2003, 17 humpback whales, 3 fin whales, 1 minke whale, 1 long finned pilot whale, and 3 whales of undetermined species were found dead in the vicinity of Georges Bank. Although a biotoxin (saxitoxin) was found in several samples collected, it was not present at lethal levels. Domoic acid was also detected and suspected as a probable cause, but because no brain samples were collected, the role of this biotoxin could not be confirmed (MMC, 2004; DoN, 2005).

6.2.4 Military Operations

This section will discuss past and present military operations occurring within the VACAPES Study Area. Specifically, the first three sections will discuss military exercises generally since these activities are associated with ESA Section 7 consultations with NMFS. In addition, this section will also discuss the Navy's Tactical Training Theater Assessment and Planning Program, which focuses on the sustainability of ranges, OPAREAs, and special use airspace within the VACAPES Study Area..

6.2.4.1 Mine Exercise

Mine Exercises (MINEX) may occur as part of an Expeditionary Strike Group (ESG) Composite Training Unit Exercise (COMPTUEX) or a Combined Carrier Strike Group (CSG) COMPUTEX/ Joint Task Force Exercises (JTFEX), but they only involve underwater detonation (UNDET) activities when they are conducted as part of a Strike Group Training exercise on the East Coast. They do not involve mine laying or searching activities involving MIW sonar (this type of training conducted during Unit Level Training [ULT] and Coordinated ULT in the Gulf of Mexico as part of a Gulf of Mexico Exercise [GOMEX] or squadron exercise [RONEX]). For an ESG COMPTUEX, UNDETs would occur in the Cherry Point box that is defined by the East Coast MINEX BO (up to 20 lb [9 kg] charges). For an ESG COMPTUEX, UNDETs would occur in the Cherry Point box that is defined by the East Coast MINEX BO (up to 20 lb [9 kg] charges). For the Combined CSG COMPTUEX/JTFEX the UNDETs would occur in Charleston in the box defined by the East Coast MINEX BO (NMFS, 2002).

The potential biological effects associated with the MINEX UNDETs are addressed in the MINEX BO issued by NMFS in 2002. The BO addresses potential impacts from MIW exercises and explosive ordnance disposal (EOD) unit-level training to loggerhead, Kemp's ridley, leatherback, hawksbill, and green sea turtles at several locations along the East Coast (Virginia Beach, Virginia; Onslow Bay, North Carolina; and Charleston, South Carolina). The BO analyzed a total of 40 MINEX events per year to be conducted between the three locations using C-4 or high explosives as well as the possible use of 10 or 20 lb (4.5 or 9.1 kg) charges, in rare instances.

NMFS states in the BO that proposed MINEX and explosive ordnance disposal training is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, leatherback, hawksbill, and green sea turtles. However, NMFS anticipates incidental take of these species and has issued an Incidental Take Statement (ITS) pursuant to Section 7 of the ESA. The ITS includes mitigation measures with implementing terms and conditions to help minimize harassment. In addition, the BO states that species of large whales, including species protected by the ESA, can be found in or near the area where this type of training would occur. However, the BO states that NMFS feels that the protective measure identified within the BO, if implemented, would allow the Navy the opportunity to reduce the chances of effects to these species to discountable levels. Mitigation measures have been designed and implemented for MINEXs in order to minimize any potential adverse effects to marine mammals and to avoid any significant or long-term adverse effects to marine mammals and the coastal, cultural, or marine environment (NMFS, 2002).

6.2.4.2 Sinking Exercise of Surface Targets

A Sinking Exercise of Surface Targets (SINKEX) is defined as the use of a vessel as a target or test platform against which live ordnance is fired. The purpose of a SINKEX is to train personnel, test weapons, and study the survivability of ship structures. The result is the sinking of the vessel. SINKEX operations differ from ship shock trials in that the warheads used in a SINKEX are significantly smaller. The environmental considerations of a SINKEX are associated with the weapons used. The exact amount of ordnance and the type of weapon used in a SINKEX is situational and training-need dependent (DoN, 2006b).

The potential expended materials created during a SINKEX are metals from the sunken vessel and shell fragments. Disposable plastics and other materials that could be considered marine debris are removed from the vessel prior to conducting a SINKEX. Expended material associated with the target vessel would not include ropes, lines, plastic or other materials with the potential to ensnare or entangle marine animals. All expended materials would sink rapidly to the ocean floor and since SINKEXs would not be continuously conducted within the same areas the sunken debris would settle over a large area. The minimal amount of materials settling to the ocean floor would not affect the sediment stability of the ocean floor or cause disturbance to natural ocean processes (DoN, 2006a).

In the late 1980's, Polychlorinated biphenyls (PCBs) was raised as a potential environmental issue. Some of the materials (i.e., insulation, wiring, felts and rubber gaskets) present on the targeted vessels were confirmed to contain PCBs. As a result, the Navy has been removing the majority of the materials containing PCBs prior to conducting a SINKEX event. However, it is still estimated that even after removal activities any given target vessel sunk during a SINKEX could contain up to 100 lbs (45 kg) of PCBs. In an effort to determine if the remaining PCBs would be an environmental issue, the Navy begun conducting a PCBs monitoring study in 1995 on sunken Navy vessels. The monitoring study has not been completed, but as of November 2006 it was determined that enough data had been gathered and transferred to the EPA to indicate that there was little likelihood that PCBs from sunken Navy vessels would present an unacceptable risk to the environment or human health. The Navy SINKEX Program currently holds a General Permit from the EPA under the Marine Protection, Research and Sanctuaries Act for conducting SINKEX activities (40 CFR 229.2).

The U.S. Navy submitted a Biological Assessment (BA) to the National Oceanic and Atmospheric Administration (NOAA) pursuant to compliance with the ESA. NOAA concluded that SINKEXs in the western Atlantic Ocean are not likely to jeopardize the continued existence of ESA listed species in a BO dated September 22, 2006 (DoN, 2008a).

6.2.4.3 Naval Surface Fire Support Training

The Navy uses the Integrated Maritime Portable Acoustic Scoring and Simulator (IMPASS) system to qualify and recertify ships in naval surface fire support. The IMPASS system is a reusable, portable system that can be deployed anywhere in the open ocean. The system is comprised of five free-floating sonobuoys that are deployed in the shape of a pentagon/house array. The sonobuoys are capable of "scoring" the landing of 5-inch (in)/54 rounds aimed at a virtual target within the sonobuoy array. The buoys serve as collectors of acoustic information. When a 5-in/54 round impacts the water, accuracy is determined by the differential time that each individual buoy receives the sound (DoN, 2008a).

The IMPASS system is used in open ocean areas along the eastern United States and in the Gulf of Mexico. Where live ordnance is used, the potential for marine mammal populations to be exposed to acoustic energy exists. Therefore, mitigation measures have been designed and implemented for the use of the IMPASS system to minimize any potential risks to marine mammals and to avoid any significant or long-term adverse effects to marine mammals and the coastal, cultural, and marine environment (DoN, 2008a).

The Navy initiated formal consultation with NMFS in February 2004 by submitting a BA for use of the IMPASS system in East Coast OPAREAs and the Eastern Gulf of Mexico Test and Training Area (EGMTTA). The Navy is currently awaiting NMFS's BO, but anticipates that the conclusion will be that the use of naval gunfire is not likely to jeopardize the existence of any listed species. The mitigation/mitigation measures have and will continue to be implemented for use of the IMPASS system in order to minimize any potential risks to threatened and endangered species.

6.2.4.4 Military Operations – Atlantic Ocean, Offshore of the Southeastern United States

Designated bomb boxes have been established in each OPAREA where inert bombs could be dropped during a major Atlantic Fleet training exercise. The process for selecting these sites within each OPAREA involved balancing operational suitability (close proximity to where the strike group is operating) and environmental suitability. Environmental suitability includes an area that possesses a low likelihood of encountering threatened and endangered species and that avoids the continental shelf, canyon areas, and the Gulf Stream, all of which are locations where threatened and endangered marine mammal and sea turtle species are most abundant. Based on the combination of prudent site-selection and the mitigation measures to be implemented in all OPAREAs that were developed as part of the BO for protection of the North Atlantic right whale (NMFS, 1997), it is anticipated that dropping inert bombs in the established bomb boxes associated with major Atlantic Fleet exercises would not affect listed species.

6.2.4.5 Cherry Point Range Complex

The Navy Cherry Point Range Complex Draft EIS/OEIS was released in August 2008. The Cherry Point Range Complex geographically encompasses offshore and near-shore OPAREAs, instrumented ranges, and SUA located near the east coast of the United States. The Cherry Point Range Complex is a set of operating and maneuver areas with defined ocean surface and subsurface areas. The surface water area of the Range Complex covers the coast of North Carolina, encompassing 18,617 nm^2 (63,936.2 km^2). The shoreward extent of the Range Complex is roughly aligned with the 3 nm (5.6 km) state territorial limits. Due to the Navy's training requirements, the objective of the Cherry Point Range Complex is to provide sustainable and modernized ocean operating areas, airspace, ranges, range infrastructure, training facilities, and resources to fully support the mission. The Study Area is centrally located between the Atlantic Fleet concentration areas in Hampton Roads, Virginia and Jacksonville, Florida, and the Marine Forces Atlantic concentrations areas in North Carolina, making it the primary venue for all levels of amphibious training and intermediate and advanced levels of CSG, ESG, and MEU training (DoN, 2008a; 2008c).

The Navy is preparing an EIS/OEIS to assess the potential environmental effects in the Navy Cherry Point Range Complex over a 10-year planning horizon. The Notice of Intent to prepare the EIS/OEIS, along with an announcement of scoping meetings, was published in the Federal Register on April 30, 2007. Two public scoping meetings were held in May 2007, and comments were received from April 30, 2007 to June 12, 2007. The Navy Cherry Point Draft EIS/OEIS was available for public comment beginning September 12, 2008 and public hearings were held in October 2008. The public comment period closed on October 27, 2008. The Navy Cherry Point Draft EIS/OEIS is incorporated by reference and is available for downloading/viewing via the internet at the following website address:

(http://www.navycherrypointrangecomplexeis.com). As stated in the Navy Cherry Point Range Complex EIS/OEIS, the No Action Alternative would continue current operations, including surge capabilities, consistent with the FRTP. For the purposes of this chapter, the No Action Alternative represents both past and present naval operations in the Navy Cherry Point Range Complex. Training operations in the Navy Cherry Point Range Complex can vary from unit level exercises to integrated major range training events. A description of non-ASW training operations typically conducted in the Navy Cherry Point Range Complex can be found in Table 6.2-4 (DoN, 2008a; 2008c).

TABLE 6.2-4
CHERRY POINT RANGE COMPLEX TYPICAL OPERATIONS (NON-ASW)

Range Operation	Description
Mine Warfare (MIW)	
Mine countermeasures (MCM)	Helicopters, surface and subsurface units detect, identify, classify, mark, disable and/or destroy sea mines using a variety of methods.
Mine neutralization	Helicopters, surface, and subsurface units, and EOD personnel identify, evaluate, localize and destroy or render safe sea mines that constitute a threat to ships, landing craft or personnel.
Surface Warfare (SUW)	
Bombing Exercise (Sea) (BOMBEX A-S)	Fixed wing aircraft deliver bombs against maritime targets.
Missile Exercise (Air-to-Surface)	Air-to-Surface Missile Exercise (Laser and Live Fire) [MISSILEX (A-S)] trains fixed-wing aircraft and helicopter aircrews in the delivery of optical, infrared seeking or laser guided missiles at surface targets.
Gunnery Exercise (Air-to-Surface)	Air-to-Surface Gunnery Exercise (GUNEX) trains fixed-wing aircraft and helicopter aircrews to attack surface targets at sea using guns.
Gunnery Exercise Ship (Surface-to-Surface) (GUNEX S-S (Ship))	Surface ships fire main battery guns and crew-served weapons against maritime targets.
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship and Helo	Crews from Navy helicopters and surface ships identify, track, intercept, board and inspect foreign merchant vessels suspected of not complying with United Nations/allied sanctions and/or conflict rules of engagement. The boarding party will be delivered from a surface ship via Rubber-hull Inflatable Boat (RHIB) or similar small craft if the target vessel is non-hostile, or via helicopter if hostile. This training event is non-firing.
Air Warfare (AW)	
Air Combat Maneuver (ACM)	Two or more aircraft engaged in continuous proactive and reactive changes in aircraft attitude, altitude, and airspeed in an attempt to destroy the opposition. Fighter aircraft do fire live weapons during ACM, just not in a training environment.
GUNEX (Air-to-Air)	GUNEX Air-to-Air training operations in which guns are fired from aircraft against unmanned aerial target drones.
MISSILEX (Air-to-Air)	Air-to-Air Missile Exercise [MISSILEX (A-A)] are training operations in which air-to-air missiles are fired from aircraft against unmanned aerial target drones such as BQM-34 and BQM-74.
Air Intercept Control (AIC)	Surface ships vector friendly aircraft to intercept and destroy adversary aircraft.

TABLE 6.2-4
CHERRY POINT RANGE COMPLEX TYPICAL OPERATIONS (NON-ASW) (Continued)

Range Operation	Description
Electronic Combat (EC)	
Electronic Combat Operations (EC)	Aircraft, surface ships, and submarines attempt to control critical portions of the electromagnetic spectrum to degrade or deny the enemy's ability to defend its forces from attach and/or recognize an emerging threat early enough to take the necessary defensive actions.
Chaff Exercise	Shipa and aircraft deploy chaff to disrupt threat targeting and missile guidance radars and to defend against an attack.
Flare Exercise	Aircraft deploy flares to disrupt threat infrared guidance systems of threat missiles.
Strike Warfare (STW)	
High-Speed Anti-Radiation Missile Exercise (HARMEX) (air-to-surface)	Aircraft crews train in the use of High-Speed Anti-Radiation Missiles (HARM), the primary weapon designed to target anti-aircraft missile sites.
Amphibious Warfare (AMW)	
Firing Exercise (FIREX)-Land (FIREX (Land))	Surface ships fire main battery guns against land targets in support of military operations ashore.
FIREX – Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	Surface ships fire main battery guns against land targets in support of military operations ashore. This training is conducted at-sea using a computer simulated land target and a series of buoys that can acoustically score the training event.
Amphibious Assault	A Marine Battalion Landing Team (typically two reinforced companies, including armor and service support units) move ashore from the Expeditionary Strike Group at-sea to establish a beachhead in hostile territory, then moves further inland for an extended period. Ingress via amphibians, landing craft and/or rotary-wing aircraft. Coordinated fire support from aircraft, surface ships and artillery.
Amphibious Raid	A reinforce company (100-150 Marines) makes a swift, short-term incursion from the Expeditionary Strike Group at-sea to a hostile area ashore for a specified purpose and a specified time, then makes a planned withdrawal. Ingress and extraction via small boats, amphibians, landing craft and/or helicopters.

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects any expended materials would cause. It was determined that there will be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the Navy Cherry Point Range Complex (DoN, 2008a; 2008c).

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles. Refer to Chapter 3 of the Navy Cherry Point Range Complex Draft EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis under the No Action Alternative indicates that 2,877 exposures to total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment. Acoustic analysis also indicates that 65 exposures to total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment. No mortalities are predicted due to the proposed activities. The results of the acoustic analysis indicates the quantity of ESA-listed marine mammal species that may be exposed to levels of sound, four exposures to an ESA-listed species may be exposed to levels of sound likely to result in Level B harassment. The results also indicate the quantity of ESA-listed sea turtles that may be exposed to levels of sound, 137 exposures may result in Level B harassment and three may result in Level A harassment. The exposure estimates for the No Action Alternative represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2008a; 2008c). These exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals and sea turtles to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal and sea turtles species or populations.

6.2.4.6 Jacksonville Range Complex

Jacksonville (JAX) Range Complex EIS/OEIS

The JAX Range Complex Draft EIS/OEIS was released in June 2008. The JAX Range Complex geographically encompasses offshore, near-shore, and onshore OPAREAs, ranges, and Special Use Airspace (SUA) located near the east coast of the United States. The JAX Range Complex, which covers both the Charleston (CHASN) and Jacksonville Operating Areas, is a set of operating and maneuver areas with defined ocean surface and subsurface areas. The surface water area of the Range Complex covers the coast of South Carolina, Georgia, and Florida, encompassing 50,090 nm^2 (172,023.6 km^2). The shoreward extent of the OPAREA is roughly aligned with the 3 nm (5.6 km) state territorial limits. Due to the Navy's training requirements, the objective of the JAX Range Complex is to provide sustainable and modernized ocean operating areas, airspace, ranges, range infrastructure, training facilities, and resources to fully support the mission. The Study Area also serves as critical support for Navy operational readiness training and for RDT&E of emerging maritime and combat technologies (DoN, 2008a; 2008c).

The Navy is preparing an EIS/OEIS to assess the potential environmental effects in the JAX Range Complex over a 10-year planning horizon. The Notice of Intent to prepare the EIS/OEIS, along with an announcement of scoping meetings, was published in the Federal Register on January 26, 2007. Four public scoping meetings were held in February 2007, and comments were received from January 26, 2007 to March 13, 2007. The JAX Draft EIS/OEIS was available for public comment beginning June 28, 2008 and public hearings were held in July 2008. The JAX Draft EIS/OEIS is incorporated by reference and is available for downloading/viewing via the internet at the following website address: (http://www.jacksonvillerangecomplexeis.com). As stated in the JAX Range Complex EIS/OEIS, the No Action Alternative would continue current operations, including surge capabilities, consistent with the FRTP. For the purposes of this chapter, the No Action Alternative represents both past and present naval operations in the JAX Range Complex. Training operations in the JAX Range Complex are very similar to the training performed at the VACAPES Range Complex; they can vary from unit level exercises to integrated major range training events. A description of non-ASW training operations typically conducted in the JAX Range Complex can be found in Table 6.2-5 (DoN, 2008a).

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects any expended materials would cause. It was determined that there will be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the JAX Range Complex (DoN, 2008a).

TABLE 6.2-5
JAX RANGE COMPLEX TYPICAL OPERATIONS (NON-ASW)

Range Operation	Description
Mine Warfare (MIW)	
Mine Laying	Airborne mine-laying training uses two types of training operations: Mine Exercises (MINEX) and Mine Readiness Certification Inspections. In the typical mining training profile, MINEXs usually involve a single aircraft sortie planting several inert training mine shapes in the water. The aircrew drops a series of (usually four) inert training shapes in the water.
Mine countermeasures	Mine Countermeasure (MCM) exercises train forces to detect, identify, classify, mark, avoid, and disable (or verify destruction of) sea mines using a variety of methods, including, air, surface, and subsurface assets.
Mine neutralization	Mine Neutralization operations involve the detection, identification, evaluation, rendering safe, and disposal of underwater unexploded ordnance that constitute a threat to ships or personnel.
Surface Warfare (SUW)	
MISSILEX (A-S)	MISSILEX (A-S) (Live Fire) trains aircraft and helicopter crews in the delivery of optical, infrared seeking, or laser guided missiles (Hellfire and Maverick) at surface targets.
GUNEX (A-S)	GUNEX (A-S) trains aircraft and helicopter crews to attack surface targets at sea using guns.
GUNEX (S-S)	GUNEX (S-S) trains ship gun crews by firing against surface targets at sea.
BOMBEX (sea)	BOMBEX (sea) allows aircrew to train in the delivery of bombs against maritime targets.
Laser targeting	MISSILEX (A-S) (Laser Only) trains aircraft or helicopter crews in the delivery of optical, infrared seeking or laser guided missiles at surface targets. This operation does not result in live missile fire, only discrimination of the target and illumination of the target with a laser.
Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)-Ship	Non-firing ULT and major exercise events. Each ship must conduct one VBSS/MIO every six months. Target vessel is typically another strike group ship or Mobile Sea Range (MSR) vessel such as Prevail.
VBSS/MIO-Helicopter	Non-firing ULT & major exercise events. NSW personnel fast-rope onto target vessel from 1st helicopter. 2nd helicopter flies close cover, and 3rd helicopter flies surveillance.
GUNEX (S-S) (Fast Attack Craft/Fast Inshore Attack Craft [FAC/FIAC])	Non-firing major exercise event only. Typically involves multiple ships prosecuting multiple targets (High Speed Maneuverable Seaborne Targets or other small craft) during a choke point transit event.
Air Warfare (AW)	
ACM	ACM is the general term used to describe an air-to-air (A-A) event involving two or more aircraft, each engaged in continuous proactive and reactive changes in aircraft attitude, and airspeed. No live weapons are fired during ACM operations.
Air Intercept Control	Surface ships and fixed wing aircraft train in using their search radar capability to direct strike fighter aircraft toward threat aircraft.
ACM Chaff Exercise	Chaff exercises train shipboard personnel and helicopter crews in the use of chaff to counter missile threats. Training and testing evens not necessarily dedicated events, but combined with other exercises.

TABLE 6.2-5
JAX RANGE COMPLEX TYPICAL OPERATIONS (NON-ASW) (Continued)

Range Operation	Description
ACM Flare Exercise	Trains aircraft personnel in the use of flares for defensive purposes when countering heat-seeking missile threats. Training and testing events not necessarily dedicated sorties, but may be combined with other exercises.
MISSILEX (A-A)	MISSILEX (A-A) are training operations in which air-to-air AIM missiles are fired from aircraft (live and non-explosive) against unmanned aerial target drones such as BWM-34 and BQM-74.
GUNEX (S-A)	GUNEXs (S-A) are conducted by surface ships with 5-inch, 76mm and 20mm Close In Weapons Systems. Targets include unmanned drone as well as targets towed behind aircraft.
Detect-to-Engage	Shipboard personnel use all shipboard sensors (search and fire control radars and Electronic Support Measures (ESM)) in the entire process of detecting, classifying, and tracking enemy aircraft and/or missiles up to the of engagement, with the goal of destroying the threat before it can damage the ship.
Strike Warfare (STW)	
BOMBEX (A-G)	BOMBEXs (Land) allow aircrews to train in the delivery of bombs against ground targets.
Combat Search and Rescue (CSAR) and Convoy Operations	CSAR operations train rescue forces personnel the tasks needed to be performed to affect the recovery of distressed personnel during war or military operations other than war.
Amphibious Warfare (AMW)	
FIREX with Integrated Maritime Portable Acoustic Scouring and Simulator System (IMPASS)	Surface-to-surface gunnery exercises with IMPASS are training operations that direct naval gunfire to strike land targets and support military operations ashore. This training is conducted at-se using a computer-simulated land target and a series of buoys that can acoustically score the training event.
Electronic Combat (EC)	
EC Operations	Air or ship crews attempt to control critical portions of the electronic spectrum used by threat radars, communications equipment, and electronic detection equipment to degrade or deny enemy attacks.
Chaff Exercise	Exercises train aircrews the use of chaff to counter enemy threats by creating radar reflective false targets. Chaff may also be used offensively by aircrews or shipcrews to hide inbound striking aircraft or ships.
Flare Exercise (Aircraft Self-Defense)	Fixed-wing aircraft and helicopters deploy flares to disrupt threat infrared missile guidance systems to defend against an attack.
Other Training	
Shipboard Electronic Systems Evaluation Facility Utilization (SESEF)	SESEF operations test ship antenna radiation pattern measurements and communications systems.

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles. Refer to Chapter 3 of the Jacksonville Range Complex EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis under the No Action Alternative indicates that 1,126 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment. Acoustic analysis also indicates that 32 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment.

The results of the acoustic analysis indicates the quantity of ESA-listed marine mammal species that may be exposed to levels of sound, one exposures of an ESA-listed species may result in Level B harassment. No mortalities are predicted due to the proposed activities. The results also indicate the quantity of ESA-listed sea turtles that may be exposed to levels of sound under the No Action Alternative, 444 sea turtles may be exposed to Level B harassment and 9 may be exposed to Level A harassment. The exposure estimates for the No Action Alternative represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2008a,e). These exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals and sea turtles to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal and sea turtles species or populations.

NSB Kings Bay

NSB Kings Bay, Georgia, is located in coastal southeastern Georgia, along the western shore of Cumberland Sound approximately 2 mi (3 km) north of St. Mary's, Georgia and approximately 35 mi (56 km) north of Jacksonville, Florida. The site was designated as NSB Kings Bay in 1982, and encompasses approximately 25 mi^2 (65 km^2). Facilities at the base enable Kings Bay to serve as a homeport, refit site, and training facility for the Navy personnel who operate and maintain the Ohio-class submarines (GlobalSecurity.org, 2007d).

The Navy Strategic Systems Programs proposed to construct and maintain security facilities to support continuous security service and incident response at NSB Kings Bay. Security improvements include a Waterfront Security Force Facility, an Auxiliary Reaction Force Facility, an Armored Fighting Vehicle Operational Storage Facility (AFVOSF); an Armory; road improvements to ensure efficient access to and from the proposed facilities; and construction of a new parking lot to replace lost parking spaces. No significant effects to environmental resources were expected.

NS Mayport

NS Mayport is located near the Port of Jacksonville on the St. Johns River in northeast Florida. NS Mayport is home to 55 tenant commands and private organizations. Some two dozen ships are berthed in the Mayport basin, including Airborne Early Warning/Ground Environment Integration Segment (AEGIS) guided-missile cruisers, destroyers, guided-missile frigates, and aircraft carriers (GlobalSecurity.org, 2007e). NS Mayport covers 5 mi^2 (14 km^2) and is the third largest naval facility in the continental United States. NS Mayport is unique in that it is home to a busy seaport as well as an air facility that conducts more than 135,000 flight operations each year (GlobalSecurity.org, 2007e).

6.2.4.7 USS MESA VERDE Ship Shock Trial

A Record of Decision was published in the Federal Register (FR) on July 28, 2008 (FR, Vol. 73, No. 145) in which the Navy announced its decision to conduct a shock trial for USS MESA VERDE in the area of the Atlantic Ocean offshore of Naval Station Mayport, Jacksonville, Florida during the summer (June 21 – September 20, 2008). The Final EIS considered all components of the physical, biological, and socioeconomic environment and concluded that potential impacts from execution of the shock trials would be less at the Mayport, Florida alternative site than at the alternative sites of Norfolk, Virginia or Pensacola, Florida.

The NMFS determined that the incidental taking of marine mammals resulting from conducting a Full Ship Shock Trial on USS MESA VERDE in the waters offshore of Mayport, Florida during the summer months would have a negligible impact on the affected marine mammal species or stocks. The Final Rule was published in the FR on July 24, 2008 (FR, Vol. 73, No. 143). The FR notice provides a list of mitigations and requirements for monitoring and reporting before, during, and after the trials are conducted.

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles. Refer to Chapter 4 of the MESA VERDE Ship Shock Trial EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 489 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment. Acoustic analysis also indicates that 8 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment. The analysis also indicates that the effect to 1 marine mammal mortality may also result. The results of the acoustic analysis indicate that no ESA-listed marine mammal species will be exposed or injured due to the training activities. The results also indicate the quantity of ESA-listed sea turtles that may be exposed to levels of sound, 2,079 species may result in Level B harassment, 46 may result in Level A harassment, and 1 may result in mortality. The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. The Navy finds that ESA-listed species may experience a cumulative impact from AFAST active sonar activities; however, they are not expected to adversely affect the populations of ESA-listed species (DoN, 2008a; 2008c).

The first shot of MESA VERDE's shock trial was successfully conducted August 16, 2008. The second shot was successfully completed on August 26, 2008 and the third and final shock trial event was completed September 13, 2008 (DoN, 2008a). As detailed in the After-Action Mitigation Report for the Shock Trial of USS MESA VERDE submitted to the Director of NMFS' Office of Protected Resources, the NMFS' Southeast Region, and the Chief of NMFS' Endangered Species Division - Office of Protected Resources, the mitigation component of the shock trial was successful. No mortalities or injuries to marine mammals or sea turtles were detected during the shock trial events or during post-mitigation monitoring. In addition, no marine mammal or sea turtle stranding has been attributed to the shock trial.

6.2.4.8 Increased Flight and Related Operations at Patuxent River Complex

The Navy evaluated increased RDT&E flight and related operations in the Patuxent River Complex. The Record of Decision allows for up to 24,400 flight hours per year, including up to 3,300 annual flight hours of military training support. The operations are under the exclusive control of Naval Air Warfare Center, Aircraft Division (NAWCAD). They include:

- NAS Patuxent River, with all its flight and ground test facilities, runways and associated airspace;
- Outlying Landing Field (OLF) Webster Field with its flight test facilities, runways, and associated airspace; and
- The Chesapeake Test Range (CTR), including its restricted airspace; aerial and surface firing range; and Hooper, Hannibal, and Tangier Island Targets.

No significant impacts were identified in the EIS although the Navy implemented a series of measures in response to public comments about aircraft noise, supersonic events, sufficiency of pilot awareness briefs, unmanned aerial vehicle (UAV) operations in the CTR, and the operation of an open-air aircraft engine test cell (DoN, 1999)

6.2.4.9 Homebasing MH-60R/S Helicopters on the East Coast of the US

The Navy is in the process of homebasing new MH-60S and MH-60R (helicopters) on the East Coast of the United States (DoN, 2002). The MH-60S aircraft type are replacing the CH-46D, HH-60H, SH-3H, and HH-1N helicopters. The missions assigned to this aircraft include combat search and rescue (CSAR); surface ship protection; and a new, organic, airborne, mine countermeasures role. The MH-60R aircraft type will replace the SH-60B and SH-60F aircraft. The missions assigned to this aircraft include anti-submarine warfare (ASW), surface warfare (SUW) and naval gun fire support (NGFS). No significant adverse short-term or long-term impacts were identified as resulting from implementing the Navy's preferred alternative, which was to homebase all or most MH-60S helicopters at Naval Station (NS) Norfolk, Virginia and all or most MH-60R helicopters at stations in the Jacksonville region.

6.2.4.10 Operational Testing of Hellfire Missile System Integration on H-60 Helicopters

The Navy proposed developmental and operational testing of Hellfire missile system integration with the H-60 helicopter (DoN, 2005). Testing involved the firing of non-explosive practice rounds and high-explosive (HE) Hellfire missiles at floating targets located in the VACAPES OPAREA. After evaluating potential impacts from the proposed action, the determination was that the proposed action would not significantly impact the environment; would have no effect on essential fish habitat (EFH); would not result in reasonably foreseeable "takes" of marine mammals; and would have no effect on threatened and endangered species under the ESA.

6.2.4.11 Homebasing F/A-18E/F Super Hornets to the East Coast of the US

The Navy has replaced F-14 fighter jets in its fleet inventory with F/A-18E/F Super Hornets. The EIS analyzed 10 Super Hornet Squadrons and one Super Hornet Fleet Replacement Squadron at several combinations of east coast Navy and Marine Corps air stations along with the impact to nearby training ranges (BT-9, BT-11, Dare County Range, and Townsend Bombing Range). The final EIS analyzed the amount of ordnance typically used at each range. The final EIS concluded there would not be an increase in the amount of ordnance expended at any of the ranges and that there would not be a significant impact to resources at these ranges (DoN, 2003).

6.2.4.12 Permanent Placement of Navy Expeditionary Combat Command (NECC) Headquarters

The Navy decided to locate the new NECC Headquarters at NAB Little Creek in Norfolk, Virginia. The action included the temporary standup and placement of new subordinate commands under the NECC at NAB Little Creek, including the Riverine Group Headquarters and Riverine Squadrons One and Two. Although the facility itself is not considered in the cumulative impacts of the proposed action, follow-on actions to permanently place riverine squadrons could potentially add to any cumulative impact of the VACAPES Study Area.

6.2.4.13 Establishment of a Military Operations on Urban Terrain (MOUT) at Navy Dare County Bombing Range (NDCBR)

The Navy evaluated the potential impacts of air-to-ground bombing using practice, non-explosive munitions, and construction of a military operations on urban terrain (MOUT) target at NDCBR located near Manteo, North Carolina (DoN, 2008a). No significant impacts to the environment were anticipated as a result of the proposed action.

6.2.4.14 Other Department of Defense Training Activities

There are several other Department of Defense users of the VACAPES Study Area. Langley Air Force Base (AFB) has an established Air Corridor that runs parallel to the Maryland and Virginia coastlines that overlaps with W-386. The Air Force uses the corridor for testing aircraft. Occasionally other Langley AFB aircraft use the warning areas within the Range Complex for flight training and testing. Seymour Johnson AFB is located in Goldsboro, NC, which is too far from VACAPES Range Complex to be used by aircrews.

Navy personnel at Naval Amphibious Base (NAB) Little Creek use the VACAPES Study Area, including the lower Chesapeake Bay for training and testing Landing Craft, Air Cushion (LCAC). Naval Air Warfare Center, Naval Surface Warfare Center and other commands at Naval Air Station Patuxent River, MD use the VACAPES Range Complex to conduct numerous RDT&E operations. Naval Special Warfare units, based at NAB Little Creek conduct training in various areas within the VACAPES Study Area depending on training requirements based on current world events.

U.S. Coast Guard, as part of the DoD role, often training in the VACAPES Study Area. Training may include firing of small arms for annual qualifications and search and rescue using aircraft or surface vessels..

6.3 Reasonably Foreseeable Future Actions Relevant to the Proposed Action

6.3.1 Military Operations

6.3.1.1 Navy Cherry Point Range Complex

As stated in Section 6.2.10.5, the Navy Cherry Point Range Complex Draft EIS/OEIS was released in August 2008. In that Draft EIS/OEIS, the Navy's preferred alternative was identified as Alternative 2, Eliminate High Explosive Bombs At-sea and Implement Enhanced Mine Warfare Training Capabilities. The Navy's preferred alternative is considered representative of its future actions within the Navy Cherry Point Range Complex. The Final EIS/OEIS is expected to be released to the public in 2009; refer to this document for all cumulative impacts (DoN, 2008a, DoN, 2008c).

Under Alternative 2, the Navy will continue conducting current activities as well as increasing range complex operations and capabilities enhancement to address Navy and DoD emerging and foreseeable future training and RDT&E requirements. Other than the continuation of current training and testing activities, the preferred alternative also allows for an across-the-board increase in most operations to provide the Navy and Marine Corps with flexibility to train for real world situations, plus change in type and quantity of operations and tactical employment of forces to accommodate expanded mission areas, force structure changes, and new range capabilities. Alternative 2 would also eliminate all high explosive (HE) bombing exercises at-sea (BOMBEX Air-to-Surface) and designate two mine warfare (MIW) training areas for major exercise MIW events. (Mine detection sonar will be used and use of this sonar is covered under this AFAST EIS/OEIS.) With the elimination of HE BOMBEX, the Navy and Marine Corps plans to continue to drop Non-Explosive Practice Munitions (NEPM or inert bombs) (DoN, 2008a; 2008c).

Furthermore, the Navy intends to perform mine neutralization operations for both ESG and CSG major exercises in the area currently designated for underwater detonation (UNDET) training, 3 to 12 nm (5.6 to 22.2 km) off the coast in the Cherry Point OPAREA (DoN, 2008a; 2008c).

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects any expended materials would cause. It was determined that there will be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the Cherry Point Range Complex (DoN, 2008a; 2008c).

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles as a result of the activities being performed with Alternative 2 (Preferred Alternative). Refer to Chapter 3 of the Navy Cherry Point Range Complex Draft EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 3 exposures to marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment. No mortalities are predicted due to the proposed activities. The results of the acoustic analysis indicates that no ESA-listed marine mammal species will may be exposed to levels of sound resulting in any level of harassment. The results also indicate that no ESA-listed sea turtles will be exposed to levels of sound likely to result in any level of harassment. The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2008a; 2008c). In addition, these exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal species or populations.

6.3.1.2 JAX Range Complex

As stated in Section 6.2.10.6, the JAX Range Complex Draft EIS/OEIS was released in June 2008. In that Draft EIS/OEIS, the Navy's preferred alternative was identified as Alternative 2, Increases and Modifications in Operational Training, Accommodate Force Structure Changes, and Implement Enhancements Mine Warfare Training Capability. The Navy's preferred alternative is considered representative of its future actions within the JAX Range Complex. The Final EIS/OEIS is expected to be released to the public in 2009; refer to this document for all cumulative impacts (DoN, 2008a).

The proposed action's purpose is to: achieve and maintain Fleet readiness using the JAX Range Complex to support and conduct current, emerging, and future training operations and RDT&E operations; expand warfare missions supported by the JAX Range Complex; and upgrade and modernize existing range capabilities to enhance and sustain Navy training and RDT&E. Also, the proposed action is needed to provide range capabilities for training and equipping combat-capable naval forces ready to deploy worldwide (DoN, 2008a).

Under Alternative 2, the Navy intends to increase or modify training and RDT&E operations from current levels as necessary in support of the FRTP, accommodate mission requirements associated with force structure changes, including those resulting form the introduction of new platforms (aircraft and weapons systems), and implement enhanced range complex capabilities in the JAX Range Complex. Alternative 2 would increase operational training, expand warfare missions, accommodate force structure changes (including changing weapon systems and platforms and homebasing new aircraft and ships), and implementing enhancements, to the minimal extent possible to meet the components of the proposed action. This alternative is composed of all currently conducted operations including the introduction of t new varients of the H-60 helicopter and new organic mine countermeasure systems. Additional mine warfare training capabilities and implementation of additional enhancements to enable the range complex to meet future requirements can also be expected of Alternative 2 (DoN, 2008a).

With the preferred alternative, the Navy expects to eliminate live bombing exercises (BOMBEX) and designate MIW Training Areas in the JAX/CHASN OPAREA for enhanced mine countermeasures and neutralization training during major exercises (DoN, 2008a). (Mine detection sonar will be used and use of this sonar is covered under the AFAST EIS/OEIS.)

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects any expended materials would cause. It was determined that there will be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the JAX Range Complex under Alternative 2 (DoN, 2008a).

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles as a result of activities performed with Alternative 2 (Preferred Alternative). Refer to Chapter 3 of the Jacksonville Range Complex EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 79 exposures to marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment and two exposures may result in Level A harassment. The results of the acoustic analysis indicate that no ESA-listed marine mammal species are expected to be exposed to levels of sound which will result in some sort of harassment. No mortalities are predicted due to the proposed activities. The results also indicate the quantity of ESA-listed sea turtles that may be exposed to levels of sound, 36 exposures may result in Level B harassment and no exposures would result in Level A harassment. The exposure estimates for the Preferred Alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2008a). In addition, these exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals and sea turtles to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal and sea turtle species or populations.

6.3.1.3 Undersea Warfare Training Range

The Navy released a Draft EIS/OEIS in September 2008 to evaluate the potential environmental effects associated with the construction and operations of an underwater instrumented range off the Southeastern U.S. Coast (DoN, 2008d). A revised Notice of Intent to prepare the EIS/OEIS and a thirty day scoping period was published in the Federal Register on September 21, 2007. Four public meetings were held during the months of September and October 2008, and comments were received from September 12, 2008 to October 27, 2008. The Draft EIS/OEIS is incorporated by reference and is available for downloading/viewing via the internet at the following website address: (http://projects.earthtech.com/uswtr/USWTR_index.htm). The proposed action is to place undersea cables and transducer nodes in a 500 nm^2 (1,713 km^2) area of the ocean to create an undersea warfare training range (USWTR) for use as an ASW training range. The ASW training would involve up to three vessels and two aircraft using the range for any one training event, although events would typically involve fewer units. The instrumented area would be connected to the shore via a single trunk cable. The proposed action would require logistical support for ASW training, including the handling (launch and recovery) of exercise torpedoes (non-explosive) and submarine target simulators (DoN, 2008d). The purpose of the proposed action is to enable the Navy to train effectively in a shallow water environment at a suitable location for Atlantic Fleet ASW capable units. The 120- to 900-ft (37- to 274-m) depth parameter for the range was derived from collectively assessing depth requirements of the platforms that would be using this range, and approximate the water depth of potential areas of conflict that the Navy has identified.

The Navy analyzed potential environmental impacts at the following four sites:

- Site A – offshore of northeastern Florida (JAX OPAREA).
- Site B – offshore of central South Carolina (CHASN OPAREA).
- Site C – offshore of southeastern North Carolina (CHPT OPAREA).
- Site D – offshore of northeastern Virginia (VACAPES OPAREA).

The Preferred Alternative has been determined to be Site A. Potential effects to physical, ecological, and socioeconomic resources were analyzed in the USWTR OEIS/EIS. With the exception of EFH, it was determined there would be no significant impact to physical, ecological (non acoustic effects only), or socioeconomic resources. Cable installation may have a temporary impact on benthic organisms, including benthic fish, during the placement of the transducer nodes and interconnect cable and the burial of the trunk cable. As this action would result in a reduction of the quantity and/or quality of some types of EFH, installation of the proposed USWTR may adversely affect EFH at all of the four proposed sites (DoN, 2008d).

Acoustic analysis was performed to determine potential effects to marine mammals from sonar activities. Refer to Chapter 4 of the USWTR OEIS/EIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 108,108 non-injurious effects on marine mammals annually as a result of exposure to sonar activities that NMFS would classify as Level B harassment under the MMPA at the preferred alternative site. In addition, the Navy estimates the potential for 7 injurious effects on marine mammals annually as a result of exposure to active sonar activities that NMFS would classify as Level A harassment under the MMPA. This estimate does not take into consideration any avoidance of vessels or sound sources by marine mammals or the implementation of mitigation measures. Navy does not anticipate Level A harassment to occur with the implementation of mitigation measures. Of these marine mammals, no threatened or endangered marine mammals will be exposed to levels of sound likely to result in Level A harassment, and 156 will be exposed to levels of sound likely to result in Level B harassment (DoN, 2008d; 2008e). Based on the acoustic screening analysis, plankton, invertebrates, seabirds, sea turtles, pinnipeds, and manatees were excluded from acoustic effect analysis (DoN, 2008d;2008e).

6.3.1.4 Surveillance Towed Array Sensor System Low Frequency Active Sonar

The Final Supplemental Environmental Impact Statement (SEIS) for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar was issued in April 2007, and the Record of Decision (ROD) was issued in August 2007 (DoN, 2007). Under the action, a maximum of four systems would be deployed in the Pacific-Indian ocean area and in the Atlantic-Mediterranean area. Of an estimated maximum 294 underway days per year, the SURTASS LFA sonar would be operated in the active mode about 240 days. During these 240 days, active transmissions would occur for a maximum of 432 hours per year per vessel. The duty cycle of the SURTASS LFA sonar would be limited (it would generally be on between 7.5 and 20 percent of the time [7.5 percent is based on historical LFA operations since 2003 and the physical maximum limit is 20 percent]). The LFA transmitters would be off the remaining 80 to 92.5 percent of the time (DoN, 2007). The decision, as stated in the ROD, implemented Alternative 2 as the Preferred Alternative (DoN, 2007).

Under Alternative 2, the SURTASS LFA sonar would be employed with geographical and seasonal restrictions to include maintaining sound pressure level below 180 dB within 12 nm (22 km) of any coastline and within the offshore biologically important areas that are outside of 12 nm (22 km). During the annual LOA process, the Navy will evaluate potential offshore biologically important areas within the proposed operating areas for each ship and incorporate restrictions, as required, into the LOA applications for NMFS's review and action. LFA sound fields will not exceed 145 dB within known recreational and commercial dive sites. Monitoring mitigation includes visual, passive acoustic, and active acoustic (high-frequency marine mammal monitoring [HF/M3] sonar) to prevent injury to marine animals when employing SURTASS LFA sonar by providing methods to detect these animals within the 180 dB LFA mitigation zone (DoN, 2007).

The Final SEIS analyzed potential impacts to fish, sea turtles, marine mammals, and socioeconomics (commercial and recreational fishing, research and exploration activities, other recreational activities). Under Alternative 2, the potential impact on any stock of fish, sharks or sea turtles from injury was considered negligible, and the effect on the stock of any fish, sharks or sea turtles from significant change in a biologically important behavior was considered negligible to minimal. Any auditory masking in fish, sharks or sea turtles is expected to be of minimal significance and, if occurring, would be temporary (DoN, 2007). The potential impact on any stock of marine mammals from injury is considered to be negligible, and the effect on the stock of any marine mammal from significant change in a biologically important behavior is considered to be minimal. Any momentary behavioral responses and possible indirect impacts to marine mammals due to potential impacts on prey species are considered not to be biologically significant effects. Any auditory masking in mysticetes, odontocetes, or pinnipeds is not expected to be severe and would be temporary (DoN, 2007). Further, there will be no significant impact to socioeconomic resources.

NMFS issued the Final Rule for the taking of Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to the U.S. Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar in August 2007 (NMFS, 2008a). NMFS has determined that the incidental taking of marine mammals resulting from SURTASS LFA sonar operations would have a negligible impact on the affected marine mammal species or stocks over the 5-year period of LFA sonar operations. That assessment is based on a number of factors: (1) The best information available indicates that effects from SPLs less than 180 dB will be limited to short-term Level B behavioral harassment averaging less than 12 percent annually for all affected marine mammal species; (2) the mitigation and monitoring is highly effective in preventing exposures of 180 dB or greater; (3) the results of monitoring as described in the Navy's Comprehensive Report supports the conclusion that takings will be limited to Level B harassment and not have more than a negligible impact on affected species or stocks of marine mammals; (4) the small number of SURTASS LFA sonar systems (two systems in FY 2008 and FY 2009 (totaling 864 hours of operation annually), 3 in FY 2010 (totaling 1296 hours of operation annually), and 4 systems in FY 2011 and FY 2012 (totaling 1728 hours of operation annually) that would be operating world-wide; (5) that the LFA sonar vessel must be underway while transmitting (in order to keep the receiver array deployed), limiting the duration of exposure for marine mammals to those few minutes when the SURTASS LFA sonar sound energy is moving through that part of the water column inhabited by marine mammals; (6) in the case of convergence zone propagation, the characteristics of the acoustic sound path, which deflect the sound below the water depth inhabited by marine mammals for much of the sound propagation (see illustration 67 FR page 46715 [July 16, 2002]); (7) the findings of the Scientific Research Program on low-frequency sounds on marine mammals indicated no significant change in biologically important behavior from exposure to sound levels up to 155 dB; and (8) during the 40 LFA sonar missions between 2002 and 2006, there were only three visual observations of marine mammals and only 71 detections by the HF/M3 sonar, which all resulted in mitigation protocol suspensions in operations. These measures all indicate that while marine mammals will potentially be affected by the SURTASS LFA sonar sounds, these impacts will be short-term behavioral effects and are not likely to adversely affect marine mammal species or stocks through effects on annual rates of reproduction or survival. In addition, mortality of marine mammals is not expected to occur as a result of LFA sonar operations (NMFS, 2008a). At this time, the Navy has no plans to employ SURTASS LFA in the VACAPES study area.

6.3.1.5 Arrival of New Submarines at Naval Submarine Base (NSB) Kings Bay, Georgia

Beginning with the arrival of the *USS Tennessee* in 1989, NSB Kings Bay housed 10 Trident submarines by 1997. However, a 1992 nuclear policy review recommended that the Ohio-class fleet ballistic missile submarines be reduced from 18 to 14 by the year 2005 (Wiss, 2006). As a result of the realignment process, five submarines departed NSB Kings Bay, Georgia, for Bangor NSB, Washington, between 2002 and 2005. The losses of these five submarines are expected to be offset by incoming submarines, which include the *USS Florida*, *USS Georgia*, and *USS Alaska*. Each submarine is expected to provide an annual economic impact of $9.5 million to the area. The population in Camden County is expected to increase by 1,000 because it is anticipated that each guided nuclear missile submarine (SSGN) will bring two crews of 160 sailors and their families (Wiss, 2006).

The *USS Georgia* was assigned a new homeport at NSB Kings Bay in 2007, after a $1 billion renovation at Norfolk Navy Shipyards. The submarine was converted from a ballistic nuclear submarine (SSBN) to an SSGN (Wiss, 2006). An SSBN carries 24 Trident missiles, whereas an SSGN is fitted to carry up to 154 conventional cruise missiles.

The Navy commissioned the *USS Alaska* on January 25, 1986. It was the seventh Trident Nuclear Powered Fleet Ballistic Missile Submarine to be constructed and one of eight Trident submarines assigned to Bangor, Washington. This submarine is scheduled to undergo a two and a half year overhaul in Norfolk, Virginia, and then be homeported to NSB Kings Bay, Georgia. The relocation is due in part to the recent 2005 Base Realignment and Closure (BRAC) process and also the Navy's desire to split the ballistic missile submarine fleet between the Pacific Coast and the East Coast.

6.3.1.6 Construction and Operation of an Outlying Landing Field to Support Carrier Air Wing Aircraft at Naval Air Station Oceana and Naval Station Norfolk, Virginia

In a Notice of Intent published on April 9, 2008, (73 *Federal Register* [FR] 19196), the Department of the Navy announced its intent to prepare an Environmental Impact Statement (EIS) to evaluate potential environmental consequences of the construction and operation of an Outlying Landing Field (OLF) at five alternative sites to support Field Carrier Landing Practice (FCLP) training requirements for carrier-based fixed-wing aircraft stationed at and transient to NAS Oceana, Virginia Beach, Virginia (F/A-18CHornet and F/A-18E/F Super Hornet squadrons and Fleet Replacement Squadrons (FRS)), and Naval Station (NS) Norfolk Chambers Field, Norfolk, Virginia (E-2-C Hawkeye, C-2A Greyhound, and E-2C/C-2A FRS). The five alternative OLF sites identified to date are: (1) Cabin Point Site, located tin Surry, Prince George, and Sussex counties, Virginia; (2) Dory Site, located in Southampton and Sussex counties, Virginia; (3) Mason Site, located in Sussex and Southampton counties, Virginia; (4) Sandbanks Site, located in Gates and Hertford counties, North Carolina, and (5) Hale's Lake Site, located in Camden and Currituck counties, North Carolina. These five site alternatives were identified by applying operational environmental and population criteria to a list of 13 sites provided by the State of North Carolina and the Commonwealth of Virginia.

While Naval Auxiliary Landing Field (NALF) Fentress would continue to provide necessary support for Field Carrier Landing Practice (FCLP) and other training requirement, this landing field alone cannot fully support training requirements of home-based and transient aircraft from NAS Oceana and NS Norfolk Chambers Field. Training requirements for aircraft based at these airfields can exceed NALF Fentress capacity up to 63% of the time during summertime when hours of darkness are limited. Capacity problems are further exacerbated when operational demands require surging additional carrier strike groups. A new OLF is required to provide year round capacity to support FCLP training requirements under the Fleet Response Plan, provide operational flexibility needed to respond to emergent national defense requirements, and FCLP training consistent with at-sea operating conditions.

Facilities at the OLF would include an 8,000-foot runway, aircraft traffic control tower, and other support buildings. The Navy also proposed to establish Class D airspace around the OLF. Property and property interests for construction of the facilities, airfield safety zones, and projected high-noise zones would need to be acquired through purchase, lease, or acquisition of restrictive use or conservation easements.

The EIS will address environmental consequences associated with construction of the airfield, associated infrastructure and support facilities, and aircraft operations. In addition, the EIS will assess socioeconomic consequences associated with acquisition of property and property interests for the OLF and any relocation of residences within the proposed airfield safety and projected high-noise zones.

Seven public scoping meetings were held during the months of April and May 2008 by the Navy on the proposed construction and operation of an OLF and public comments were accepted until June 7, 2008. Additional information concerning this EIS can be obtained from visiting the project web site at http:www.OLFEIS.com

6.3.1.7 Permanent Homeporting of Riverine Squadrons under NECC

The Navy is assessing the permanent homeporting of Riverine Group 1, which is composed of three active riverine squadrons. Each squadron will have 224 personnel and 16 multi-mission riverine crafts. The primary mission of the Navy's riverine force is to conduct maritime security operations, which may include, but is not limited to patrol and interdiction, the delivery of land assault forces, resupply and logistics, medical evacuation, security operations, fire support, and civil action support. The EA will analyze the potential environmental effects resulting from the homeporting action and related training requirements of the riverine force. The homeporting action would entail the construction or modification of various administrative, maintenance, storage, and support facilities. Riverine training would include live and inert fire combat training and vessel training at inland facilities and in near-shore waters. The homeport sites under evaluation include Naval Weapons Station (NWS) Yorktown, NAB Little Creek, and Naval Construction Battalion Center (NCBC) Gulfport.

6.3.1.8 Proposed Dredging of the Norfolk Harbor Channel in Norfolk and Portsmouth, Virginia

The Navy, in cooperation with the Army Corps of Engineers (USACE), has prepared a Draft Environmental Impact Statement (DEIS) to evaluate the environmental consequences of deepening approximately five miles of the Norfolk Harbor Federal Navigational Channel in the Southern Branch of the Elizabeth River, separating Norfolk and Portsmouth, Virginia. Dredging will extend from the Lamberts Point Deperming Station in the Lamberts Bend Reach south to the Norfolk Naval Shipyard (NNSY) in the Lower Reach. This channel is the only means of nuclear-class aircraft carrier (CVN) access to the Lamberts Bend Deperming Station and NNSY. The current average depth of the Norfolk harbor Channel from Lamberts Bend to the Lower Reach at NNSY is maintained by the USACE Norfolk District, varying in depth from approximately 40 to 43 feet below mean lower low water (-40 to -43 feet MLLW). The existing channel depths are not sufficient to allow safe, unrestricted access by CVNs to the Lamberts Bend Deperming Station and NNSY and to avoid incidents of fouling and clogging of the cooling systems of the CVNs. The Navy needs at least 6 feet of water between the aircraft carrier's keel and the bottom of the river channel.. A Notice of Intent for the EIS was published in the Federal Register on September 19, 2006 (71 FR 54803) which also announced two public scoping meetings were held in October 2006 in Norfolk and Porstmouth, Virginia.

The Proposed action would occur solely within the Norfolk Harbor Channel's existing limits and deepen the heavily used waterway at Lamberts Bend to -50 feet MLLW, plus three feet of overdredge for a new depth-in-channel of -53 feet MLLW. The remainder of the channel (Port Norfolk, Town Point, and Lower Reaches) would be deepened to -47 feet MLLW plus three feet of overdredge for a new depth-in-channel of -50 feet MLLW. Overdredge depth is typically needed to ensure project depths and allow a margin of accuracy. The proposed action would bring the Norfolk harbor Channel in compliance with the Naval Sea Systems Command (NAVSEA) water depth requirements for homeports and entrance channels to shipyards, providing CVNs with continuous safe and uninterrupted access to the Lamberts Point Deperming Station and NNSY.

The DEIS evaluates the potential environmental impacts of two action alternatives and the No Action Alternative. Alternative A (the preferred alternative) would implement the proposed dredge depths for aircraft carriers for homeports and entrance channels to shipyards. Alternative B would involve a combination of partial deepening of the Norfolk Harbor Channel and operational restrictions based on tidal activity. It would represent an improvement over the existing situation in that with partial deepening, there is less likelihood of sediment from the river bottom fouling ship systems. However, with only the partial deepening, the carrier movements would still need to wait for high tide conditions to provide the needed water depths below the keel of the carriers. Under both alternatives, dredged materials would meet USACE sediment quality thresholds for disposal at the Craney Island Dredged Materials Management Area (CIDMMA). Under the No Action Alternative, no deepening of the Norfolk harbor Channel would occur. The channel would continue to be available at the existing controlling dimensions and access to the deperming station and NNSY would remain restricted for use by carriers.

Dredging would be done either by hydraulic (pipeline) or mechanical (clam-shell/bucket) equipment. Hydraulic dredging uses a cutterhead to break up sediment on the river bottom and suction to transport the material through a flexible pipeline to the disposal site. For the mechanical system, the river bottom materials are scooped out, placed on a barge, and then transported to the disposal site. Under the preferred alternative, it is anticipated that approximately 4 million cubic yards of dredged material would be removed. This would be equivalent to about 1 foot of dredged material spread over 2,500 acres.

In addition, the DEIS addresses potential environmental impacts on multiple resources, including but not limited to: water resources, air quality, noise, biological resources, cultural resources, traffic, socioeconomic and environmental justice, general services, utilities and infrastructure, and environmental health and safety. With the exception of noise and aesthetics, no significant impacts are identified for any resource area.

With regard to earth resources, the Navy performed several project specific surveys to understand existing conditions in the Elizabeth River and to assess the potential impacts of dredging on water quality and marine life. The surveys were also important for determining disposal options for the sediments to be dredged. Sediment samples were taken from three different depths at 30 separate locations within the channel area. These 90 samples were collected and analyzed for physical and chemical properties per a plan developed with the Virginia Department of Environmental Quality (VADEQ), the Virginia Marine Resources Commission and the Corps. Follow-up sediment testing was also done in the Lower Reach by the Corps to determine acceptability of dredged material for Craney Island disposal. Clay is the primary sediment type of project area, followed by sand and silt. Evidence of chemical compounds were detected in some of the sediment samples, with the majority of these potential pollutants occurring in the upper layer of river sediment. These channel sediments would be removed by the deepening with Alternatives A or B. Federal and state permits are required and will be obtained before dredging and disposal will occur. After review of sediment sampling and testing results, the Corps-Norfolk District has indicated that the dredged material would be acceptable for placement at Craney Island.

As for water quality, short term impact with the channel from suspended sediment (turbidity) during dredging are predicted for Alternatives A and B. Mixed sediment and water samples, called elutriate, were tested for 122 chemical parameters to determine the potential for contaminants to be released to the water after dredging or to travel via water discharge after dredged material is placed at Craney Island. Results were compared to VADEQ surface water quality standards and were found to be within standards for the protection of human health and the environment. Also, hydrodynamic modeling was conducted by the Virginia Institute of Marine Science (VIMS) under contract with the Navy to study the potential impacts of dredging on elevation, salinity, current speed, sedimentation potential) of the Elizabeth River. VIMS used a computer model to predict long and short term effects. The model predicted the following minor long term changes: (a) Surface elevation:0.2%; (b) Surface and Bottom Currents: less than 10%; (c) Surface and Bottom Salinity: average 0.03 parts per thousand (ppt) with maximum of 0.16 ppt or less than 1% of the existing 15 ppt to 25 ppt of the Elizabeth River; and, (d) Sedimentation: 0.5% to 2% increase during low flow conditions.

Potential impacts to biological resources (benthic habitat and marine and terrestrial species) were also analyzed with the following conclusions. Macrobenthic surveys of the river bottom were conducted by specialists at Old Dominion University in Norfolk under contract with the Navy. Grab samples of the upper layer of sediment at 25 locations were collected in the proposed dredging area. The analysis documented the presence and diversity of organisms living on the river bottom. The macrobenthic communities of Norfolk Harbor Channel rated degraded or severely degraded on the Benthic Index of Biotic Integrity, which indicates the quality of the river bottom environment, as compared with all locations within Chesapeake Bay. There would be short term impacts to river organisms from dredging activities with Alternatives A and B, including the direct removal of benthic species. However, benthic communities would recolonize, and the removal of the degraded sediment would result in improved habitat quality for benthic species. Degraded sediments would not be removed with the No Action Alternative.

An Essential Fish Habitat (EFH) assessment was prepared, as required by the Magnuson-Stevens Fishery Conservation and Management Act, and included in the DEIS. The proposed dredging project would result in local, temporary impacts to designated EFH, other managed fisheries resources, and prey organisms of EFH species. However, based on the expected short term nature of the direct impacts, minimal changes to aquatic habitat, and the generally degraded quality of the existing marine environment, these impacts are not considered to be significant.

Federal and state regulatory agencies were contacted about the potential for threatened or endangered species or other special-status species to be present within the area affected by the proposed action alternatives. There were no recent records of any federally listed species occurring in the proposed project area nor was any protion of the area classified as critical habitat for those species. The CIDMMA provides nesting and foraging habitat for 270 species of birds, many of them migratory species. The continuing rotational use of the disposal containment cells and habitat management measures undertaken by the Corps at the Craney Island disposal area would prevent the "taking" (i.e., killing or transporting) of migratory birds or their eggs, which is prohibited under the Migratory Bird Treaty Act.

There would be no reasonably foreseeable takes of marine mammals as defined by the MMPA, as these species are not likely to occur within the area affected. In the unlikely event bottlenose dolphin (the only mammal that may occur near the project area) move into the area during dredging, they are highly mobile and would likely leave the area.

Potentially significant noise impacts may occur at one receptor (Town Point Park), depending on the actual dredge equipment to be used. The Navy's policy is to comply with local noise ordinances to the maximum extent practicable, therefore mitigation or minimization measures may be implemented, if needed, at Town Point Park. There is also a potential for cumulative visual impacts from implementation of the proposed action due to the need for the USACE to increase the height of dikes surrounding the containment cells at CISMMA to maintain capacity.

The Notice of Availability of the DEIS for public comment was published in the Federal Register (74 FR 3034) on January 16, 2009, and the period for receiving comments closed on March 2, 2009. Also, an announcement was published in the Federal Register (74 FR 4145) concerning the public information meeting which was held on February 11, 2009, in Portsmouth, Virginia, where Navy representatives were available to explain the proposal, answer questions, and receive comments from the public. The DEIS is incorporated by reference and is available for electronic public viewing at http://www.NorfolkdredgingEIS.com.

6.3.2 Other Federal and State Agency Action

6.3.2.1 LNG Atlantic Ocean, Offshore of the Southeastern United States

The only LNG terminal offshore of the southeastern United States is currently under construction and is an extension of the El Paso – Southern LNG located at Elba Islands, Georgia. There are no other proposed FERC or MARAD/USCG regulated terminals offshore of the southeastern United States (FERC, 2009).

6.3.2.2 Proposed LNG Facilities, Northeastern United States

Sparrows Point LNG Proposal – Sparrows Point, MD. In January of 2007, AES Sparrows Point LNG, LLC submitted an application to FERC for the construction and operation of a LNG or LNG import and re-gasification facility located at the Sparrows Point Industrial Complex near Baltimore, Maryland. The project will include a marine receiving terminal, three full containment 160,000 m^3 (209,272 yd^3) storage tanks, and facilities to support ship berthing and cargo offloading. Construction is expected to begin in 2008 and be completed in 2010. A Final EIS is currently being prepared and expected to be released later this year (AES, 2007).

6.3.2.3 MMS Regulated Activities: Alternative Energy Development (Offshore Wind, Wave, and Ocean Current Energy Capture)

United States Department of the Interior, MMS, released a final programmatic EIS in support of the establishment of a program for authorizing AEAU activities on the OCS, as authorized by Section 388 of the Energy Policy Act, and codified in subsection 8(p) of the OCSLA. The final programmatic EIS examines the potential environmental effects of the program on the OCS and identifies policies and best management practices that may be adopted for the program.

Offshore wind farms are being used in a number of countries to harness the energy of the moving air over the oceans and converting it to electricity. At present, the only wind farms worldwide are located off the coasts of Europe in waters 98 ft (30 m) deep or less. These wind farms currently harness just over 600 megawatts (MW) of offshore wind energy. However, offshore wind projects proposed worldwide through 2010 would produce more than 11,000 MW. Of these proposed projects, wind farm energy production in the United States would amount to roughly 500 MW (MMS, 2007g). With the passage of the Energy Policy Act of 2005, MMS was given jurisdiction over offshore alternative energy projects, including wind farms (MMS, 2007h).

Construction and everyday operation of offshore wind farms has the potential to affect several environmental resources, especially biological resources. Potential effects might include bird collisions with rotors or towers, increases in underwater noise due to construction and operational vibrations, the creation of underwater electromagnetic fields, and sea floor alterations due to installation (MMS, 2007g).

6.3.2.4 Proposed Marine Container Terminal at the Charleston Naval Complex

There are five marine terminals in the Charleston Harbor area that are owned and operated by the South Carolina State Ports Authority (SCSPA). North Charleston Terminal, Columbus Street Terminal, and Wando Welch Terminal are primarily container terminals and Union Pier and Veterans terminals are dedicated break-bulk facilities (SCSPA, 2008). Combined, the terminals comprise over two million square feet of warehouse and storage space and can accommodate more than 17 vessels at a time (City of North Charleston, 2008). Channels leading to the terminals are deep and wide enough to handle 8,000 twenty-foot equivalent (TEU) ships. All terminals are located within two hours of the open sea (SCSPA, 2008).

In 2004, the Port of Charleston handled approximately 1.725 million 20-foot equivalent units (TEU) (USACE, 2004). The volume of containerized cargo is projected to increase 4.28 percent per year and will reach four million TEUs by the year 2025 (SCSPA, 2008; USACE, 2007c). To accommodate the increase in future demand for the number of containers that pass through the Port of Charleston each year, construction of a sixth terminal was permitted in 2007 (USACE, 2007c). This port facility will be located on the Cooper River approximately 0.3 mi^2 (0.9 km^2) of land at the south end of the former Charleston Navy Base in North Charleston, South Carolina (USACE, 2007c).

It is estimated that the baseline vessel traffic on the Cooper River will increase from 1,365 trips per year in 2004 to 3,219 trips per year in 2025 (USACE, 2006). This equates to an increase from 3.7 trips per day in 2004 to 8.8 trips per day in 2025, or just over five trips per day over a 21-year period. The proposed facility is estimated to be operational in 2012 (USACE, 2006).

6.3.2.5 Port Access Route Study

The Coast Guard is conducting a Port Access Route Study (PARS) on the area east and south of Cape Cod, Massachusetts, to include North Atlantic right whale critical habitat, mandatory ship reporting system area, and the Great South Channel including Georges Bank out to the exclusive economic zone (EEZ) boundary (DoN, 2008a). The purpose of the PARS is to analyze potential vessel routing measures that might help reduce ship strikes with the highly endangered North Atlantic right whale while minimizing any adverse effects on vessel operations. The recommendations of the study will inform the Coast Guard and may lead to appropriate international actions.

6.4 DISCUSSION OF CUMULATIVE IMPACTS RELATIVE TO THE PROPOSED ACTION

6.4.1 Assessing Proposed Action Impacts

Where feasible, the cumulative impacts were assessed using quantifiable data. However, quantifiable data were not always available; this analysis utilized qualitative information where necessary. For example, commercial shipping, commercial and recreational fishing except for the Fishery Management Plans (FMPs) that are developed by the Regional Fishery Management Councils (RFMCs) and implemented by NMFS, boating, and other activities occurring are not required to comply with the NEPA or analyze potential impacts; therefore, there is little to no analysis data available for these activities. Since a quantitative analysis of potential impacts for these areas is not possible; qualitative information, such as known marine species injuries or deaths was used as appropriate. In addition, since an analysis of potential environmental impacts for future actions (identified in Section 6.3) has not been completed, assumptions based on past actions were used.

Cumulative impacts resulting from sonar training were assessed using the conclusions from the Atlantic Fleet Active Sonar Training (AFAST) EIS/OEIS. Potential impacts to resources are identified in the following sections.

All past, present, and reasonably foreseeable future military activities described in this chapter are grouped together under Military Operations. It should be noted that the individual military actions tend to impact different resources, and when grouped together should not be interpreted to mean that each military activity would impact all resources.

6.4.2 Bathymetry and Sediments

In the marine environment, bathymetry is the water depth and ocean bottom topography. This section also reviewed impacts to marine sediments (sand, organic matter, and minerals that accumulate at the bottom of a body of water).

6.4.2.1 VACAPES EIS/OEIS Conclusions

The primary effect of the Navy's training activities in the VACAPES Study Area would be the deposition of expended training materials and their accumulation over time. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there will be no significant impact to bathymetry or sediments in territorial waters due to expended material or sediment displacement. In addition, there will be no significant harm to bathymetry or sediments in non-territorial waters due to expended material or sediment displacement for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.2.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

A wide variety of debris is commonly observed off the Atlantic coast of the United States. Marine debris comes from a variety of land-based and ocean sources (Laist *et al*., 1999). In addition to trash that finds its way into the marine environment, discarded or lost fishing gear is also an issue of concern for accumulating item on the ocean floor. Civilian and commercial recreational activities (e.g., recreational/commercial fishing, and cruise ship operations) contribute to these potential impacts to bathymetry and sediments in the OPAREA by adding foreign materials to the environment that eventually accumulate on the ocean bottom. These foreign materials may not have even entered the environment in the VACAPES OPAREA since ocean currents have the ability to move materials for great distances.

In the marine environment, the analysis of all current and proposed operations indicates any expending of military materials at sea, over a long period of time, can cause potential incremental impacts to sediment quality. However, the at-sea Study Area is vast and chemical releases from decaying debris would rapidly dilute in the water; thus, accumulation of chemicals in sediments is not likely to occur. Therefore, it is expected that although there would be a potential for minor incremental, but recoverable, cumulative impacts, these impacts would not be considered significant as they would be localized and temporary.

The accumulation of materials settling on the ocean bottom would be covered by sediment deposition over time. With regard to the direct, indirect, and cumulative impacts of the proposed action, impacts are expected to be temporary in the marine environment. Most of the materials would be harmless, but some would consist of metals such as lead. However none of the materials accumulating at these densities would measurably affect sediment quality. Thus, the concentration of training military expended materials in U.S. territory would have no significant impact on bottom topography and sediment quality.

The analysis of all current and proposed operations indicates any debris at sea, over a long period of time, can cause potential incremental impacts to sediment quality. However, the Study Area where the proposed action for the Alternatives previously described in this chapter are proposed to occur is vast and chemical releases would rapidly dilute in the water; thus, accumulation of chemicals in sediments is not likely to occur. Therefore, it is expected that although there would be a potential for minor incremental, but recoverable, adverse cumulative impacts, these impacts would not be considered significant as they would be localized and temporary. No significant cumulative impacts to sediments from expended materials in territorial waters are anticipated from the No Action Alternative, Alternative 1, or Alternative 2. No significant cumulative harm to bathymetry and sediments in non-territorial waters is expected as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.3 Hazardous Materials/Hazardous Waste

This section covered hazardous materials which include petroleum products, missiles, munitions, and targets. However, military munitions (virtually all missiles, munitions, and targets) are not considered hazardous waste when used for their intended purpose, which includes training of military personnel and research and development activities. This includes virtually all missiles, munitions, and targets used at the VACAPES Study Area.

Non-hazardous expended material were also discussed under this resource area and are defined as parts of a device that are made of non-reactive materials, including parts made of steel or aluminum, polymers (*e.g.,* nylon, rubber, vinyl, and various other plastics), glass fiber, and concrete. While these items represent accumulate on the seafloor, their strong resistance to degradation and their chemical composition mean that they do not chemically contaminate the surrounding environment by leaching heavy metals or organic compounds.

Military expended materials (MEM) are all the materials that the Navy uses in training and testing that are not recovered at or before the end of an event. These materials include non-explosive practice munitions, remains of high explosives, training targets, chaff, remains of flares, and other material sometimes referred to as debris.

Hazardous material, waste, and MEM used and generated during the VACAPES Study Area operations would be managed in accordance with applicable federal and state regulations, and DoD service guidelines. Any spills or mishaps would be handled pursuant to all applicable federal and state laws, and DoD regulations.

6.4.3.1 VACAPES EIS/OEIS Conclusions

In the marine environment, MEM that sinks to the sea floor would gradually degrade, be overgrown by marine life, and/or be incorporated into the sediments. Military munitions are not considered hazardous waste when used for their intended purpose, which includes training of military personnel and research and development activities. Floating non-hazardous expended material may be lost from target boats and would either degrade over time or wash ashore as flotsam. The combustion products from the detonation of high explosives are commonly found in sea water. Initial concentrations of explosion by-products are not expected to be hazardous to marine life and would not accumulate in the area training because exercises are spread out over time and the chemicals would rapidly disperse in the ocean. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be less than significant impacts in territorial waters due to hazardous material. In addition, there would be less than significant harm in non-territorial waters due to hazardous material for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.3.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Expended material would introduce small amounts of potentially hazardous chemicals into the marine environment. The water quality analysis of all current and proposed operations indicates that concentrations of constituents of concern associated with material expended in the VACAPES Range Complex are well below water quality criteria established to protect aquatic life (see Section 3.3, Water Resources). The combustion products from the detonation of high explosives are commonly found in sea water Carbon Monoxide (CO), carbon dioxide (CO_2), hydrogen (H_2), water (H_2O), and ammonia (NH_3). The primary contaminants that would be released from explosives used in mine warfare training are nitro aromatic compounds such as TNT, cyclonite (Royal Demolition Explosive or RDX), and octogen (High Melting Explosive or HMS) (URS *et al.,* 2000). Initial concentrations of explosion by-products are not expected to be hazardous to marine life (DoN, 2001) and would not accumulate in the training area because exercises are spread out over time and the chemicals would rapidly disperse in the ocean. Therefore, no adverse impacts from chemical by-products would be expected.

The analysis of all current and proposed operations indicates any expending of military materials at sea, over a long period of time, can cause potential incremental impacts to sediment and water quality. However, the Study Area where the proposed action and actions previously described in this chapter are occurring is vast and chemical releases would rapidly dilute in the water; thus, accumulation of chemicals in sediments and water is not likely to occur. Therefore, it is expected that although there would be a potential for minor incremental, but recoverable, adverse cumulative impacts, these impacts would not be considered significant as they would be localized and temporary. No significant cumulative impacts to sediments or water quality from expended materials are anticipated from the No Action Alternative, Alternative 1, or Alternative 2. No significant cumulative harm to water quality from expended materials in non-territorial waters is expected as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.4 Water Resources

Water quality in the marine environment is affected by Gulf Stream currents, temperature and salinity, sediment transport and deposition, and water and air pollutants from inland streams and emission sources. Water quality was evaluated with respect to the possible release of hazardous constituents from the aircraft, vessels, and munitions used in the VACAPES Study Area.

6.4.4.1 VACAPES EIS/OEIS Conclusions

The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in releases of hazardous constituents in violation of state or federal water quality standards; therefore, unavoidable significant adverse effects to water resources would not occur. The analysis of environmental stressors and alternatives indicated no significant impact to water resources in U.S. territorial waters; likewise, no significant harm in non-territorial waters would be expected. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there will be no significant impact to water quality in territorial waters. In addition, there will be no significant harm to water quality in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.4.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Other federal and state actions such as dredging operations for channel maintenance, oil and gas leases, other Department of Defense activities, increases the potential for fuel spills and other contaminants that may contribute to potential impacts water resources. Commercial activities like fishing and cruise ships also have the capacity to impact water resources with fuel spills and leaving debris at sea (trash and lost fishing gear).

It is expected that although there would be a potential for minor incremental, but recoverable, adverse cumulative impacts by Navy actions, these impacts would not be considered significant as they would be localized, temporary, and quickly dispersed. The analysis of environmental stressors and alternatives indicated no significant impacts to water resources in U.S. territorial waters; likewise, no significant harm in non-territorial waters would be expected. As such, any incremental contribution of Navy training to existing stressors would be nominal.

Effects to water quality from past, present, and reasonably foreseeable future activities would most likely occur from the degradation of expended materials and increased turbidity due to localized disturbances of ocean bottom sediments caused by construction, dredging, and oil and gas industry activities. However, these effects would most likely be minor and temporary and would not have a significant impact on marine water quality. Moreover, water quality conditions would most likely return to normal after project completion. Therefore, when combined with construction, dredging, and oil and gas industry actions, alternative energy development (MMS, 2007b), activities under the No Action Alternative, Alternative 1, Alternative 2, or Alternative 3 are not expected to significantly impact marine water quality. Cumulative impacts in territorial waters would be minor, but recoverable and would not be significant. No significant cumulative harm to water resources in non-territorial waters is expected as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.5 Air Quality

The air quality of the VACAPES Study Area is generally very good. The analysis considered emission sources associated with warfare areas, distances to shore from where exercises take place, and the percentage of training events that take place below 3,000 feet. Most air emissions associated with range complex operations occur more than 3 nm offshore. Depending on factors such as wind direction, emissions in these offshore areas have the potential to mix with air above adjoining cities and counties in Delaware, Maryland, Virginia, and North Carolina.

Other areas assessed for air quality impacts included a small, restricted airspace (R-6606) near Naval Air Station Oceana Dam Neck Annex and an area at the mouth of the Chesapeake Bay north of Naval Amphibious Base (NAB) Little Creek and Naval Station Norfolk. Sussex County, Delaware has been designated "nonattainment," at a level of "moderate nonattainment" for the 8-hour ozone standard.

6.4.5.1 VACAPES EIS/OEIS Conclusions

Emissions associated with implementation of Alternatives 1 and 2 would result in increases in air emissions above baseline (No Action Alternative) conditions. Within U.S. territory, emission increases are mainly associated with increased MH-60S operations, small boat, and range support craft motor emissions. Outside U.S. territory, emission increases are mainly associated with increased surface vessel operations and additional contributions from fixed-wing aircraft operations. In conclusion, although Alternatives 1 and 2 would result in increases in emissions of air pollutants, all air impacts would be less than significant in scope and intensity for the following reasons:

- All training and testing events analyzed in this VACAPES EIS/OEIS within or adjacent to Maryland and North Carolina, occurs within areas designated by the USEPA as in attainment for all criteria pollutants. Therefore, the General Conformity Rule does not apply.
- All training and testing events analyzed in this VACAPES EIS/OEIS within or adjacent to Delaware occur within areas designated by the USEPA as nonattainment areas for 8-hour ozone. However, since test track flights occur above 6,000 feet, aircraft emissions would not affect pollutant concentrations at ground level. [Bob, I DoN't believe the previous sentence is necessary since it refers to the Atlantic Test Range of NAS Pax River. Need to discuss] A Record of Non-Applicability (RONA) is included with this EIS/OEIS (see Appendix L).
- Helicopter training emissions within or adjacent to the Hampton Roads Air Quality Control Region are below *de minimis* levels and a RONA has been prepared and included with this EIS/OEIS in Appendix L. These MH-60S emissions associated with the Homebasing of the aircraft at Naval Station Norfolk were evaluated in an Environmental Assessment (DoN, 2002) and determined to be below *de minimis* levels.
- The majority of training event types and the majority of training event operations/sorties occur more than 12 nm from the shore, and would not affect the air quality for human receptors. Furthermore, the majority of aircraft training emissions occur above 3,000 feet (above the atmospheric inversion layer), and would be without impact on the local air quality.
- F/A-18 E/F emissions associated with the Homebasing of the aircraft at Naval Air Station Oceana were evaluated in a Final Environmental Impact Statement (DoN, 2003) and determined to be below *de minimis* levels.

Therefore, there would be no significant impact to air quality from implementing the No Action Alternative, Alternative 1, or Alternative 2. Furthermore, there would be no significant harm to the air quality over non-territorial waters from implementing the No Action Alternative, Alternative 1, or Alternative 2.

6.4.5.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Past, present, and planned projects in the VACAPES Range Complex include various construction projects occurring onshore. Periodically, sand replenishment projects approved by the Minerals Management Service and the U.S. Army Corps of Engineers occur along the beaches of the VACAPES Study Area. Offshore barges involved in the projects produce minor emissions, as do onshore sand-moving bulldozers. Alternative energy development (MMS, 2007b), construction activities or sand replenishment projects would be temporary and would not, in combination with air emissions associated with the VACAPES Range Complex operations, be anticipated to cause a significant cumulative impact. Past, present, and planned projects also include short-term testing of weapons systems which would also be temporary.

Additional past, present, and planned projects include training exercises based at onshore military installations. The addition of riverine squadrons at the newly formed Navy Expeditionary Combat Command, Navy Amphibious Base Little Creek, VA will contribute to these air emissions. Air emissions within the VACAPES Study Area also emanate from RDT&E operations at NAS Patuxent River; aircraft and rockets launched from Wallops Flight Facility; U.S. Air Force F-15 and F-22 aircraft from Langley Air Force Base training within W-386, W-72, and W-110; and F/A-18E/F Super Hornets training at Navy Dare County Bombing Range, NC. These training exercises have been required to demonstrate conformity with applicable SIP (unless conducted within an attainment area), which involves a demonstration that the emissions would not result in a cumulatively significant impact for nonattainment criteria pollutants. Given the vast area across which these emissions occur and the relative sparse emission sources, no significant cumulative impacts to air quality would occur as a result of these activities with the additional training activities proposed from either, the No Action Alternative, Alternative 1, or Alternative 2. No significant cumulative harm to air quality in non-territorial waters is expected as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.6 Airborne Noise

Increases in operational activity in the VACAPES Study Area will increase airborne noise levels. However, because Navy training and testing takes place in remote and cleared areas, airborne noise levels will primarily affect military personnel operating the equipment/weapon systems producing the noise. Military personnel wear personal protective equipment and are not considered sensitive receptors as such term is used in this EIS/OEIS analysis. Underwater noise impacts to aquatic life are addressed in Sections 3.6 (Marine Communities), 3.7 (Marine Mammals), 3.8 (Sea Turtles), 3.9 (Fish), and 3.10 (Seabirds and Migratory Birds). There are not expected to be any unavoidable significant environmental effects associated with proposed action-generated noise.

6.4.6.1 VACAPES EIS/OEIS Conclusions

Airborne noise levels generated by the proposed action under the No-Action Alternative and Alternatives 1 and 2 would be less than significant because:

- Noise from training activities in the VACAPES OPAREA would be dispersed and intermittent, which would not contribute substantially to long-term noise levels, and few or no sensitive receptors (non-participants) would be exposed to these noise events;
- Noise would be generated in training areas that have been in similar use for more than 50 years - no new public areas would be exposed to noise from training and testing activities;
- The incremental increases in the numbers of range events would not substantially increase long term average noise levels; hourly average equivalent noise levels are and would remain relatively low; and

- Increased helicopter operations at Naval Station Norfolk were evaluated in the MH-60R/S Siting Study Environmental Assessment and determined to be less than significant.

6.4.6.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Airborne noise impacts may be cumulative in the sense that the average ambient noise of an area could increase from several independent actions and the increased number of noise events of a particular kind (e.g., an explosion) from unrelated actions could result in an increased sensitivity of human receptors and therefore an increase in the number of complaints. Alternative energy development in the form of wind farms, oil and gas production and harnessing wave energy could all contribute to the anthropogenic noise environment (MMS, 2007b). Commercial and recreational fishing and vessels, commercial shipping vessels, vessels associated with dredging operations contribute to the total anthropogenic airborne noise environment in the VACAPES Study Area. Aircraft, rockets, and other test vehicles from NAS Patuxent River, NASA Wallops Flight Facility, NAS Oceana, and Langley Air Force Base also contribute to the overall noise environment. Commercial aircraft departing and arriving at airports adjacent to the VACAPES Study Area can also contribute to the overall Study Area airborne noise levels.

However, as stated previously, due to the vast size of the Study Area and the flight altitudes at which many of the Navy training and testing operations take place, the average ambient airborne noise contributed by these current and proposed Navy events are negligible. Furthermore, the analysis of all current and proposed operations indicates Alternatives 1 and 2 would produce noise similar to ongoing activities within the VACAPES Range Complex plus noise that is unique, particularly along some land-water interfaces.

Current Standard Operating Procedures for the proposed action involving aircraft noise and live bombs would minimize potential direct and indirect impacts so there would be no adverse impacts. No significant cumulative impacts to airborne noise quality would occur as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2. No significant cumulative harm to airborne noise quality in non-territorial waters is expected as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.7 Marine Communities

This section of the EIS/OEIS addresses plankton and macroalgae, benthic communities, and artificial habitats within the VACAPES Study Area. Plankton include phytoplankton (plant-like/algae), zooplankton (animals), ichthyoplankton (fish eggs and larvae, a form of zooplankton), and bacterioplankton (bacteria). Benthic communities analyzed include live/hard bottom communities, corals and coral reefs, and soft bottom communities. There are 41 offshore artificial reefs within the VACAPES OPAREA, found primarily nearshore on the inner continental shelf The VACAPES OPAREA also contains numerous shipwrecks, most of which are more widely dispersed on the continental shelf than the artificial reefs. The concentration of shipwrecks off the North Carolina coast near Cape Hatteras and the Outer Banks gives evidence to why this area is called "the graveyard of the Atlantic."

6.4.7.1 VACAPES EIS/OEIS Conclusions

Short-term and localized disturbances to the water column and soft bottom communities may occur. Localized mortality to plankton and benthic organisms may occur. No long-term population or community-level effects are expected. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there will be no significant impact to marine communities in territorial waters. In addition, there will be no significant harm to marine communities in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.7.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Past, present, planned, and reasonably foreseeable actions which would most likely have the greatest effect on marine communities are dredging, beach nourishment, and commercial fishing. Other activities described earlier in Chapter 6 within the VACAPES Study Area contributing to effects on marine communities include commercial transportation, dredging, coastal development, oil/gas exploration and development, sand and mineral mining, cooling water intake and discharge, wastewater discharge, mariculture, and recreational fishing. Additional potential threats to marine communities include degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, disease, natural events, and global climate change (SAFMC, 2007; Field *et al.*, 2001). Although the analysis of alternatives indicated no significant impacts in U.S. territorial waters and no significant harm in non-territorial waters are expected to marine communities, there would be a potential for minor incremental, but recoverable, adverse cumulative impacts when these impacts are consider with other projects and actions in the area. However, because Navy training activities would be relatively isolated due to the large expanses of area between activity locations, these impacts would not be considered significant because they are localized and temporary.

6.4.8 Marine Mammals

Endangered Species Act

The Navy has consulted with NMFS under Section 7 of the ESA regarding its determination of effect for federally listed marine mammals and critical habitat. Table 3.7-21 provides a summary of the Navy's determination of effect for federally listed marine mammals that potentially occur in the VACAPES Study Area. The Study Area does not contain designated critical habitat for any listed species. Consequently, the proposed action would have no effect on critical habitat.

Marine Mammal Protection Act

The analysis presented in Chapter 3 indicates that several species of marine mammals could be exposed to impacts associated with underwater detonations and explosive ordnance use under the No Action Alternative, Alternative 1, or Alternative 2 (Preferred Alternative) that could result in Level A or Level B harassment as defined by MMPA provisions that are applicable to the Navy. Exposure estimates are provided in Tables 3.7-14, 3.7-15, and Tables 3.7-17 through 3.7-20. Other stressors associated with the No Action Alternative, Alternative 1, or Alternative 2 are not expected to result in Level A or Level B harassment. Accordingly, the Navy is working with NMFS through the MMPA permitting process to ensure compliance with the MMPA.

6.4.8.1 VACAPES EIS/OEIS Conclusions

The analysis of potential effects on marine mammals included modeling of explosions, acoustic effects analysis, disturbance analysis associated with vessel movements, analysis of vessel strikes on marine mammals, analysis of disturbance associated with aircraft overflights, and analyses of other training activities conducted in the VACAPES EIS/OEIS Study Area. The AFAST EIS/OEIS also analyzed the effects to marine mammals due to exposure to small explosives during deployment of the AN/SSQ-110A IEER sonobuoy. The AFAST EIS/OEIS used the same small explosives criteria (for single explosions) presented in Section 3.7.3.2 of this EIS/OEIS.

To estimate the number of exposures of marine mammals to sound that would result in regulatory levels of harassment, sonar activities were acoustically modeled for the VACAPES Study Area. By analyzing both the acoustic propagation of each source and the estimates of marine mammal presence, annual marine mammal exposures were calculated (Table 6.4-1). When interpreting the modeling results, it is important to recognize the limitations of the model. The model does not reflect implementation of protective measures (such as reducing power levels or ceasing sonar use in the presence of marine mammals) and it assumes the acoustic footprint extends to the seafloor regardless of the operating environment (in reality the zone of influence for physiological effects is shaped like a bubble in deeper waters). Sonar power reduction would reduce the likelihood of hearing impairment due to close aboard exposure, but some animals could be missed or could surface within the safety zone. Others could receive multiple pings that cause TTS due to added energy of multiple exposures over a short time period.

In addition, the exposure estimates rely on the best available information from marine mammal surveys. Marine species density models rely on limited survey data, and for some species data are insufficient to estimate densities (blue whale, white-beaked dolphin, hooded seal, and harp seal throughout the AFAST Study Area; harbor porpoise, gray seal, harbor seal, sei whale in the VACAPES OPAREA).

Due to the above reasons, quantitative exposure estimates should be used in conjunction with a qualitative analysis to assess potential impacts.

TABLE 6.4-1
ESTIMATED ANNUAL TAKES OF MARINE MAMMALS UNDER THE AFAST SELECTED ALTERNATIVE

Species	Mortality	PTS	TTS	Risk-Function (Behavioral)
Atlantic spotted dolphin	0	10	1287	97900
Atlantic white-sided dolphin				
Bottlenose dolphin	0	3	405	32657
Clymene dolphin	0	0	51	4299
Common dolphin	0	4	850	47499
False killer whale				
Fraser's dolphin				
Killer whale				
Kogia spp.	0	0	5	408
Melon-headed whale				
Pantropical spotted dolphin	0	1	108	8998
Pilot whales***	0	1	159	13220
Pygmy killer whale				
Risso’s dolphin	0	1	92	7276
Rough-toothed dolphin	0	0	2	194
Short-finned pilot whale****				
Sperm whale**	0	0*	36	3087
Spinner dolphin				

TABLE 6.4-1
ESTIMATED ANNUAL TAKES OF MARINE MAMMALS UNDER THE AFAST SELECTED ALTERNATIVE (Continued)

Species	Mortality	PTS	TTS	Risk-Function (Behavioral)
Striped dolphin	0	8	839	75409
White beaked dolphin				
Beaked whale	0	0	8	771
Harbor porpoise				
Bryde's whale				
Fin whale**	0	0	1	68
Humpback whale**	0	0	4	403
Minke whale	0	0	0	21
North Atlantic right whale**	0	0	1	45
Sei whale**				
Gray Seal				
Harbor Seal				

* Indicates an exposure greater than or equal to 0.05, therefore, is considered a "may affect" for ESA-listed species.
** Denotes species listed in accordance with the Endangered Species Act
*** Pilot whales include both short- and long-finned pilot whales along the East Coast

Potential acoustic effects to individual marine mammal species, including those for which density data are not available to quantify potential exposures, are discussed in sections 4.4.10.3 (ESA-listed species) and 4.4.10.4 (non-ESA-listed species) of the AFAST FEIS/OEIS. Most exposures would cause short-term recoverable behavioral effects, and protective measures, such as sonar power reduction and shutdown as an animal approaches a vessel, would reduce the likelihood of physiological effects.

The quantified physiological and behavioral effects above account solely for exposures to levels of sound associated with the effects thresholds discussed previously. Other potential acoustic effects are also discussed in the AFAST EIS/OEIS. Currently, evidence of acoustically mediated bubble growth and decompression sickness is limited and inconclusive; therefore, these phenomena are discussed but not considered as potential effects. Investigations of air cavity resonance predict it would occur at frequencies lower than those analyzed in the AFAST EIS/OEIS. The potential for masking, in which sounds interfere with an animal's ability to hear other sounds, exists; however, due to the intermittent use and narrow-frequency band of sonars, masking effects are considered negligible. The reader should refer to Section 4.4.10.2.4 of the AFAST EIS/OEIS for a discussion of what is known about the possibility of these phenomena.

Proposed actions may result in temporary changes to the water column and potential long-term or permanent alterations to the benthic habitat. This area designated as critical habitat for the North Atlantic right whale serves as the only known calving ground for the species (NMFS, 1994; NMFS, 2002; NMFS, 2005). Although the water column may be disrupted on a very short-term basis, it is unlikely that reproductive behaviors of the North Atlantic right whale would be altered. Impacts to the sea floor may be longer term in nature; however, they are unlikely to affect the function of the right whale calving ground critical habitat. Therefore, the proposed actions may alter North Atlantic critical habitat, but is not likely to destroy or adversely modify critical habitat.

The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in significant impacts to marine mammals in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected. The proposed action may affect listed species, but it is not anticipated to displace animals. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be no significant impact to marine mammals in territorial waters. In addition, there will be no significant harm to marine mammals in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.8.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The combination of potential impacts resulting from the proposed action in addition to prior and future Navy activities, oil/gas exploration and development activities, dredge-and-fill operations, water quality degradation, pollution (chemicals, marine debris, noise), recreational and commercial fishing, vessel traffic, as well as whale-watching, may affect the blue, fin, humpback, North Atlantic right, sei and sperm whales found in the proposed Study Area. Activities considered have the potential to harm marine mammals and their habitats. Chronic sublethal impacts (e.g., stress) resulting in persistent physiological or behavioral changes and/or avoidance of impacted areas could cause declines in survival or productivity, resulting in either acute or gradual population declines (e.g., Fair and Becker, 2000).

The major impact-producing factors of oil/gas exploration, alternative energy development (MMS, 2007b), and other development activities include degradation of water quality resulting from operational discharges; noise from helicopter and vessel traffic, operating platforms, and drillships; explosive platform removals; seismic surveys; oil spills; oil spill response activities; and discarded debris (MMS, 2007b).

A wide variety of debris is commonly observed off the Atlantic coast of the United States. Marine debris comes from a variety of land-based and ocean sources (Laist *et al*., 1999). Both entanglement in and ingestion of debris has caused the death or serious injury of large whales (Laist, 1997; Laist *et al*., 1999). Because of their buoyancy and persistence, plastic items contribute disproportionately to the overall impacts of marine debris (Laist *et al*., 1999). In addition to trash that finds its way into the marine environment, discarded or lost fishing gear is also a concern for marine mammals (Laist, 1997; Spellman, 1999).

The fishing industry has a profound effect on marine mammals. Commercial fisheries may accidentally entangle and drown or injure cetaceans during fishing operations by lost and discarded fishing gear, or compete with cetaceans for the same fishery resources (Northridge and Hofman, 1999). Entanglement in fishing gear accounts for a significant portion of baleen whale mortality in U.S. waters (NMFS, 2008a). Entanglement in fixed fishing gear, in particular in sink gillnets and a variety of pot and trap fisheries, is one of the most important factors depressing the growth rate of the North Atlantic right whale population (Katona and Kraus, 1999; Kenney, 2002; Johnson *et al.,* 2007). Humpback whales, perhaps because of their abundance in coastal waters where nets are commonly used or because of the many barnacles they carry, seem to be extremely vulnerable to entanglement in fishing gear (Lien, 2002). Trites *et al*. (1997) suggested that fisheries might indirectly compete with cetaceans by reducing the amount of primary production accessible to cetaceans, thereby negatively affecting their numbers. NMFS changes to the Atlantic Large Whale Take Reduction Plan may have a positive impact on Atlantic large whales (NMFS, 2008a).

Insufficient information is available to determine how, or at what levels and in what combinations, environmental contaminants may affect cetaceans (MMC, 2002; 2003). There is growing evidence that high contaminant burdens are associated with several physiological abnormalities, including skeletal deformations, developmental impacts, reproductive and immunological disorders, and hormonal alterations (Reijnders and Aguilar, 2002). It is possible that anthropogenic chemical contaminants initially cause immunosuppression, rendering whales susceptible to opportunistic bacterial, viral, and parasitic infection (De Swart *et al*., 1995).

Several mortality events (die-offs) have been reported for cetaceans in the western North Atlantic. Biotoxins, viruses, bacteria, or El Niño events have been implicated (Geraci *et al.*, 1989; Domingo *et al.,* 2002; MMC, 2004; Hohn *et al*., 2006).

Habitat loss and degradation is now acknowledged to be a significant threat to marine mammal populations (Kemp, 1996). The impact of coastal development on whales has not been thoroughly investigated. Habitat alteration has the potential to disrupt the social behavior, food supply, and health of whales. Such activities may stress the animals and cause them to avoid traditional feeding and breeding areas or migratory routes. The most serious threat to cetacean populations from habitat destruction may ultimately prove to be its impact on the lower trophic levels in their food chains (Kemp, 1996).

Migrating baleen whales may be affected by whale-watching activities on the East Coast, as well as in the Caribbean (Katona and Kraus, 1999; Hoyt and Hvenegaard, 2002). Impacts of whale watching on cetaceans may be measured in a short time-scale (i.e., startle reaction) or as a long-term effect on reproduction or survivability (IFAW, 1995). There is little evidence to show that short-term impacts have any relation to possible long-term impacts on cetacean individuals, groups, or populations (IFAW, 1995). Whale watching could have an effect on whales by distracting them, displacing them from rich food patches, or be dispersing food patches with wake or propeller wash (Katona and Kraus, 1999).

Climatic fluctuations have produced a growing concern about the impacts of climate change on marine mammal populations (Learmonth *et al.*, 2006). Responses of marine mammals to climate change are difficult to interpret due to the confounding impacts of natural responses and human influences. Additionally, the time scale on which marine mammals respond to direct or indirect impacts of climate change may be diluted or muted. Large-scale climatic events may affect the distribution and abundance of marine mammal species, either directly or indirectly, through alterations of habitat characteristics and distribution (Harwood, 2001; Forcada *et al*., 2005; Keiper *et al.*, 2005; MacLeod *et al*., 2005; Shelden *et al*., 2005; Simmonds and Isaac, 2007).

In the North Atlantic region, climate variability has been directly linked to the North Atlantic Oscillation (NAO), which influences the abundance of marine mammal prey such as zooplankton and fish. In years when the NAO Index was positive, the average SST increased and was followed by increases in copepod (*Calanus finmarchicus*) abundance which is the principal prey of North Atlantic right whales (Conversi *et al*., 2001). In the 1970s and 1980s, NAO conditions were generally positive; they were favorable to *Calanus* abundance and, in principal, to North Atlantic right whale calving rates. However, this cannot be verified because the North Atlantic right whale data series does not begin until 1982 (Greene *et al*., 2003). In the late 1980s and 1990s, the NAO Index was mainly positive but exhibited two substantial, multi-year reversals to negative values. This was followed by two major, multi-year declines in copepod prey abundance (Pershing *et al.,* 2001; Drinkwater *et al*., 2003). Subsequently, the North Atlantic right whale calving rate declined for two periods, mirroring the copepod trend with a time lag (Greene *et al*., 2003). Although the NAO Index has been essentially positive for the past 25 years, models indicate that greenhouse warming and the subsequent rise in ocean temperature may lead to increased climatic variability and more severe fluctuations in the NAO Index. Such fluctuations would be expected to cause dramatic shifts in the reproductive rate of critically endangered North Atlantic right whales (Drinkwater *et* *al.,* 2003; Greene *et al.,* 2003) and possibly a northward shift in the location of right whale calving grounds (Kenney, 2007).

Ocean acidification may occur from an increase of CO_2 dissolved in ocean water that creates carbonic acid. The CO_2 emissions are the result of human activity and have resulted in the ocean pH dropping from 8.16 to 8.05 since the late 1980s (ScienceDaily, 2009). Ocean acidification potentially could result in the ability of sound in the water to travel greater distances, thereby increasing the amount of energy to which marine mammals and sea turtles may be exposed. The Navy's quantitative analysis of acoustic sources affecting marine mammals and sea turtles is based on the best available science; *e,g*, for sonar, modeling involved analysis in areas based on potential activities and transmission loss (DoN, 2009). In response to a petition from the Center for Biological Diversity, EPA stated on January 16, 2009, that it will initiate an evaluation of ocean acidification impacts, to determine whether the current water-quality criterion for pH should be modified to address ocean acidification.

Military operations other than those described in the proposed action may contribute to the impacts on marine mammals in the VACAPES Study Area. Airborne noise from aircraft operations based at NAS Patuxent River (DoN, 1999) operating primarily in W-386 and NAS Oceana transiting to and from Navy Dare County Bombing Range, NC (DoN, 2003; 2008f), contribute to the anthropogenic noise environment. Small boats proposed to be homebased at Navy Amphibious Base Little Creek would also contribute to the cumulative impacts with their vessel movements and engine noise.

It is possible that harassment in any form may cause a stress response (Fair and Becker, 2000). Cetaceans can exhibit similar stress symptoms as found in terrestrial mammals (Curry, 1999). It is important to recognize that disturbance from ship traffic, ships, aircraft, and drilling rigs and/or exposure to sub lethal levels of biotoxins and anthropogenic contaminants may stress animals, weakening their immune systems, making them more vulnerable to parasites and diseases. Chronic stress may cause damage to the heart muscle and vasculature (Curry, 1999). Stressed animals may also fail to reproduce at normal rates or have been found with significantly high fetotoxicity and malformations in the young, as evidenced in some small laboratory mammals. Marine mammals may stay in an area despite disturbance (such as noise) if no alternative areas meet the requirements of the animals.

With respect to the cumulative effects from the Navy's use of active mid and high frequency sonar, the acoustic analysis from the AFAST EIS/OEIS is incorporated here to provide a basis for analyzing the cumulative effects from active sonar use. The data used in this analysis includes the effects associated with active sonar use throughout the entire AFAST Study Area (Figure 1.1-2), (not just those inside the VACAPES Study Area as discussed in section 3.19 of this document).

In the AFAST FEIS/OEIS, an acoustic analysis was performed in order to estimate the effects associated with active sonar use. Chapter 4 of the AFAST EIS/OEIS discusses the methodology used to measure these effects in detail. The results of acoustic analysis indicate that 16,521 exposures to ESA-listed marine mammals may be exposed to levels of sound likely to result in Level B harassment under the AFAST Selected Alternative. It also indicates that one exposure to an ESA-listed marine mammal may be exposed to levels of sound likely to result in Level A harassment under the AFAST Selected Alternative. The exposure estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. In the AFAST FEIS/OEIS, the Navy finds that ESA-listed species may experience a cumulative impact from AFAST activities; however, they are not expected to adversely affect the populations of ESA-listed species. As part of the environmental documentation for the AFAST FEIS/OEIS, the Navy has completed consultation with NMFS in accordance with Section 7 of the ESA. See the AFAST website (http://afasteis.gcsaic.com) for additional information on the Biological Opinion.

The AFAST FEIS/OEIS acoustic analysis indicates that 1,911,195 exposures to marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment under the AFAST Selected Alternative. This acoustic analysis also indicates that 126 exposures to marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment under the AFAST Selected Alternative. The exposure estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. The Navy has determined that AFAST activities will have a negligible impact on marine mammal species or stock. The Navy has completed consultation with NMFS in accordance with the MMPA for concurrence. See the AFAST website (http://afasteis.gcsaic.com) for additional information on the Letter of Authorization.

With regard to cumulative impacts of the proposed action, impacts are expected to be limited to temporary behavioral impacts. Mitigation measures (discussed in Chapter 5) would be implemented during the proposed exercises to minimize any potential adverse impacts to marine mammals and to avoid any significant or long-term adverse impacts to threatened and endangered species. The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in significant cumulative impacts to marine mammals in U.S. territorial waters; likewise no significant cumulative harm in non-territorial waters would be expected.

6.4.9 Sea Turtles

The ESA established protection over and conservation of threatened and endangered species. All five species of sea turtles that potentially occur in the Study Area are listed as threatened or endangered. The ESA requirements are discussed in Section 3.8.1.1. The Navy has initiated the ESA Section 7 consultation process with NMFS. Critical habitat for listed species has not been designated under the ESA in the Study Area.

6.4.9.1 VACAPES EIS/OEIS Conclusions

The analysis of potential effects on sea turtles included modeling of explosions, acoustic effects analysis, disturbance analysis associated with vessel movements, analysis of vessel strikes on sea turtles, analysis of disturbance associated with aircraft overflights, and analyses of other training activities conducted in the VACAPES Study Area. The AFAST EIS/OEIS evaluated potential direct and indirect effects to sea turtles as a result of exposure to in-water sound and non-acoustic interactions during sonar activities in Section 4.5.

Assessing whether a sound may disturb or injure a sea turtle involves understanding the characteristics of the acoustic sources, the presence of sea turtles in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those animals. Little is known about the role of sound and hearing in sea turtles; however, their greatest sensitivity appears to be at frequencies below the frequencies used by sonar systems during Atlantic fleet sonar activities. Use of these systems, therefore, is not expected to acoustically affect sea turtles. Sea turtles are, however, expected to be physiologically or behaviorally affected by use of explosive source sonobuoys. Effects to sea turtles were analyzed in the AFAST EIS/OEIS using the same methods and criteria presented for small explosive impacts (single explosions) to sea turtles in the VACAPES EIS/OEIS (Section 3.8).

Table 6.4-2 shows that no acoustic exposures resulting in a physiological effect are anticipated in the VACAPES Study Area. In the case of single explosions, behavioral effects are expected to be limited to short-term startle effects.

TABLE 6.4-2
ESTIMATED SEA TURTLE ACOUSTIC EXPOSURES FROM EXPLOSIVE SOURCE SONOBUOYS

Species	Mortality	PTS	TTS
Loggerhead sea turtle	0	0*	1
Kemp's ridley sea turtle[1]	0	0	0
Leatherback sea turtle	0	0	0*
Hardshell sea turtles[2]	0	0*	0*

** Indicates an exposure greater than or equal to 0.05, therefore is considered a "may affect" for ESA listed species*
1. This category does not include Kemp's ridley sea turtles in the Gulf of Mexico. They are included in the hardshell sea turtle class. 2. This category includes green, hawksbill, and unidentified hardshell species for all regions. It also includes Kemp's ridley sea turtles in the Gulf of Mexico, and may include extralimital occurrences of olive ridley turtles along the Atlantic coast.

The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in significant impacts to sea turtles in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected. The proposed action may affect listed species, but it is not anticipated to displace animals. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be no significant impact to sea turtles in territorial waters. In addition, there will be no significant harm to sea turtles in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2..

6.4.9.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The combination of potential impacts resulting from the proposed action in addition to prior and future Navy activities, oil/gas exploration and development activities, dredge-and-fill operations, water quality degradation, natural catastrophes, pollution (chemicals, marine debris, noise), recreational and commercial fishing, vessel traffic, beach nourishment, beach lighting, power plant entrainment, and human consumption, affect the loggerhead, Kemp's ridley, hawksbill, green, leatherback, and turtles that might be found in the proposed Study Area. Activities considered under this analysis have the potential to harm sea turtles and their nesting and foraging habitats. Chronic sublethal impacts (e.g., stress) resulting in persistent physiological or behavioral changes and/or avoidance of impacted areas could cause declines in survival or productivity, resulting in either acute or gradual population declines (Milton and Lutz, 2003).

Sea turtles face harm from human activities throughout their migratory ranges, both in their foraging habitats and on their nesting beaches. Sea turtles are particularly vulnerable because of their wide ranging movements in coastal waters (NRC, 1990). Demographic analyses suggest that a reduction of human-induced mortality in juvenile, subadult, or adult life stages will have a significantly greater effect on population growth than reduction of human-induced mortality of eggs and hatchlings (NRC, 1990).

Incidental catch in fisheries is widely recognized as a major mortality factor for sea turtles. A major source of mortality for loggerhead and Kemp's ridley turtles is incidental capture and drowning in shrimp trawls (Henwood and Stuntz, 1987; Frazier *et al*., 2007). Other fisheries and fishery-related activities are also important sources of mortality (Witzell, 1992), but collectively only one-tenth as important as shrimp trawling (NRC, 1990).

Man-made debris (from offshore and coastal sources) has become an increasing concern (Laist, 1997). Both entanglement in and ingestion of debris has caused the death or serious injury of sea turtles (Lutcavage *et al*. 1997; Laist *et al*. 1999). Because of their buoyancy and persistence, plastic items contribute disproportionately to the overall impacts of marine debris. Most of the debris that either entangles animals or is found in their stomachs is made of plastic (Laist, 1997). Leatherback turtles that mistake plastics for jellyfish may be more vulnerable to marine debris than other turtle species.

Dredge-and-fill activities occur in many of the coastal seasonal habitats of sea turtles in the southeastern United States and other locales. Dredging operations affect turtles through incidental take and by degrading the habitat. In addition to direct take, channelization of the inshore and nearshore areas can degrade foraging and migratory habitat through spoil dumping, degraded water quality/clarity, and altered current flow (NRC, 1990).

Sea turtles can become entrained in intake pipes for cooling water at coastal power plants (NRC, 1990). An offshore intake structure may look like a reef to some turtles, suitable for resting, and these turtles are subsequently drawn into the cooling system (Witham, 1995). Feeding leatherbacks probably follow large numbers of jellyfish into the intake (Witham, 1995). Thermal effluents from power plants may cause hatchlings to become disoriented and reduce their swimming speed (O'Hara, 1980) and degrade seagrass and reef habitats (Coston-Clements and Hoss, 1983).

Sea turtles frequent coastal areas such as algae and seagrass beds to seek food and shelter (Carr and Caldwell, 1956). Submerged vegetated areas may be lost or damaged by activities that alter salinity, increase turbidity, or disturb natural tidal and sediment exchange (Gibson and Smith, 1999). Natural catastrophes, including storms, floods, droughts, and hurricanes, can also substantially damage sea turtle habitats and nesting beaches (Martin, 1996). In addition, the hurricane season for the Caribbean and western North Atlantic (June to November) overlaps closely with the sea turtle nesting season (March through November) (NRC, 1990). Hurricanes cause mortality to turtle nests in two ways: immediate drowning from ocean surges and after hatching as a result of radically altered beach topography. Species that have limited nesting ranges, such as the Kemp's ridley, would be highly impacted if a hurricane hit its nesting beach (Milton *et al.* 1994). Indirect impacts (contamination of food or poisoning of reef-building communities) on the marine and coastal habitats of sea turtles include pollution of coastal waters from storm-associated runoff.

Construction, vehicle traffic, beachfront erosion, and artificial lighting are activities that disturb sea turtles or their nesting beaches. Traffic may cause compression damage to nests, and beach cleaning may destroy nests or cause compaction, lowering hatching success (Coston-Clements and Hoss, 1983). Physical obstacles, such as tire tracks and sand piles, may slow the rate of sea-approach for hatchling turtles and increase their susceptibility to stress and predation (Witham, 1995). Obstructions to the high water mark prevent nesting, and breakwalls are the most common and drastic type of obstruction. Erosion of nesting beaches results in the loss of nesting habitat. Human interference has hastened erosion in many places. Artificial lighting from buildings, streetlights, and beachfront properties has a disorienting effect on hatchlings, as well as adults (Witherington and Martin, 2003). Females tend to avoid areas where beachfront lighting is most intense; turtles also abort nesting attempts more often in lighted areas. Hatchlings are attracted to lights, and any delay for them to make it to the water increases vulnerability to terrestrial predators. Condominiums block sun on turtle nesting beaches, which could presumably affect sex ratios of hatchlings (the sex of a turtle is dependent on egg temperature) by increasing the number of males produced (Mrosovsky *et al*., 1995). Increased human activities, including organized turtle watches, on nesting beaches may affect nesting activity, specifically, a female turtle not spending as much time camouflaging nest sites (Johnson *et al*. 1996). Nest depredation by predators such as raccoons, snakes, and fire ants is also a great concern (Boulon, 1999).

Sand mining, beach renourishment, and oil-spill cleanup operations may remove sand from the littoral zone and temporarily disturb onshore sand transport, potentially disturbing sea turtle nesting activities (Witherington, 1999). The main causes of permanent nesting beach loss are the reduction in sediment transport, rapid rate of relative sea-level rise, coastal construction, and development, and recreational use of accessible beaches near large population centers. Crain *et al.* (1995) reviewed the literature on sea turtles and beach nourishment and found certain problems repeatedly identified.

Chronic pollution, including industrial and agricultural waste and urban runoff, threatens sea turtles worldwide. Some turtle species have lifespans greater than 50 years and have a high trophic level in the marine ecosystem, creating the potential for bioaccumulation of heavy metals and pesticides (Davenport *et al.*, 1990). Organochlorine pollutants have been documented in eggs, post-yearlings, and adult turtles (Rybitski *et al.* 1995). Not all species accumulate residues at the same rate; loggerheads consistently have higher levels of both polychlorinated biphenyls (PCB) and dichlorodiphenyldichloroethylene (DDE) than green turtles, and it has been hypothesized that the variation is due to dietary differences (George, 1997). Contaminants could stress the immune system of turtles or act as co-carcinogens indirectly by disrupting neuroendocrine functions (Colborn *et al.,* 1993; Milton and Lutz, 2003). In some marine mammals, chronic pollution has been linked with immune suppression, which raises a similar concern for sea turtles.

Green turtle fibropapillomatosis (GTFP) (debilitating tumors occurring primarily in green turtles) is a growing threat to the survival of green turtle populations worldwide (Herbst, 1994). This disease may cause an increased susceptibility to marine parasites and anemia, as well as obstructed feeding and swimming, greater vulnerability to fishing net entanglement, disorientation, and impaired vision or blindness (Norton *et al*. 1990). Similar lesions have been reported in loggerhead turtles (Herbst, 1994). Studies suggest that turtles in nearshore habitats with nearby human disturbance have a higher incidence of GTFP (Herbst and Klein, 1995). Turtles with GTFP are chronically stressed and suffer from immunosuppression (Aguirre *et al*., 1995).

Climatic fluctuations have produced a growing concern about the impacts of climate change on various marine species, including sea turtles. Responses of sea turtles to climate change are difficult to interpret due to the confounding impacts of natural responses and human influences. Additionally, the time scale on which sea turtles respond to direct or indirect impacts of climate change may be diluted or muted. Global warming will likely increase the foraging range of leatherback turtles farther into temperate and boreal waters as isotherms shift (James *et al.,* 2006; McMahon and Hays, 2006). Large-scale climatic events may affect turtles by loss of nesting beaches as sea levels rise (Vagg and Hepworth, 2006). Nesting biology of sea turtles is strongly affected by temperature, both in timing and in the sex-ratio of hatchlings; the impacts of climate change may upset the natural ratio of male to female hatchlings, as higher temperatures during incubation tend to produce more females (Hays *et al*., 2003; Hawkes *et al.,* 2007). Earlier nesting and longer nesting seasons are being correlated with warmer sea surface temperatures (Weishampel *et al,*. 2004; Hawkes *et al.,* 2007).

Military operations other than those described in the proposed action may contribute to the impacts on sea turtles in the VACAPES Study Area. Airborne noise from aircraft operations based at NAS Patuxent River (DoN, 1999) operating primarily in W-386 and NAS Oceana transiting to and from Navy Dare County Bombing Range, NC (DoN, 2003; 2008), contribute to the anthropogenic noise environment. Small boats proposed to be homebased at Navy Amphibious Base Little Creek would also contribute to the cumulative impacts with their vessel movements and engine noise.

With respect to the cumulative effects from the Navy's use of active mid and high frequency sonar , the acoustic analysis from the AFAST EIS/OEIS is incorporated here to provide a basis for analyzing the cumulative effects from active sonar use. The data used in this analysis includes the effects associated with active sonar use throughout the entire AFAST Study Area (see Figure 1.1-2) (not just those inside the VACAPES Study Area as discussed in section 3.19 of this document).

All of the turtles species found in the AFAST Study Area are ESA-listed species. As such, the Navy's has completed consultation with NMFS in accordance with Section 7 of the ESA. Acoustic analysis for mid-and high-frequency active sonar activities was not performed for sea turtles due to the fact that sea turtles appear to be most sensitive only to low frequencies.

Acoustic effects on sea turtles from explosive source sonobuoys (AN/SSQ-110A) were analyzed in Chapter 4 of AFAST FEIS/OEIS. Acoustic analysis in the AFAST FEIS/OEIS indicates that a total of five exposures to sea turtles may be exposed to levels of sound likely to result in Level B harassment under the AFAST Selected Alternative. Acoustic analysis also indicates that a total of one exposure to a sea turtle may be exposed to levels of sound likely to result in Level A harassment under the AFAST Selected Alternative,. Included in the Level A exposure numbers, acoustic analysis indicates that no sea turtles may be exposed to levels of sound likely to result in mortality under the AFAST Selected Alternative. The exposure estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. See Section 4.5.2 of AFAST FEIS/OEIS for additional information.

With regard to the direct, indirect, and cumulative impacts of the proposed action, impacts are expected to be limited to temporary behavioral impacts for non-sonar related activities. Protection and conservation measures would be implemented during the proposed action to minimize potential adverse impacts to sea turtles and to avoid significant or long-term adverse impacts to threatened and endangered species. As such, there is a potential for minor, but recoverable, cumulative impacts to sea turtles under the No Action Alternative, Alternative 1, Alternative 2, and Alternative 3. Impacts would be temporary and localized and would not be considered significant. No significant cumulative impacts to sea turtles would occur as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2. No significant cumulative harm to sea turtles in non-territorial waters is expected as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.10 Fish and Essential Fish Habitat

Potential threats to fish include fishing, vessel traffic, degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), and introduction of exotic species, disease, natural events, and global climate change (SAFMC, 1998; Field *et al*., 2003; Jackson *et al*., 2001; IEF, 2006).

Fishing and non-fishing activities, individually or in combination, can adversely affect EFH and Managed Species (NOAA, 1998; Dayton *et al.*, 2003; Morgan and Chuenpagdee, 2003). Potential impacts of commercial fishing include over-fishing of targeted species and bycatch, both of which negatively affect fish stocks (Barnette, 2001; NRC, 2002; Dieter *et al.*, 2003). Mobile fishing gears such as bottom trawls disturb the seafloor and reduce structural complexity (Auster and Langton, 1998; Johnson, 2002). Indirect effects of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing, and generation of marine debris (Hamilton, 2000). Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats. Recreational fishing also poses a threat because of the large number of participants and the intense, concentrated use of specific habitats (Coleman *et al.*, 2004).

Natural stresses include storms and climate-based environmental shifts, such as harmful algal blooms and hypoxia. Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Pew Oceans Commissions, 2003).

Potential cumulative impacts of Navy training exercises include release of chemicals into the ocean, introduction of MEMs into the water column and onto the seafloor, mortality and injury of marine organisms near the detonation or impact point of ordnance or explosives, and physical and acoustic impacts of vessel activity. The incremental contribution by the proposed action (or alternatives) to impacts on the marine environment is expected to be insignificant.

6.4.10.1 VACAPES EIS/OEIS Conclusions

The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse effects to fish populations, managed species, or essential fish habitat. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be no impact to EFH and fish in territorial waters. In addition, there would be no significant harm to EFH and fish in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2. Therefore, EFH consultation with NMFS is not required.

Findings for ESA-listed fish included the following.

- Implementation in the Atlantic Ocean of the No Action Alternative, Alternative 1, or Alternative 2 would have no effect on the shortnose sturgeon.
- Implementation in the lower Chesapeake Bay of the No Action Alternative or Alternative 1 would have no effect on the shortnose sturgeon.
- Implementation in the lower Chesapeake Bay of Alternative 2 may affect the shortnose sturgeon.
- Implementation of the No Action Alternative, Alternative 1, or Alternative 2 would have no effect on the smalltooth sawfish.

The Study Area does not contain designated critical habitat for any listed species. Consequently, the proposed action would have no effect on critical habitat.

The Navy is consulting with NMFS regarding its determination of effect for federally listed fish. The analysis of environmental stressors and alternatives indicated no significant impact to fish populations or habitat in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected.

6.4.10.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The overall effect on fish stocks would be negligible compared to the impact of commercial and recreational fishing in the VACAPES Study Area. Past, present, planned, and reasonably foreseeable actions within the VACAPES Study Area includes commercial and recreational vessel traffic, coastal development, oil/gas exploration and development, sand and mineral mining, dredging and fill operations, beach nourishment, cooling water intake and discharge, and wastewater discharge,. Potential threats to fish include ship and boat traffic, degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, disease, natural events, and global climate change (SAFMC, 2007; Field *et al.*, 2001). NMFS changes to the Atlantic Large Whale Take Reduction Plan may have a positive impact on fish (NMFS, 2008a)

Military operations other than those described in the proposed action may contribute, though very minor, to the impacts on fish in the VACAPES Study Area. Airborne noise from aircraft operations based at NAS Patuxent River (DoN, 1999) operating primarily in W-386 and NAS Oceana transiting to and from Navy Dare County Bombing Range, NC (DoN, 2003), contribute to the anthropogenic noise environment. Small boats proposed to be homebased at Navy Amphibious Base Little Creek would also contribute to the cumulative impacts with their vessel movements and engine noise.

Natural stresses include storms and climate-based environmental shifts, such as harmful algal blooms and hypoxia. Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Pew Oceans Commissions, 2003).

With respect to the cumulative effects from the Navy's use of active mid and high frequency sonar , the acoustic analysis from the AFAST EIS/OEIS is incorporated here to provide a basis for analyzing the cumulative effects from active sonar use. The data used in this analysis includes the effects associated with active sonar use throughout the entire AFAST Study Area (see Figure 1.1-2) (not just those inside the VACAPES Study Area as discussed in section 3.19 of this document).

The overall effect on fish stocks would be negligible compared to the impact of commercial and recreational fishing in the AFAST Study Area. After completion of an active sonar activity, repopulation of an area by fish should take place within a matter of hours. Even for fish that are able to detect mid-frequency sounds, both the fish and vessels are moving. Therefore, the exposure to mid-frequency sounds is transient in nature. As such, the exposure would be temporary and not considered significant. As such, no long-term changes to species abundance or diversity, loss or degradation of sensitive habitats, or effects to threatened and endangered species are expected. There is the potential for minor, but recoverable cumulative impacts to marine fish under the AFAST EIS/OIS No Action Alternative, Alternative 1, Alternative 2, and Alternative 3.

Since the majority of AFAST activities are short-term and occur underwater, interaction with EFH during active sonar activities is not expected to be significant. Any impacts would be temporary and localized and as such, there is the potential for minor, but recoverable cumulative effects to EFH. No significant cumulative impacts are anticipated.

The overall effect on fish stocks, Managed Species and EFH would be negligible compared to the impact of commercial and recreational fishing. Thus, no significant cumulative impacts to fish or EFH would occur in U.S. territorial waters as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2. Likewise, no significant harm in non-territorial waters would be expected.

No significant cumulative impacts to fish or fish habitat would occur as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2. No significant cumulative harm to fish or fish habitat in non-territorial waters is expected from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.11 Seabirds and Migratory Birds

A total of 61 seabird species could potentially occur in the OPAREA. Two federally listed seabird species, the roseate tern (*Sterna dougallii*) and Bermuda petrel (*Pterodroma cahow*) potentially occur in the VACAPES Study Area. Offshore pelagic waters support non-breeding and transient pelagic seabirds, loons, gannets, and terns. Potential threats to seabirds include: (1) fisheries interactions, (2) exposure to oil and hazardous materials, (3) debris ingestion and entanglement, and (4) collisions with lighted ships, platforms, and wind energy turbines (Hunter *et al*., 2006).

6.4.11.1 VACAPES EIS/OEIS Conclusions

Analyses of vessel movements, aircraft overflights, and other training activities in the VACAPES Study Area were conducted to identify potential effects on seabirds and migratory birds. The analysis indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse effects to seabirds and migratory birds. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be no significant impact to sea birds in territorial waters. In addition, there would be no significant harm to sea birds in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2. The analysis of environmental stressors and alternatives indicated no significant impact to seabirds and migratory birds in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected.

6.4.11.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The overall cumulative effect on seabirds and migratory birds would be minor in the VACAPES Study Area. Past, present, planned, and reasonably foreseeable actions within the VACAPES Study Area includes commercial and recreational fishing, commercial and general aviation traffic, alternative energy development (MMS, 2007b) and coastal development. Military operations other than those described in the proposed action may contribute to the bird strike effects in the VACAPES Study Area. Airborne noise from aircraft operations based at NAS Patuxent River (DoN, 1999) operating primarily in W-386 and NAS Oceana transiting to and from Navy Dare County Bombing Range, NC (DoN, 2003), contribute to the anthropogenic noise environment, causing minor behavior disturbances.

As discussed in the analysis presented in Section 3.10.3 and summarized in Table 3.10-4, the No Action Alternative, Alternative 1, and Alternative 2 would not diminish the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem. The proposed action would not have a significant adverse effect on migratory bird populations. As a result and in accordance with 50 CFR Part 21, the Navy is not required confer with the USFWS on the development and implementation of conservation measures to minimize or mitigate adverse impacts to migratory birds not listed under the ESA. Therefore, there is the potential for minor, but recoverable, cumulative impacts to seabirds and migratory birds under the No Action Alternative, Alternative 1, and Alternative 2 U.S. territorial waters. Likewise, there is the potential for minor, but recoverable, cumulative harm to seabirds and migratory birds under the No Action Alternative, Alternative 1, and Alternative 2 non-territorial waters.

As such, the potential for the alternatives to contribute incrementally or synergistically to the impacts of other actions on seabirds or migratory birds is very low. Thus, no significant cumulative impacts to seabirds and migratory birds would occur in U.S. territorial waters as a result of training activities from the No Action Alternative, Alternative 1, or Alternative 2. Likewise, no significant cumulative harm in non-territorial waters would be expected.

6.4.12 Land Use

The VACAPES Range Complex does not include any land areas. Instead, it is a set of operating and maneuvering areas with defined air, ocean surface and subsurface areas. Offshore activities are military, commercial, and recreational. Although the Federal Aviation Administration (FAA) has established warning areas for military operations, virtually all airspace and seaspace are available for co-use most of the time.

6.4.12.1 VACAPES EIS/OEIS Conclusions

No offshore events associated with the proposed activities are associated with land encroachment or land forms and soil. Land-based modes of transportation and utility systems are not associated with offshore events. No changes to existing real estate use or agreements are proposed as a result of implementing the No Action Alternative, Alternative 1, or Alternative 2. Additionally, the scenic quality of the offshore area is not affected by proposed activities. Therefore, the proposed activities associated with the No Action Alternative, Alternative 1, or Alternative 2 would have no impact on land use.

6.4.12.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

There are no unavoidable significant cumulative impacts to land use as a result of implementing the No Action Alternative, Alternative 1, or Alternative 2. No significant cumulative harm to land use in non-territorial waters is expected from the No Action Alternative, Alternative 1, or Alternative 2. The proposed actions would be consistent with the enforceable policies of States of Delaware, Maryland, Virginia, and North Carolina's Coastal Zone Management Programs and there are no cumulative effects.

6.4.13 Cultural Resources

Shipwrecks are vulnerable to the impacts of time, tides, storm surges, and marine organisms, damage from boats, wakes, anchor drops, and looting. Over time, elements of the ship deteriorate, break apart, and are covered by sand and marine organisms. Any future damage from mine warfare or mine neutralization efforts would contribute to the cumulative damage over time.

Materials such as shells and mine fragments expended during the proposed operations would sink to the ocean bottom. It is unlikely these materials would come into contact with a shipwreck. However, if expended materials were to sink onto a shipwreck, or in the near vicinity, it would not affect the historic properties of the shipwreck. Eventually, the expended materials would provide a substrate for benthic colonization and would likely be covered by shifting sediments.

6.4.13.1 VACAPES EIS/OEIS Conclusions

Potential stressors analyzed for their potential to affect shipwrecks were related to mine warfare training, use of non-explosive practice munitions, underwater detonations and high-explosive ordnance, and military expended materials. The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse effects to cultural resources. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be less than significant impact to cultural resources in territorial waters. In addition, there would be less than significant harm to cultural resources in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2. The analysis of environmental stressors and alternatives indicated no significant impact to cultural resources in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected.

6.4.13.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Most past, present, and reasonably foreseeable future ocean activities such as commercial ship traffic, fishing, dredging, debris, energy exploration, or scientific research, would not substantially affect underwater cultural resources. This is most likely due to lack of physical contact with shipwrecks since their locations are cataloged. Moreover, any activities with the potential for significant impacts on cultural resources will require Section 106 consultation, and would be mitigated as required by law. Where avoidance was practiced, no cumulative impact would result since there would be no contact with the cultural resource. Where cultural resources could not be avoided, Section 106 consultation would mitigate any potential adverse affects to the cultural resources. Therefore, there is the potential for minor, but recoverable cumulative impacts to cultural resources in territorial waters under the No Action Alternative, Alternative 1 or Alternative 2. No significant cumulative harm to cultural resources in non-territorial waters is expected from the No Action Alternative, Alternative 1, or Alternative 2.

6.4.14 Transportation

Because the VACAPES Range Complex does not include land areas, the transportation analysis addressed only marine and air traffic. As demonstrated by current conditions, military and civilian uses of the offshore sea and air areas are compatible. Where naval vessels and aircraft are conducting operations that are not compatible (for example, hazardous weapons firing), they are confined to the OPAREA away from shipping lanes and inside special use airspace. Hazardous operations are communicated to all vessels and operators by the U.S. Coast Guard, FAA, and Fleet Area Control and Surveillance Facility Virginia Capes (FACSFAC VACAPES), located at Naval Air Station Oceana, Virginia.

6.4.14.1 VACAPES EIS/OEIS Conclusions

Implementation of the proposed action would not produce any significant regional transportation impacts. Impacts on commercial and recreational transportation would be short term in nature and produce some temporary access limitation. Some offshore operations, especially if coincident with peak fishing locations and periods, could cause temporary displacement to individual travelers. However, most offshore operations are of short duration and have a small operational footprint.

The transportation analysis evaluated the potential for existing or proposed military air or vessel traffic to affect existing transportation and circulation conditions in the VACAPES Study Area. The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse effects to transportation. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be less than significant impact to transportation resources in territorial waters. In addition, there would be less than significant harm to transportation resources in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2. The analysis of environmental stressors and alternatives indicated no significant impact to transportation in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected.

6.4.14.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Most past, present, and reasonably foreseeable future ocean activities such as military operations, commercial ship traffic, fishing, energy exploration, or scientific research, would not substantially affect transportation. Although the analysis of alternatives indicated no significant impacts in U.S. territorial waters and no significant harm in non-territorial waters would be expected to transportation, there would be a potential for minor incremental, but recoverable, cumulative impacts when these impacts are consider with other projects and actions in the area. However, because Navy training activities would be relatively isolated due to the large expanses of area between activity locations, these impacts would not be considered significant because they are localized and temporary.

6.4.15 Demographics

Demographics were assessed through the identification and evaluation of socioeconomic factors, including population trends, age structure, race and ethnicity, and educational achievement. The affected environment for demographics includes the states of Delaware, Maryland, Virginia, and North Carolina. Impacts to demographics are assessed in terms of their direct impacts on the local economy and related impacts on population and expenditure within the Study Area. Demographic impacts would be considered important if the alternative chosen for implementation resulted in a substantial shift in population trends, spending and earning patterns, or community resources (notably housing and education).

6.4.15.1 VACAPES EIS/OEIS Conclusions

Implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in a change in the demographics within the Study Area of the coastal counties of the States of Delaware, Maryland, Virginia, and North Carolina. Neither would there be a change to the local population or economy as a result of the proposed offshore training activities under the proposed action.

The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in impacts to demographics or significant harm. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be less than significant impact to demographics in territorial waters. In addition, there would be less than significant harm to demographics in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.15.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Considering the scope of other actions in the geographic region and their interrelationship with the No Action Alternative, Alternative 1, and Alternative 2 and the lack of demographic impacts proposed in this EIS/OEIS, no further analysis of cumulative impacts is relevant.

6.4.16 Regional Economy

The regional economy was assessed through evaluation of economic factors, including industry, commercial fishing, tourism, and recreational fishing. The Study Area for assessment of the regional economy includes the states of Delaware, Maryland, Virginia, and North Carolina. Specific data for regional economic indicators on industry, commercial fishing, tourism, and recreational fishing are presented in this section of the EIS/OEIS. The environmental consequences of the regional economy are assessed in terms of the direct effect that impacts form the propose action would have on the local economy.

6.4.16.1 VACAPES EIS/OEIS Conclusions

People do not live within the VACAPES Range Complex in non-territorial waters more than 12 nm from the shore. Therefore, the regional economy was considered only from a NEPA perspective and was not evaluated in accordance with EO 12114. The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse effects to the regional economy. None of the alternatives would have a significant impact to the regional economy. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, would be less than significant impact to regional economy in territorial waters. In addition, there would be less than significant harm to regional economy in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.16.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

NMFS changes to the Atlantic Large Whale Take Reduction Plan may contribute to cumulative impacts to the commercial fishing industry economy (NMFS, 2008a). Alternative energy exploration and development along the Atlantic seaboard may contribute to the regional economy in a positive way (MMS, 2007b). Considering the scope of other actions in the geographic region and their interrelationship with the No Action Alternative, Alternative 1, and Alternative 2 and the lack of regional economic impacts proposed in this EIS/OEIS, no significant cumulative impacts to the regional economy is expected.

6.4.17 Recreation

Water-based recreation occurs throughout the VACAPES Study Area, but most activities are conducted in bays or nearshore ocean waters in small boats (less than 25 feet). Fishing is probably the most common activity with, for example, more than 1.4 million people participating in marine recreational fishing off Virginia in 2002. Boating and diving on artificial reefs and shipwrecks also are popular.

Where naval vessels and aircraft are conducting operations that are not compatible (*e.g*., hazardous weapons firing), they are confined to OPAREAs away from shipping lanes and inside Special Use Airspace. Advanced notice of hazardous operations is communicated to all vessels and operators by use of NOTMARs, issued by the USCG, and NOTAMs, issued by the FAA. These provide recreational boaters and other users notice that the military will be operating in a specific area, and will allow them to plan their own activities accordingly.

6.4.17.1 VACAPES EIS/OEIS Conclusions

The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse effects to recreation. The analysis of environmental stressors and alternatives indicated no significant impact to recreation in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected. When the potential impacts due to sonar activities (to include AFAST expended materials and IEER explosion data) are included with the potential impacts due to range complex activities for the No Action Alternative, Alternative 1, or Alternative 2, there would be less than significant impact to recreational resources in territorial waters. In addition, there would be less than significant harm to recreational resources in non-territorial waters for the No Action Alternative, Alternative 1, or Alternative 2.

6.4.17.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

In the marine environment, other federal and state actions such as oil and gas leases, dredging operations for channel maintenance, other Department of Defense activities, as well as their associated vessel traffic, increases the potential for encounter with recreational activities that may disrupt a users' enjoyment of an area. Commercial activities like fishing and cruise ships also have the capacity to disrupt the more individual recreational activities as well.

It is expected that although there would be a potential for minor incremental, but recoverable, cumulative impacts by Navy actions at sea, these impacts would not be considered significant as they would be temporary and advanced notice is given. The analysis of environmental stressors and alternatives indicated no significant impacts to recreational use of U.S. territorial waters or significant harm to use of non-territorial. As such, any incremental and cumulative contribution of Navy training to existing stressors would be nominal.

6.4.18 Environmental Justice

The affected environment is open water with no permanent human populations. Because of the absence of populations of children in these areas and the safety restrictions placed on the general public during military operations in the VACAPES Study Area, children would not experience health risks or safety risks. Because of the absence of people beyond the 12 nm territorial limit, environmental justice was considered only from a NEPA perspective and was not evaluated in accordance with EO 12114.

6.4.18.1 VACAPES EIS/OEIS Conclusions

Impacts to environmental justice or protection of children would occur if the alternatives disproportionately affected minority populations, low-income populations, or populations of children. The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse impacts to environmental justice.

6.4.18.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Considering the scope of other actions in the geographic region and their interrelationship with the No Action Alternative, Alternative 1, and Alternative 2 and the lack of environmental justice impacts proposed in this EIS/OEIS, no further analysis of cumulative impacts is relevant.

6.4.19 Public Health and Safety

Public health and safety issues include potential hazards inherent in flight operations, vessel movements, mine laying and clearance, and underwater detonations and high-explosive ordnance. It is the policy of the Navy to observe every possible precaution in the planning and execution of all of its activities to prevent injury to people or damage to property. Potentially, health and safety risks could be posed to the military, commercial, institutional, and recreational activities that take place in the VACAPES Study Area.

6.4.19.1 VACAPES EIS/OEIS Conclusions

The analysis of environmental stressors indicated that implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not result in unavoidable significant adverse effects to public health and safety. The analysis of environmental stressors and alternatives indicated no significant impact to public health and safety in U.S. territorial waters; likewise no significant harm in non-territorial waters would be expected.

6.4.19.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The overall cumulative effect of the proposed actions on public health and safety would be minor in the VACAPES Study Area. Past, present, planned, and reasonably foreseeable actions within the VACAPES Study Area includes military operations, commercial and recreational fishing, commercial and general aviation traffic, and coastal development. There are no past, present, or foreseeable actions that would potentially compromise public health and safety. Therefore, there are no significant cumulative impacts to public health and safety in territorial waters as a result of No Action Alternative, Alternative 1, and

Alternative 2. No significant cumulative harm to public health and safety in non-territorial waters is expected as a result of the No Action Alternative, Alternative 1, or Alternative 2.

6.4.20 Atlantic Fleet Sonar Training

In January 2009, the Navy, after carefully weighing the operational and environmental consequences of the proposed action, announced its decision to designate areas along the East Coast of the United States and in the Gulf of Mexico where MFA and HFA sonar and the IEER system training; RDT&E activities will occur, and to conduct these activities (DoN, 2009c). The Navy's decision regarding MFA sonar activities includes the advanced extended echo ranging system as a replacement for the IEER system. These activities are collectively described as "active sonar activities" in the Final EIS/OEIS for AFAST.

6.4.20.1 VACAPES EIS/OEIS Conclusions

The active sonar activities that are described in this EIS/OEIS are not new and do not involve significant changes in systems, tempo, or intensity from past events. Moreover, there will be no significant effects to geology, water quality, marine habitat, airspace management, cultural resources, or socioeconomics within the Study Area under the No Action Alternative, Alternative 1, or Alternative 2. As such, implementation of the proposed action will not pose disproportionate high or adverse effects to minority or low-income populations, or environmental health and safety risks to children.

6.4.20.2 VACAPES EIS/OEIS Incremental Contribution and Cumulative Impacts from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The Navy published the Record of Decision for the AFAST EIS/OEIS in January 2009 (DoN, 2009c) and determined that the Selected Alternative, the No-Action Alternative, best meets the requirements for the proposed AFAST active sonar activities. Since the proposed action will not pose disproportionate high or adverse effects to minority or low-income populations, or environmental health and safety risks to children, the proposed action will not result in any cumulative impacts.

6.5 Assessing Individual Past, Present, and Future Impacts

In this chapter, past and present actions, as well as reasonably foreseeable future action, have been identified. In Table 6.5-1 a value of "NE" through "***" was assigned to each action based on its potential to cause an adverse effect to a specific resource area. An example of each value is as follows:

- An "NE" value would be given to an action that has no adverse impacts to a particular resource.
- A "*" would be given to an action that has the potential for minor, but recoverable, adverse impacts to a particular resource. Examples include negligible or less than significant effect to a resource.
- A "**" would be given to an action that has the potential for moderate, but recoverable, adverse impacts to a particular resource. Examples include a measurable effect to a resource, but an effect that would be recoverable.
- A "***" would be given to an action that has the potential for major, non-recoverable, adverse impacts to a particular resource. Examples include a significant effect to a resource, including impacts that are not recoverable.

Once a value was assigned to each resource for an individual action, an assessment was conducted to determine whether there would be cumulative impacts to the resource area in relation to the proposed action. Cumulative impacts were considered likely to occur for the following actions:

- Actions occurring at the same or overlapping areas at the same or similar time.
- Actions occurring in the vicinity at the same or similar time.
- Actions occurring at the same or overlapping areas at some other time.

The same valuation process was used to determine the overall cumulative impact to a resource. It is important to note that even if a resource was given a value of "**" or "***" for an individual action, it does not automatically generate a cumulative impact of "**" or "***". This is due to difference in space and time from other actions or the resource that is potentially affected. For instance, regulatory permits can be granted for certain actions that involve the likely "taking" of protected species, such as marine mammals, sea turtles, or migratory birds. Even though these individual impacts would be considered moderate to severe (depending on the action and species affected), regulations are in place to ensure the continued survival of the respective species. Moreover, the implementation of mitigation and mitigation measures for individual actions has the potential to further reduce the cumulative impact. Table 6.5-1 summarizes the results of the cumulative impacts analysis for each resource area identified previously in this EIS/OEIS that could potentially be affected by the proposed action; other past, present and reasonably expected future actions potentially affecting the same resources; and the magnitude of each individual action.

TABLE 6.5-1
SUMMARY OF CUMULATIVE IMPACTS BY RESOURCE AREA

		Bathymetry/Sediments	Hazardous Materials/Waste	Water Resources	Air Quality	Noise Environment	Marine Communities	Marine Mammals	Sea Turtles	Fish	Seabirds/Migratory Birds	Land Use	Cultural Resources	Transportation	Demographics	Regional Economy	Recreation	Environmental Justice	Public Health and Safety
Past and Present Actions	**Commercial and Recreational Fishing**	*	*	NE	NE	NE	**	**	**	**	**	NE	*	NE	NE	NE	NE	NE	NE
	Maritime Traffic	*	*	*	NE	*	NE	**	*	NE	NE	NE	*	*	NE	*	*	NE	*
	Scientific Research	NE	*	NE	NE	NE	*	*	*	*	*	NE	NE	NE	NE	NE	NE	NE	NE
	Debris	*	*	*	NE	NE	**	**	**	**	**	NE	*	NE	NE	NE	NE	NE	NE
	Environmental Contamination and Biotoxins	NE	NE	**	NE	NE	**	**	**	**	**	NE	NE	NE	NE	NE	NE	NE	NE
	Marine Ecotourism	NE	NE	*	NE	NE	NE	*	*	NE	NE	NE	NE	NE	NE	*	*	NE	NE
	Military Operations	*	*	*	*	*	*	*	*	*	*	*	*	*	NE	*	*	NE	*
	MMS: Oil and Gas	**	*	**	**	*	*	**	**	*	**	NE	*	NE	NE	NE	NE	NE	NE
	NASA	NE	*	NE	NE	*	NE	NE	NE	NE	*	NE	NE	NE	NE	NE	NE	NE	NE
	Dredging	**	**	**	**	*	**	NE	**	**	NE	NE	*	NE	NE	NE	NE	NE	NE
Future Actions	**Military Operations**	*	*	*	*	*	*	*	*	*	*	NE	*	NE	NE	NE	NE	NE	*
	MMS Oil and Gas Leases/Offshore Windfarms	*	NE	*	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
VACAPES Proposed Action		*	*	*	*	*	*	*	*	*	*	NE	*	*	NE	NE	*	NE	NE
Cumulative Impacts		*	*	*	*	*	*	**	**	*	*	NE	*	*	NE	NE	*	NE	NE

NE= No Adverse Impacts; *=Potential for minor, but recoverable, adverse impacts; **=Potential for moderate, but recoverable, adverse impacts
***=Potential for major, non-recoverable, adverse impacts

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CHAPTER 8 : GLOSSARY OF TERMS

Access—the right to transit to and from and to make use of an area.

Accretion—growth by gradual external addition.

Activity—an individual scheduled training function or action such as missile launching, bombardment, vehicle driving, or Field Carrier Landing Practice.

Advisory Council on Historic Preservation—a 19-member body appointed, in part, by the President of the United States to advise the President and Congress and to coordinate the actions of Federal agencies on matters relating to historic preservation, to comment on the effects of such actions on historic and archaeological cultural resources, and to perform other duties as required by law (Public Law 89-655; 16 United States Code 470).

Aeronautical Chart—a map used in air navigation containing all or part of the following: topographic features, hazards and obstructions, navigation aids, navigation routes, designated airspace, and airports.

Aesthetic—a pleasing appearance, effect, or quality that allows appreciation of character-defining features, such as of the landscape.

Air Basin—a region within which the air quality is determined by the meteorology and emissions within it with minimal influence on and impact by contiguous regions.

Air Defense Identification Zone—the area of airspace over land or water, extending upward from the surface, within which the ready identification, the location, and the control of aircraft are required in the interest of national security.

Air Route Traffic Control Center (ARTCC)—a facility established to provide air traffic control service to aircraft operating on Instrument Flight Rules flight plans within controlled airspace and principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to aircraft operating under Visual Flight Rules.

Air Traffic Control—a service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

Air Traffic Control Assigned Airspace (ATCAA)—Federal Aviation Administration-defined airspace not over an Operating Area (OPAREA) within which specified activities, such as military flight training, are segregated from other Instrument Flight Rules air traffic.

Airfield—usually an active and/or inactive airfield, or infrequently used landing strip, with or without a hard surface, without Federal Aviation Administration-approved instrument approach procedures. An airfield has no control tower and is usually private.

Airport—usually an active airport with hard-surface runways of 3,000 feet or more, with Federal Aviation Administration approved instrument approach procedures regardless of runway length or composition. An airport may or may not have a control tower. Airports may be public or private.

Airspace, Controlled—airspace of defined dimensions within which air traffic control service is provided to Instrument Flight Rules flights and to Visual Flight Rules flights in accordance with the airspace classification. Controlled airspace is divided into five classes, dependent upon location, use, and degree of control: Class A, B, C, D, and E.

Airspace, Special Use—airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon non-participating aircraft.

Airspace, Uncontrolled—uncontrolled airspace, or Class G airspace, has no specific definition but generally refers to airspace not otherwise designated and operations below 1,200 feet above ground level. No air traffic control service to either Instrument Flight Rules or Visual Flight Rules aircraft is provided other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

Airspace—the space lying above the earth or above a certain land or water area (such as the Atlantic Ocean); more specifically, the space lying above a nation and coming under its jurisdiction.

Airway—Class E airspace established in the form of a corridor, the centerline of which is defined by radio navigational aids.

Alert Area—a designated airspace in which flights are not restricted but there is concentrated student training or other unusual area activity of significance.

Alkaline—basic, having a pH greater than 7.

Alluvium—a general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream or on its floodplain or delta, or as a cone or fan at the base of a maintained slope.

Altitude Reservation—altitude reservation procedures are used as authorization by the Central Altitude Reservation Function, an air traffic service facility, or appropriate air route traffic control center, under certain circumstances, for airspace utilization under prescribed conditions.

Aluminum Oxide (Al_2O_3)—a common chemical component of missile exhaust. Under natural conditions, the chemical is not a source of toxic aluminum; the U.S. Environmental Protection Agency has determined that nonfibrous Al_2O_3, as found in solid rocket motor exhaust, is nontoxic.

Ambient Air Quality Standards—legal limitations on pollutant concentration levels allowed to occur in the ambient air established by the U.S. Environmental Protection Agency or state agencies. Primary ambient air quality standards are designed to protect public health with an adequate margin of safety. Secondary ambient air quality standards are designed to protect public welfare-related values including property, materials, and plant and animal life.

Ambient Air—that portion of the encompassing atmosphere, external to buildings, to which the general public has access.

Amplitude—the maximum departure of the value of a sound wave from the average value.

Anthropogenic—human-related.

Applications of Offensive Military Power—the ability to employ various means of destructive and/or disruptive force which a Naval unit/Strike Group can apply against an opponent at a given time.

Aquaculture—the cultivation of the natural produce of water, such as fish or shellfish.

Archaeology—a scientific approach to the study of human ecology, cultural history, prehistory and cultural processes, emphasizing systematic interpretation of material remains.

Area of Potential Effect—the geographic area within which direct and indirect impacts generated by the Proposed Action and alternatives could reasonably be expected to occur and thus cause a change in historic, architectural, archaeological, or cultural qualities possessed by the property.

Artifact—any thing or item that owes its shape, form, or placement to human activity. In archaeological studies, the term is applied to portable objects (e.g., tools and the by-products of their manufacture).

Attainment Area—an air quality control region that has been designated by the U.S. Environmental Protection Agency and the appropriate state air quality agency as having ambient air quality levels as good as or better than the standards set forth by the National Ambient Air Quality Standards, as defined in the Clean Air Act. A single geographic area may have acceptable levels of one criteria air pollutant, but unacceptable levels of another; thus, an area can be in attainment and non-attainment status simultaneously.

Average Daily Traffic (ADT)—the total volume of traffic passing a given point or segment of a roadway in both directions divided by a set number of days.

A-weighted Sound Level—a number representing the sound level which is frequency-weighted according to a prescribed frequency response established by the American National Standards Institute (ANS1.4-19711) and accounts for the response of the human ear.

Azimuth—a distance in angular degrees in a clockwise direction from the north point.

Backyard Range—a range within a radius of one hour's drive (50-65 miles) of a unit, such that training there can be considered non-deployed for personnel tempo (PERSTEMPO) purposes.

Benthic Communities—of or having to do with populations of bottom-dwelling flora or fauna of oceans, seas, or the deepest parts of a large body of water.

Benthopelagic—living and feeding near the sea floor as well as in midwaters or near the surface.

Benthos—the sea floor.

Bioaccumulation—building up of a substance, such as PCBs, in the systems of living organisms (and thus, a food web) due to ready solubility in living tissues.

Biological Diversity—the complexity and stability of an ecosystem, described in terms of species richness, species evenness, and the direct interaction between species such as competition and predation.

Biological Resources—a collective term for native or naturalized vegetation, wildlife, and the habitats in which they occur.

Booster—an auxiliary or initial propulsion system that travels with a missile or aircraft and that may not separate from the parent craft when its impulse has been delivered; may consist of one or more units.

Brackish—slightly salty; applicable to waters whose saline content is intermediate between that of streams and sea water.

Calcareous—containing calcium carbonate.

Candidate Species—a species of plant or animal for which there is sufficient information to indicate biological vulnerability and threat, and for which proposing to list as "threatened" or "endangered" is or may be appropriate.

Carbon Dioxide—a colorless, odorless, incombustible gas which is a product of respiration, combustion, fermentation, decomposition and other processes, and is always present in the atmosphere.

Carbon Monoxide—a colorless, odorless, poisonous gas produced by incomplete fossil-fuel combustion; it is one of the six pollutants for which there is a national ambient standard (see Criteria Pollutants).

Carrier Strike Group Composite Training Unit Exercise (CSG COMPTUEX) —an Integrated Phase, at-sea, major range event that integrates the aircraft carrier and carrier air wing with surface and submarine units in a challenging environment. Commander Strike Force Training Atlantic schedules and conducts the CSG COMPTUEX in accordance with a schedule of events plan. It is nominally 26 days long with two scenario-driven "mini" multi-threat battle problems, one that is about 24 hours long and the other about 18 hours long. Typically, live-fire operations that take place during COMPTUEX including long-range air strikes, naval surface fire support, and other surface gunnery and missile exercises.

CATM-9—Captive Carry Training Missile (Sidewinder). Used for pilot training in aerial target acquisition and use of aircraft controls/displays. All components are non-explosive and no missile actually leaves the aircraft.

Cetacean—an order of aquatic, mostly marine, animals including the whales, dolphins, porpoise, and related forms with large head, fishlike nearly hairless body, and paddle-shaped forelimbs.

Class A Airspace (also Positive Controlled Area)—airspace designated in Federal Aviation Administration Regulation Part 71 within which there is positive control of aircraft

Coastal Zone—a region beyond the littoral zone occupying the area near the coastline in depths of water less than 538.2 feet. The coastal zone typically extends from the high tide mark on the land to the gently sloping, relatively shallow edge of the continental shelf. The sharp increase in water depth at the edge of the continental shelf separates the coastal zone from the offshore zone. Although comprising less than 10 percent of the ocean's area, this zone contains 90 percent of all marine species and is the site of most large commercial marine fisheries. This may differ from the way the term "coastal zone" is defined in the State Coastal Zone Management Program (Hawaii Revised Statutes Chapter 205 A).

Community—an ecological collection of different plant and animal populations within a given area or zone.

Component (Cultural Resources)—a location or element within a settlement or subsistence system. Archaeological sites may contain several components that reflect the use of the locality by different groups in different time periods.

Continental Shelf—a shallow submarine plain of varying width forming a border to a continent and typically ending in a steep slope to the oceanic abyss.

Continental Slope—the steep slope that starts at the shelf break about 492 to 656 feet and extends down to the continental rise of the deep ocean floor.

Continental United States (CONUS)—the United States and its territorial waters between Mexico and Canada, but excluding overseas states.

Control Area (CTA)—a controlled airspace extending upwards from a specified limit above the earth.

Controlled Access—area where public access is prohibited or limited due to periodic training operations or sensitive natural or cultural resources.

Controlled Airspace—airspace of defined dimensions within which air traffic control service is provided to Instrument Flight Rules flights and to Visual Flight Rules flights in accordance with the airspace classification. Controlled airspace is divided into five classes, dependent upon location, use, and degree of control: Class A, B, C, D, and E.

Controlled Firing Area (CFA)—airspace wherein activities are conducted under conditions so controlled as to eliminate hazards to non-participating aircraft and to ensure the safety of persons and property on the ground.

Copepod—a small, shrimp-like crustacean.

Coral Reef—a calcareous organic area composed of solid coral and coral sand.

Council on Environmental Quality (CEQ)—established by the National Environmental Policy Act, the CEQ consists of three members appointed by the President. A CEQ regulation (Title 40 Code of Federal Regulations 1500-1508, as of July 1, 1986) describes the process for implementing the National

Environmental Policy Act, including preparation of environmental assessments and environmental impact statements, and the timing and extent of public participation.

Co-Use—Scheduled uses that safely allow other units to transit the area or conduct activities.

Criteria Pollutants—pollutants identified by the U.S. Environmental Protection Agency (required by the Clean Air Act to set air quality standards for common and widespread pollutants); also established under state ambient air quality standards. There are standards in effect for six criteria pollutants: sulfur dioxide, carbon monoxide, particulate matter, nitrogen dioxide, ozone, and lead.

Cultural Resources—prehistoric and/or historic sites, structures, districts, artifacts, or any other physical evidence of human activity considered of importance to a culture, subculture, or community for scientific, traditional, religious, or any other reason.

Culture—a group of people who share standards of behavior and have common ways of interpreting the circumstances of their lives.

Cumulative Impact—the impact of the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Current—a horizontal movement of water or air.

C-weighted—utilized to determine effects of high-intensity impulsive sound on human populations, a scale providing unweighted sound levels over a frequency range of maximum human sensitivity.

Danger Area—(1) In air traffic control, an airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times; (2) (DoD only) A specified area above, below, or within which there may be potential danger.

Decibel (dB)—the accepted standard unit of measure for sound pressure levels. Due to the extremely large range of measurable sound pressures, decibels are expressed in a logarithmic scale.

Degradation—the process by which a system will no longer deliver acceptable performance.

Demersal—living close to the seafloor.

Direct Effects—immediate consequences of program activities.

Direct Impact—effects resulting solely from program implementation.

District—National Register of Historic Places designation of a geographically defined area (urban or rural) possessing a significant concentration, linkage, or continuity of sites, structures, or objects united by past events (theme) or aesthetically by plan of physical development.

Diurnal—active during the daytime.

Dunes—hills and ridges of sand-size particles (derived predominantly from coral and seashells) drifted and piled by the wind. These dunes are actively shifting or are so recently fixed or stabilized that no soil horizons develop; their surface typically consists of loose sand.

Easement—a right of privilege (agreement) that a person or organization may have over another's property; an interest in land owned by another that entitles the holder of the easement to a specific limited use; a recorded right of use by the United States over property of the State of Hawaii to limit exposure to safety hazards.

Ecosystem—all the living organisms in a given environment with the associated non-living factors.

Effects—a change in an attribute, which can be caused by a variety of events, including those that result from program attributes acting on the resource attribute (direct effect); those that do not result directly from the action or from the attributes of other resources acting on the attribute being studied (indirect effect); those that result from attributes of other programs or other attributes that change because of other programs (cumulative effects); and those that result from natural causes (for example, seasonal change).

Effluent—an outflowing branch of a main stream or lake; waste material (such as smoke, liquid industrial refuse, or sewage) discharged into the environment.

Electromagnetic Radiation (EMR)—waves of energy with both electric and magnetic components at right angles to one another.

Electronic Countermeasures (ECM)—includes both active jamming and passive techniques. Active jamming includes noise jamming to suppress hostile radars and radios, and deception jamming, intended to mislead enemy radars. Passive ECM includes the use of chaff to mask targets with multiple false echoes, as well as the reduction of radar signatures through the use of radar-absorbent materials and other stealth technologies.

En Route Airways—a low-altitude (up to, but not including 18,000 feet [5,486.4 meters] mean sea level) airway based on a center line that extends from one navigational aid or intersection to another navigational aid (or through several navigational aids and intersections) specified for that airway.

En Route Jet Routes—high altitude (above 18,000 feet mean sea level) airway based on a center line that extends from one navigational aid or intersection to another navigational aid (or through several navigational aids and intersections) specified for that airway.

Encroachment—the placement of an unauthorized structure or facility on someone's property or the unauthorized use of property.

Endangered Species—a plant or animal species that is threatened with extinction throughout all or a significant portion of its range.

Endemic—plants or animals that are native to an area or limited to a certain region.

Environmental Justice—an identification of potential disproportionately high and adverse impacts on low-income and/or minority populations that may result from proposed Federal actions (required by Executive Order 12898).

Epibenthic—living on the ocean floor.

Epipelagic—living in the ocean zone from the surface to 109 fathoms (656 feet).

Erosion—the wearing away of a land surface by water, wind, ice, or other geologic agents.

Estuary—a water passage where the tide meets a river current; an arm of the sea at the lower end of a river; characterized by brackish water.

Event—a significant operational employment during which training is accomplished. "Event" is a Navy approved employment schedule term. The event may be primarily designated as operational, such as TRANSIT, MIO, or STRIKEOPS during which training may take place. Training events may be periods of operational employment that are also considered major training events such as Composite Training Unit Exercise (COMPTUEX), Joint Training Fleet Exercise (JTFEX), or other exercises such as BRIGHT STAR, COBRA GOLD, or UNIFIED ENDEAVOR.

Exclusive Use—scheduled solely for the assigned unit for safety reasons.

Exotic—not native to an area.

Expanded Warfare Mission—conducting training in a mission area not previously conducted in the range complex, either because it is a new mission area (e.g. training associated with maritime security or Organic Mine Countermeasures) or it is a pre-existing mission area not previously conducted in a particular range complex, but because of force structure changes, will start up in the foreseeable future (e.g. CSAR training in VACAPES Range Complex, previously done primarily in JAX Range Complex).

Expeditionary Strike Group Composite Training Unit Exercise (ESG COMPTUEX) —an Integrated Phase, at-sea, major range event that is a standard part of every Marine Expeditionary Unit's (MEU) pre-deployment training program and lasts for about 18 days. The exercise centers on situational training exercises in which the MEU is issued a series of orders that are designed to replicate the types of missions they are likely to face during their deployment. The MEU then quickly plans and executes the missions to test their rapid-response capabilities. Typically, the first half of the ESG COMPTUEX focuses on preparing the amphibious ships of the ESG for the missions they will perform while on deployment. The embarked Marines normally launch ship-to-shore raids and conduct urban-combat training at areas ashore. Over the next several days, the MEU's equipment and its ground combat element are loaded into the amphibious ships of the ESG by landing craft from the beach.

Explosive Ordnance Disposal (EOD)—the process of recovering and neutralizing domestic and foreign conventional, nuclear and chemical/biological ordnance and improvised explosive devices; a procedure in Explosive Ordnance Management.

Explosive Safety Quantity-Distance (ESQD)—the quantity of explosive material and distance separation relationships providing defined types of protection based on levels of risk considered acceptable.

Facilities—physical elements that can include roads, buildings, structures, and utilities. These elements are generally permanent or, if temporary, have been placed in one location for an extended period of time.

Fathom—a unit of length equal to 6 feet; used to measure the depth of water.

Feature—in archaeology, a non-portable portion of an archaeological site, including such facilities as fire pits, storage pits, stone circles, or foundations.

Federal Candidate Species—taxa for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species.

Fee Simple Land—land held absolute and clear of any condition or restriction, and where the owner has unconditional power of disposition.

Feral—having escaped from domestication and become wild.

Fleet Area Control and Surveillance Facility (FACSFAC)—Navy facility that provides air traffic control services and controls and manages Navy-controlled offshore operating areas and instrumented ranges.

Fleet Readiness Training Plan (FRTP)—the 27-month cycle that replaces the Interdeployment Training Cycle. The FRTP includes four phases prior to deployment: Maintenance, Unit Level Training, Integrated Training, and Sustainment.

Fleet Response Plan/Fleet Readiness Program (FRP)—the Fleet Response Plan was the Navy's response to the 2002/2003 international situations in Afghanistan and Iraq. The Fleet Readiness Program was later developed by the Fleet commanders. Both names refer to the same operational construct. The FRP is designed to more rapidly develop and then sustain readiness in ships and squadrons so that, in a national crisis or contingency operation, the Navy can quickly surge significant combat power to the scene.

Flight Information Region (FIR)—an airspace of defined dimensions within which flight information service and alerting service are provided. Flight information service is provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights, and alerting service is provided to notify appropriate organizations regarding aircraft in need of search and rescue aid and to assist such organizations as required.

Flight Level—a level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury stated in three digits that represent hundreds of feet. For example, flight level 250 represents a barometric altimeter indication of 25,000 feet; flight level 255 represents an indication of 25,500 feet.

Flight Termination—action taken in certain post-launch situations, such as a missile veering off of its predicted flight corridor; accomplished by stopping the propulsive thrust of a rocket motor via explosive charge. At this point, the missile continues along its current path, falling to earth under gravitational influence.

Floodplain—the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands; includes, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year (100-year floodplain).

Force Structure Changes—improvements and/or modifications to Naval operational forces based on personnel changes, equipment/platform upgrades and weapons modernization.

Free Flight—a joint initiative of the aviation industry and the Federal Aviation Administration to allow aircraft to take advantage of advanced satellite voice and data communication to provide faster and more reliable transmission to enable reductions in vertical, lateral, and longitudinal separation of aircraft, more direct flights and tracts, and faster altitude clearance. It will allow pilots, whenever practicable, to choose their own route and file a flight plan that follows the most efficient and economical route, rather than following the published preferred instrument flight rules routes.

Frequent User—a unit that conducts training and exercises in the training areas on a regular basis but does not maintain a permanent presence.

Fugitive Dust—any solid particulate matter that becomes airborne, other than that emitted from an exhaust stack, directly or indirectly as a result of the activities of man. Fugitive dust may include emissions from haul roads, wind erosion of exposed soil surfaces, and other activities in which soil is either removed or redistributed.

Global Commons—areas established by treaty or recognized under customary international law that are beyond the territorial jurisdiction of any nation. The High Seas (Global Commons) do not include EEZs established and recognized under international law as set forth in reference (i). In addition, although the Antarctica continental land mass is part of the global commons, by court decision, NEPA (and not E.O. 12114), applies to U.S. actions that would impact the environment of the continental land mass of Antarctica.

Ground Hazard Area—the land area contained in an arc within which all debris from a terminated launch will fall. For example, the arc for a Strategic Target System launch is described such that the radius is approximately 10,000 feet to the northeast, 9,100 feet to the east, and 9,000 feet to the south of the launch point. For the Vandal launch, the arc is 6,000 feet.

Groundwater Table—the highest part of the soil or underlying rock material that is wholly saturated with water.

Groundwater—water within the earth that supplies wells and springs; specifically, water in the zone of saturation where all openings in rocks and soil are filled, the upper surface of which forms the water table.

Habitat—the area or type of environment in which a species or ecological community normally occurs.

Hazardous Air Pollutants—other pollutants, in addition to those addressed by the NAAQS, that present the threat of adverse effects to human health or to the environment as covered by Title III of the Clean Air Act. Incorporates, but is not limited to, the pollutants controlled by the National Emissions Standards for Hazardous Air Pollutants program.

Hazardous Material—generally, a substance or mixture of substances capable of either causing or significantly contributing to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; it may pose a threat or a substantial present or potential risk to human health or the environment. Hazardous materials use is regulated by the U.S. Department of Transportation, the Occupational Safety and Health Administration, and the Emergency Right-to-Know Act.

Hazardous Waste—a waste, or combination of wastes, which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Hertz (Hz)—the standard radio equivalent of frequency in cycles per second of an electromagnetic wave. Kilohertz (kHz) is a frequency of 1,000 cycles per second. Megahertz (MHz) is a frequency of 1 million cycles per second.

High Explosive (HE)—used when describing explosive ordnance, i.e., ordnance typically used in combat or possessing same or similar explosive-filler as combat ordnance; example – 20mm through 2,000LB Mk-80 series HE.

Historic Properties—under the National Historic Preservation Act, these are properties of national, state, or local significance in American history, architecture, archaeology, engineering, or culture, and worthy of preservation

Host—the Facilities Host holds plant account of all Class I (Land) and most Class II (Buildings) property. The Operational Host determines and executes operational policy for the range/range complex.

Hydraulic Conductivity—the rate in gallons per day water flow through a cross section of one square foot under a unit hydraulic gradient, at the prevailing temperature.

Hydrocarbons—any of a vast family of compounds containing hydrogen and carbon, including fossil fuels.

Hydrochloric Acid—a common chemical component of missile exhaust believed to injure plant leaves and affect wildlife.

Hydrology—the science dealing with the properties, distribution, and circulation of water on the face of the land (surface water) and in the soil and underlying rocks (groundwater).

Hydrophone—an instrument for listening to sound transmitted through water.

Impact Area—the identified area within a range intended to capture or contain ammunition, munitions, or explosives and resulting debris, fragments, and components from various weapon system employments.

Impacts (effects)—an assessment of the meaning of changes in all attributes being studied for a given resource; an aggregation of all the adverse effects, usually measured using a qualitative and nominally subjective technique. In this Environmental Impact Statement, as well as in the Council on Environmental Quality regulations, the word impact is used synonymously with the word effect.

Implementing Enhanced Range Complex Capabilities—warfare training and doctrine improvements that result from the modernization and replacement of range support infrastructure and instrumentation at Naval air, sea and subsurface tactical ranges.

Indurated—rendered hard, as in dunes where surface sand is loose, but subsurface areas become increasingly compact (see lithified).

Infrastructure—the system of public works of a country, state, or region, such as utilities or communication systems; physical support systems and basic installations needed to operate a particular area or facility.

Inhibited Red Fuming Nitric Acid (IRFNA)—a liquid hypergolic propellant utilized as an oxidizer (as in the Lance). This reddish-brown acid is highly corrosive, spontaneously reacting with UDMH and certain other organic substances. It also dissolves in water, and care must be taken regarding its induced boiling effects. Its highly toxic, characteristically pungent vapors irritate skin and eyes.

In-Shore—lying close to the shore or coast.

Instrument Flight Rules (IFR)—rules governing the procedures for conducting instrument flight; it is a term used by pilots and controllers to indicate type of flight plan.

Interdeployment Readiness Cycle—the period by which Naval units progress through maintenance/unit level training, integrated training, and sustainment training stages prior to being deployed with the Fleet to support the gaining CINC.

Intermittent User—a unit that conducts training and exercises in the training areas throughout the year, but not on a regularly scheduled basis, and does not maintain a permanent presence.

International Waters—sea areas beyond 12 nm of the U.S. shoreline.

Intertidal Zone—occupies the space between high and low tide, also referred to as the littoral zone; found closest to the coastal fringe and thus only occurring in shallow depths.

Ionizing Radiation—particles or photons that have sufficient energy to produce direct ionization in their passage through a substance. X-rays, gamma rays, and cosmic rays are forms of ionizing radiation.

Isobath—the line on a marine map or chart joining points of equal depth, usually in fathoms below mean sea level.

Jet Routes—a route designed to serve aircraft operating from 18,000 feet (5,486 meters) up to and including flight level 450, referred to as J routes with numbering to identify the designated route.

Joint Task Force Exercise (JTFEX) —a scenario-driven, sea control, power projection exercise with the purpose of evaluating the readiness of naval forces and testing the interoperability and proficiency of these forces in realistic scenarios ranging from military operations other than war to armed conflict. JTFEX typically encompasses operations from in port to sea-air-land combat, to special warfare, to humanitarian assistance operations. JTFEX is a dynamic and complex major range event that is the culminating exercise in the Sustainment Phase training for the Carrier Strike Group (CSG) or Expeditionary Strike Group (ESG). JTFEX is nominally 10 days long, not including a 3-day in port Force Protection Exercise, and can be the last at-sea exercise for the CSG prior to deployment.

Land/Sea Use—the exclusive or prioritized commitment of a land/sea area, and any targets, systems, and facilities therein, to a continuing purpose that could include a grouping of operations, buffer zone, environmental mitigation, etc. The land/sea area may consist of a range/range complex, grouping of similar facilities, or natural resource-based area with no facilities.

Lead—a heavy metal which can accumulate in the body and cause a variety of negative effects; one of the six pollutants for which there is a national ambient air quality standard (see Criteria Pollutants).

Lead-based Paint—paint on surfaces with lead in excess of 1.0 milligram per square centimeter as measured by X-ray fluorescence detector, or 0.5 percent lead by weight.

Leptocephalic—small, elongate, transparent, planktonic.

Level of Service (LOS)—describes operational conditions within a traffic stream and how they are perceived by motorists and/or passengers; a monitor of highway congestion that takes into account the average annual daily traffic, the specified road segment's number of lanes, peak hour volume by direction, and the estimated peak hour capacity by a roadway's functional classification, area type, and signal spacing.

Lithified—the conversion of newly deposited sediment into an indurated rock.

Littoral—species found in tide pools and near-shore surge channels.

Loam—a loose soil composed of a mixture of clay, silt, sand, and organic matter.

Long-Term Sustainability of Department of Defense Ranges—the ability to indefinitely support national security objectives and the operational readiness of the Armed Forces, while still protecting human health and the environment.

Major Exercise—a significant operational employment of live, virtual, and/or constructive forces during which live training is accomplished. A Major Exercise includes multiple training objectives, usually occurring over an extended period of days or weeks. An exercise can have multiple training operations (sub-events each with its own mission, objective and time period. Examples include C2X, JTFEX, SACEX, and CAX. Events (JTFEX) are composed of specific operations (e.g., Air-to-Air Missile), which consist of individual activities (e.g., missile launch).

Maneuver Area—range used for maneuver element training.

Maneuver Element—basic element of a larger force independently capable of maneuver. Normally, a Marine Division recognizes its infantry battalions, tank battalion, and light armored reconnaissance (LAR) battalion as maneuver elements. A rifle (or tank/LAR) battalion would recognize its companies as maneuver elements. A rifle (or tank/LAR) company would recognize its platoons as maneuver elements. Maneuver below the platoon level is not normally possible since fire and movement can be combined only at the platoon level or higher. The Army and National Guard recognize a squad and platoon as maneuver elements.

Maneuver—employment of forces on the battlefield through movement in combination with fire, or fire potential, to achieve a position of advantage with respect to the enemy in order to accomplish the mission.

Marine Corps Ground Unit—Marine Expeditionary Unit Ground Combat Element, or Battalion Landing Team, composed of an infantry battalion of about 1,200 personnel reinforced with artillery, amphibious assault vehicles, light armored reconnaissance assets and other units as the mission and circumstances require. (The analysis will scale units of different size or composition from this Battalion Landing Team standard unit to include a 12-man Special Operations platoon.)

Maritime—of, relating to, or bordering on the sea.

Material Safety Data Sheet—presents information, required under Occupational Safety and Health Act standards, on a chemical's physical properties, health effects, and use precautions.

Medical Evacuation—emergency services, typically aerial, designed to remove the wounded or severely ill to medical facilities.

Mesopelagic—the oceanic zone from 109 to 547 fathoms (656 to 3,280 feet).

Migration—repeated departure and return of individuals and their offspring to and from an area.

Migratory Birds—birds characterized by their practice of passing, usually periodically, from one region or climate to another.

Military Operating Area—airspace below 18,000 feet used to separate or segregate certain non-hazardous military flight activities from Instrument Flight Rules traffic and to identify for Visual Flight Rules traffic where these activities are conducted.

Military Training Route—an airspace corridor established for military flight training at airspeeds in excess of 250 nautical miles/hour.

Minority—minority populations, as reported by the 2000 Census of Population and Housing, includes Black, American Indian, Eskimo or Aleut, Asian or Pacific Islander, Hispanic, or other.

Mitigation—a method or action to reduce or eliminate adverse environmental impacts. Such measures may avoid impacts by not taking a certain action or parts of an action; minimize impacts by limiting the magnitude of an action; rectify impacts by restoration measures; reduce or eliminate impacts over time by preservation or maintenance measures during the action; or compensate for impacts by replacing or providing substitute resources or environments.

Mobile Sources—any movable source that emits any regulated air pollutant.

Mortality—the number of deaths in a given time or place.

Munitions Constituents—any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

National Airspace System—the common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.

National Ambient Air Quality Standards (NAAQS)—as set by the Environmental Protection Agency under Section 109 of the Clean Air Act, nationwide standards for limiting concentrations of certain widespread airborne pollutants to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility and materials (secondary standards). Currently, six pollutants are regulated by primary and secondary NAAQS: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide (see Criteria Pollutants).

National Environmental Policy Act (NEPA)—Public Law 91-190, passed by Congress in 1969. The Act established a national policy designed to encourage consideration of the influences of human activities, such as population growth, high-density urbanization, or industrial development, on the natural environment. The National Environmental Policy Act procedures require that environmental information be made available to the public before decisions are made. Information contained in the National Environmental Policy Act documents must focus on the relevant issues in order to facilitate the decision-making process.

National Register of Historic Places Eligible Property—property that has been determined eligible for the National Register of Historic Places listing by the Secretary of the Interior, or one that has not yet gone through the formal eligibility determination process but which meets the National Register of Historic Places criteria for section review purposes; eligible properties are treated as if they were already listed.

National Register of Historic Places—a register of districts, sites, buildings, structures, and objects important in American history, architecture, archaeology, and culture, maintained by the Secretary of the

Interior under authority of Section 2 (b) of the Historic Sites Act of 1935 and Section 101 (a)(1) of the National Historic Preservation Act of 1966, as amended.

National Wildlife Refuge—a part of the national network of refuges and wetlands managed by the U.S. Fish and Wildlife Service in order to provide, preserve, and restore lands and waters sufficient in size, diversity and location to meet society's needs for areas where the widest possible spectrum of benefits associated with wildlife and wildlands is enhanced and made available. This includes 504 wildlife refuges nationwide encompassing 92 million acres and ranging in size from one-half acre to thousands of square miles. Dedicated to protecting wildlife and their habitat, U.S. refuges encompass numerous ecosystems and are home to a wide variety of fauna, including large numbers of migratory birds and some 215 threatened or endangered species.

Native Americans—used in a collective sense to refer to individuals, bands, or tribes who trace their ancestry to indigenous populations of North America prior to Euro-American contact.

Native Species—plants or animals living or growing naturally in a given region and often referred to as indigenous.

Native Vegetation—often referred to as indigenous, these are plants living or growing naturally in a given region without agricultural or cultivational efforts.

Navigational Aid—any visual or electronic device, airborne or on the surface, which provides point-to-point guidance information or position data to aircraft in flight.

Near-Shore—an indefinite zone that extends seaward from the shoreline.

Neritic—relating to the shallow ocean waters, usually no deeper than 109 fathoms (656 feet).

Nitrogen Dioxide—gas formed primarily from atmospheric nitrogen and oxygen when combustion takes place at high temperatures.

Nitrogen Oxides—gases formed primarily by fuel combustion and which contribute to the formation of acid rain. In the presence of sunlight, hydrocarbons and nitrogen oxides combine to form ozone, a major constituent of photochemical smog.

Nitrogen Tetroxide—a dark brown, fuming liquid or gas with a pungent, acrid odor, utilized in rocket fuels.

Nonattainment Area—an area that has been designated by the U.S. Environmental Protection Agency or the appropriate state air quality agency as exceeding one or more of the national or state ambient air quality standards.

Non-directional Radio Beacon—a radio beacon transmitting non-directional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine the aircraft's bearing to or from the radio beacon and “home” on or track to or from the station.

Non-explosive, Practice Munitions (NEPM)—used when describing most common types of practice ordnance. However, non-explosive, practice munitions may contain spotting charges or signal cartridges for impact locating purposes (smoke charges for daylight spotting, flash charges for night spotting); example - MK-76, BDU-45. Some non-explosive, practice munitions may also contain unburned propellant (such as rockets).

Non-ionizing Radiation—electromagnetic radiation at wavelengths whose corresponding photon energy is not high enough to ionize an absorbing molecule. All radio frequency, infrared, visible, and near ultraviolet radiation are non-ionizing.

Non-Point Source Pollution—diffuse pollution; that is, from a combination of sources; typically originates from rain and melted snow flowing over the land (runoff). As runoff contacts the land's surface, it picks up many pollutants in its path: sediment, oil and grease, road salt, fertilizers, pesticides, nutrients, toxics, and other contaminants. Runoff also originates from irrigation water used in agriculture and on landscapes. Other types of non-point pollution include changes to the natural flow of water in stream channels or wetlands.

Notice to Airmen (NOTAM)—a notice containing information, not known sufficiently in advance to publicize by other means, the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the National Airspace System), the timely knowledge of which is essential to personnel concerned with flight operations.

Notice to Mariners (NOTMAR)—a periodic notice regarding changes in aids to navigation, dangers to navigation and other information essential to mariners.

Off-Shore—open-ocean waters over the continental slope which are deeper than 200 meters, beyond the continental shelf break.

Operating Area (OPAREA)—ocean area not part of a range used by military personnel or equipment for training and weapons system Research, Development, Test & Evaluation (RDT&E).

Operation—A combination of activities accomplished together for a scheduled period of time for an intended military mission or task. An operation can range in size from a single unit exercise to a Joint or Combined event with many participants (e.g., aircraft, ships, submarines, troops).

Operational Range—a range that is under the jurisdiction, custody, or control of the Secretary of Defense and is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities.

Ordnance—military supplies including weapons, ammunition, combat vehicles, and maintenance equipment.

OTTO Fuel—a torpedo fuel.

Ozone (O_3)—a highly reactive form of oxygen that is the predominant component of photochemical smog and an irritating agent to the respiratory system. Ozone is not emitted directly into the atmosphere but results from a series of chemical reactions between oxidant precursors (nitrogen oxides and volatile organic compounds) in the presence of sunlight.

Ozone Layer—a naturally occurring layer of ozone 7 to 30 miles above the earth's surface (in the stratosphere) which filters out the sun's harmful ultraviolet radiation. It is not affected by photochemical smog found in the lower atmosphere, nor is there any mixing between ground level ozone and ozone in the upper atmosphere.

Paleontological Resources—fossilized organic remains from past geological periods.

Paleontology—the study of life in the past geologic time, based on fossil plants and animals.

Participant—an individual ship, aircraft, submarine, amphibious vehicle, or ground unit.

Particulate Matter, Fine Respirable—finely divided solids or liquids less than 10 microns in diameter which, when inhaled, remain lodged in the lungs and contribute to adverse health effects.

Particulate Matter, Total Suspended—finely divided solids or liquids ranging from about 0.1 to 50 microns in diameter which comprise the bulk of the particulate matter mass in the atmosphere.

Particulate Matter—particles small enough to be airborne, such as dust or smoke (see Criteria Pollutants).

Payload—any non-nuclear and possibly propulsive object or objects, weighing up to 272.2 kilograms (600 pounds), which are carried above the Strategic Target System third stage.

Pelagic Zone—commonly referred to as the open ocean.

Pelagic—of the ocean waters.

Peninsula—a portion of land nearly surrounded by water and generally connected with a larger body by an isthmus, although the isthmus is not always well defined.

Per Capita—per unit of population; by or for each person.

Permeability—a quality that enables water to penetrate.

Pesticide—any substance, organic, or inorganic, used to destroy or inhibit the action of plant or animal pests; the term thus includes insecticides, herbicides, fungicides, rodenticides, miticides, fumigants, and repellents. All pesticides are toxic to humans to a greater or lesser degree. Pesticides vary in biodegradability.

pH—a measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity.

Photosynthesis—the plant process by which water and carbon dioxide are used to manufacture energy-rich organic compounds in the presence of chlorophyll and energy from sunlight.

Physiography—geography dealing with the exterior physical features and changes of the earth (also known as physical geography).

Phytoplankton—plant-like organisms that drift with the ocean currents, with little ability to move through the water on their own. Predominately one-celled, phytoplankton float in the photic zone (sunlit surface waters of the ocean, which extends to only about 100 meters (330 feet) below the surface), where they obtain sunlight and nutrients, and serve as food for zooplankton and certain larger marine animals.

Pinniped—having finlike feet or flippers, such as a seal or walrus.

Plankton—free-floating, usually minute, organisms of the sea; includes larvae of benthic species.

Pliocene—of, relating to, or being the latest epoch of the Tertiary Period or the corresponding system of rocks; following the Pleistocene and prior to the Miocene.

PM-2.5 and PM-10—standards for measuring the amount of solid or liquid matter suspended in the atmosphere; refers to the amount of particulate matter less than or equal to 2.5 and 10 micrometers in diameter, respectively. The PM-2.5 and PM-10 particles penetrate to the deeper portions of the lungs, affecting sensitive population groups such as children and people with respiratory or cardiac diseases.

Point Source—a distinct and identifiable source, such as a sewer or industrial outfall pipe, from which a pollutant is discharged.

Population Density—the average number of individuals or organisms per unit of space or area.

Potable Water—water that is safe to drink.

Potentially Hazardous Debris—inert debris impacting the earth with a kinetic energy equal to or greater than 11 foot-pounds.

Prehistoric—literally, "before history," or before the advent of written records. In the old world writing first occurred about 5400 years ago (the Sumerians). Generally, in North America and the Pacific region, the prehistoric era ended when European explorers and mariners made written accounts of what they encountered. This time will vary from place to place.

Prohibited Area—designated airspace where aircraft are prohibited, except by special permission. Can also apply to surface craft.

Radar—a radio device or system for locating an object by means of radio waves reflected from the object and received, observed, and analyzed by the receiving part of the device in such a way that characteristics (such as distance and direction) of the object may be determined.

Range—a land or sea area designated and equipped for any or all of the following reasons:

Range Activity—an individual training or test function performed on a range or in an Operating Area. Examples include missile launching, bombardment, and vehicle driving. Individual RDT&E functions are also included in this category.

Range Complex—a geographically integrated set of ranges, operational areas, and associated special use airspace, designated and equipped with a command and control system and supporting infrastructure for freedom of maneuver and practice in munitions firing and live ordnance use against scored and/or tactical targets and/or Electronic Warfare tactical combat training environment.

Range Operation—a live training exercise, RDT&E test, or field maneuver conducted for a specific strategic, operational or tactical military mission, or task. A military action. Operations may occur independently, or multiple operations may be accomplished as part of a larger event. One operation consists of a combination of activities accomplished together. The type of operation can include air, land, sea, and undersea warfare training or testing. Participants can include a specific number and type of aircraft, ships, submarines, amphibious or other vehicles and personnel. Ordnance broadly encompasses all weapons, missiles, shells, and expendables (chaff and flares). An individual operation occurs over a given geographic footprint for a scheduled period of time. An example is a Mining Operation. Each Mining Operation is discrete and relatively short in duration, but it may be combined with other operations in a single, larger exercise, like a JTFEX, which lasts for several days or weeks.

Range Safety Zone—area around air-to-ground ranges designed to provide safety of flight and personnel safety relative to dropped ordnance and crash sites. Land use restrictions can vary depending on the degree of safety hazard, usually decreasing in magnitude from the weapons impact area (including potential ricochet) to the area of armed over flight and aircraft maneuvering.

Readiness—the ability of forces, units, weapon systems, or equipment to deliver the outputs for which they were designed (includes the ability to deploy and employ without unacceptable delays).

Region of Influence—the geographical region that would be expected to be affected in some way by the Proposed Action and alternatives.

Relative Humidity—the ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature.

Relief—the difference in elevation between the tops of hills and the bottoms of valleys.

Remediation—all necessary actions to investigate and clean up any known or suspected discharge or threatened discharge of contaminants, including without limitation: preliminary assessment, site investigations, remedial investigations, remedial alternative analyses and remedial actions.

Restricted Area—a designated airspace in which flights are prohibited during published periods of use unless permission is obtained from the controlling authority.

Runoff—the portion of precipitation on land that ultimately reaches streams, often with dissolved or suspended materials.

Safety Zone—administratively designated/implied areas designated to limit hazards to personnel and the public, and resolve conflicts between operations. Can include range safety zones, ESQDS, surface danger zones, special use airspace, HERO/HERP areas, etc.

Saline—consisting of or containing salt.

Sampling—the selection of a portion of a study area or population, the analysis of which is intended to permit generalization of the entire population. In archaeology, samples are often used to reduce the amount of land area covered in a survey or the number of artifacts analyzed from a site. Statistical sampling is generally preferred since it is possible to specify the bias or probability of error in the results, but judgmental or intuitive samples are sometimes used.

Scoping—a process initiated early during preparation of an Environmental Impact Statement to identify the scope of issues to be addressed, including the significant issues related to the Proposed Action. During scoping, input is solicited from affected agencies as well as the interested public.

Seamount—a peaked, underwater mountain that rises at least 3,281 feet above the ocean floor.

Seawall—a wall or embankment to protect the shore from erosion or to act as a breakwater.

Security Zone—area where public or non-operational support access is prohibited due to training operations of a classified or hazardous nature.

Seduction Chaff—radar confusion reflectors, consisting of thin metallic strips, which are used to reflect electronic signals for confusion purposes. A defensive electronic countermeasures system designed/intended to hide or obscure the launch platform from air-to-surface or surface-to-surface attack.

Sensitive Habitats—areas of special importance to regional wildlife populations or protected species that have other important biological characteristics (for example, wintering habitats, nesting areas, and wetlands).

Sensitive Receptor—an organism or population of organisms sensitive to alterations of some environmental factor (such as air quality or sound waves) that undergo specific effects when exposed to such alteration.

Short-Term Public Exposure Guidance Level—an acceptable concentration for unpredicted, single, short-term, emergency exposure of the general public, as published by the National Research Council.

Site—in archaeology, any location where human beings have altered the terrain or have discarded artifacts.

Solid Waste—municipal waste products and construction and demolition materials; includes non-recyclable materials with the exception of yard waste.

Sonobuoy—hydrophones, or floating sensors, which acoustically score bomb drops during a training exercise from the sound where a bomb impacts the surface of the ocean.

Sortie—a single operational training or RDT&E event conducted by one aircraft tin a range or operating area. A single aircraft sortie is one complete flight (i.e., one take-off and one final landing).

Special Use Airspace—consists of several types of airspace used by the military to meet its particular needs. Special use airspace consists of that airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of these activities, or both. Special use airspace, except for Control Firing Areas, are chartered on instrument flight rules or visual flight rules charts and include hours of operation, altitudes, and the controlling agency.

Species—a taxonomic category ranking immediately below a genus and including closely related, morphologically similar individuals which actually or potentially interbreed.

Specific Absorption Rate—the time rate at which radio frequency energy is absorbed per unit mass of material, usually measured in watts per kilogram (W/kg).

Stakeholder—those people or organizations that are affected by or have the ability to influence the outcome of an issue. In general this includes regulators, the regulated entity, and the public. It also includes those individuals who meet the above criteria and do not have a formal or statutorily defined decision-making role.

State Historic Preservation Officer (SHPO)—the official within each state, authorized by the state at the request of the Secretary of the Interior, to act as liaison for purposes of implementing the National Historic Preservation Act.

State Jurisdictional Waters—sea areas within 3 nm of a state's continental and island shoreline.

Stationary Source—any building, structure, facility, installation, or other fixed source that emits any regulated air pollutant.

Stormwater—runoff produced during storms, generally diverted by rain spouts and stormwater sewerage systems. Stormwater has the potential to be polluted by such sources as yard trimmings and pesticides. A stormwater outfall refers to the mouth of a drain or sewer that channels this runoff.

Subsistence Economy—a community, usually based on farming and/or fishing, that provides all or most of the basic goods required by its members for survival, usually without any significant surplus for sale.

Subsistence—the traditional harvesting of natural resources for food, clothing, fuel, transportation, construction, art, crafts, sharing, and customary trade.

Subspecies—a geographically defined grouping of local populations which differs taxonomically from similar subdivisions of species.

Substrate—the layer of soil beneath the surface soil; the base upon which an organism lives.

Sulfur Dioxide—a toxic gas that is produced when fossil fuels, such as coal and oil, are burned.

Sustainable Range Management—management of an operational range in a manner that supports national security objectives, maintains the operational readiness of the Armed Forces, and ensures the long-term viability of operational ranges while protecting human health and the environment.

Sustaining the Capability—maintaining necessary skills, readiness and abilities.

Symbiotic—living in or on the host.

System of Systems—all communications, electronic warfare, instrumentation, and systems linkage supporting the range/range complex.

Taking—to harass, harm, pursue, hunt, shout, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Taking can involve harming the habitat of an endangered species.

Targets—earthwork, materials, actual or simulated weapons platforms (tanks, aircraft, EW systems, vehicles, ships, etc.) comprising tactical target scenarios within the range/range complex impact areas. Could also include SEPTAR, AQM, BQM, MQM, etc.

Tenant—a unit that has an Inter-Service Support Agreement with the host for use of the training areas and that maintains a permanent presence.

Thermocline—a thin, narrow region in a thermally stratified body of water which separates warmer, oxygen-rich surface water from cold, oxygen-poor deep water and in which temperature decreases rapidly with depth. In tropical latitudes, the thermocline is present as a permanent feature and is located 200 to 1,000 feet below the surface.

Threatened Species—a plant or animal species likely to become endangered in the foreseeable future.

Topography—the configuration of a surface including its relief and the position of its natural and man-made features.

Traditional Resources—prehistoric sites and artifacts, historic areas of occupation and events, historic and contemporary sacred areas, material used to produce implements and sacred objects, hunting and gathering areas, and other botanical, biological, and geographical resources of importance to contemporary groups.

Transient—remaining a short time in a particular area.

Troposphere—the atmosphere from ground level to an altitude of 6.2 to 9.3 miles (see stratosphere).

Turbid—the condition of being thick, cloudy, or opaque as if with roiled sediment; muddy.

Uncontrolled Airspace—airspace of defined dimensions in which no air traffic control services to either instrument flight rules or visual flight rules aircraft will be provided, other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

Understory—a vegetal layer growing near the ground and beneath the canopy of a taller layer.

Unique and Sensitive Habitats—areas of special importance to regional wildlife populations or protected species that have other important biological characteristics (for example, wintering habitats, nesting areas, and wetlands).

Unsymmetrical Dimethyl Hydrazine (UDMH)—a liquid hypergolic propellant utilized as a missile fuel (as in the Lance); clear and colorless, UDMH has a sharp ammonia-like or fishy odor, is toxic when inhaled, absorbed through the skin, or taken internally. It is dissolvable in water, but not sensitive to shock or friction; however, when in contact with IRFNA, or any other oxidizing material, spontaneous ignition occurs. In addition, UDMH vapors greater than 2 percent in air can be detonated by electric spark or open flame.

Upland—an area of land of higher elevation.

Upwelling—the replenishing process of upward movement to the surface of marine often nutrient-rich lower waters (a boon to plankton growth), especially along some shores due to the offshore drift of surface water as from the action of winds and the Coriolis force.

U.S. Territorial Waters—sea areas within 12 nm of the U.S. continental and island shoreline.

Viewshed—total area seen within the cone of vision from a single observer position, or vantage point; a collection of viewpoints with optimal linear paths of visibility.

Vista—a distant view through or along an avenue or opening.

Visual Flight Rules (VFR)—rules that govern the procedures for conducting flight under visual conditions; used by pilots and controllers to indicate type of flight plan.

Volatile Organic Compound (VOC)—one of a group of chemicals that react in the atmosphere with nitrogen oxides in the presence of heat and sunlight to form ozone; it does not include methane and other compounds determined by the Environmental Protection Agency to have negligible photochemical reactivity. Examples of volatile organic compounds include gasoline fumes and oil-based paints.

Warfare Mission—referring to one of the eight Primary Mission Areas (MIW, AMW, SUW, ASW, AW, STW, EC, NSW) as further broken down into sub-events (MCM, amphibious assault, GUNEX(S-S), TRACKEX(Sub), MISSILEX(A-A), BOMBEX(A-G), CHAFFEX, CSAR).

Warning Area—a designated airspace in which flights are not restricted but avoidance is advised during published times of use.

Wastewater—water that has been previously utilized; sewage.

Wetlands—lands or areas that either contain much soil moisture or are inundated by surface or groundwater with a frequency sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include such areas as bogs, marshes, mud and tidal flats, sloughs, river overflows, seeps, springs, or swamps.

Wholly Inert—ordnance with no explosive, propellant, or pyrotechnic component (non-reactive); example: BDU-50, BDU-56 (both are non-reactive heavy-weights with no explosive charges).

Yearly Average Day-Night Sound Level (DNL or L_{dn})—utilized in evaluating long-term environmental impacts from noise, this is an annual mean of the day-night sound level.

Zoning—the division of a municipality (or county) into districts for the purpose of regulating land use, types of buildings, required yards, necessary off-street parking, and other prerequisites to development. Zones are generally shown on a map, and the text of the zoning ordinance specifies requirements for each zoning category.

Zooplankton—animals that drift with the ocean currents, with little ability to move through the water on their own, ranging from one-celled organisms to jellyfish up to 1.8 meters (6 feet) wide. Zooplankton live in both surface and deep waters of the ocean; crustaceans make up about 70 percent. While some float about freely throughout their lives, many spend only the early part of their lives as plankton.

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The individuals, agencies, and organizations listed below received a copy of the Virginia Capes Range Complex Draft Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). Please note that not all states have a Clearinghouse. For states not having a Clearinghouse, a copy of the VACAPES Range Complex Draft EIS/OEIS was sent to the most relevant state agency. A list of stakeholders: individuals, agencies, and organizations that received notification of the availability of the VACAPES Range Complex Draft EIS/OEIS and the notice of public hearing are presented at the end of this section.

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The Honorable Barbara Mikulski US Senate 503 Hart Senate Office Building Washington, DC 20510	The Honorable Benjamin Cardin US Senate 509 Hart Senate Office Building Washington, DC 20510
The Honorable Frank M. Kratovil, Jr. US Congressman 1st District, Maryland 314 Cannon House Office Building Washington, DC 20515	The Honorable C.A. Dutch Ruppersberger US Congressman 2nd District, Maryland 1730 Longworth House Office Building Washington, DC 20515
The Honorable John Sarbanes US Congressman 3rd District, Maryland 426 Cannon House Office Building Washington, DC 20515	The Honorable Steny H. Hoyer US Congressman 5th District, Maryland 1705 Longworth House Office Building Washington, DC 20515
The Honorable Elijah E. Cummings US Congressman 7th District, Maryland 2235 Rayburn House Office Building Washington, DC 20515	

Virginia	
The Honorable Jim Webb US Senate 144 Russell Senate Office Building Washington DC 20510	The Honorable John Warner US Senate 225 Russell Senate Office Building Washington, DC 20510
The Honorable Robert Wittman US Congressman 1st District, Virginia 1318 Longworth House Office Building Washington DC 20515	The Honorable Glenn C Nye, III US Congressman 2nd District, Virginia 116 Cannon House Office Building Washington DC 20515
The Honorable Robert C. Scott US Congressman 3rd District, Virginia 1201 Longworth House Office Building Washington DC 20515	The Honorable James P. Moran US Congressman 8th District, Virginia 2239 Longworth House Office Building Washington DC 20515
The Honorable Tom Davis US Congressman 11th District, Virginia 1248 Rayburn House Office Building Washington DC 20515	
North Carolina	
The Honorable Richard Burr US Senate 217 Russell Senate Office Building Washington DC 20510	The Honorable Kay Hagan US Senate B40A Dirksen Senate Office Building Washington DC 20510
The Honorable G.K. Butterfield US Congressman 1st District, North Carolina 413 Cannon House Office Building Washington DC 20515	The Honorable Walter B. Jones US Congressman 3rd District, North Carolina 2333 Rayburn House Office Building Washington DC 20515
The Honorable Mike McIntyre US Congressman 7th District, North Carolina 2437 Rayburn House Office Building Washington DC 20515	

STAKEHOLDER LIST

Postcards were disseminated to individuals, agencies, and organizations listed below. The postcards acted as formal notification of the availability of the VACAPES Range Complex Draft EIS/OEIS and announcement of public hearings. The notice of public hearing is presented after the listing of stakeholders. At the end of this table is a list of private entities that attended the public hearings.

STATE ELECTED OFFICIALS	
Delaware	
The Honorable Jack Markell Office of the Governor Tatnail Building William Penn Street, 2nd Floor Dover, DE 19901	The Honorable Harris B. McDowell, III. Delaware Senate – 1st District PO Box 1401 Dover, DE 19903
The Honorable Margaret Rose Henry Delaware Senate – 2nd District PO Box 1401 Dover, DE 19903	The Honorable Robert Marshall Delaware Senate District 3 P.O. Box 1401 Dover, DE 19903
The Honorable Michael Katz Delaware Senate District 4 P.O. Box 1401 Dover, DE 19903	The Honorable Catherine L. Cloutier Delaware Senate – 5th District PO Box 1401 Dover, DE 19903
The Honorable Liane Sorenson Senate Minority Whip Delaware Senate District 6 P.O. Box 1401 Dover, DE 19903	The Honorable Patricia Blevins Senate Majority Whip Delaware Senate District 7 P.O. Box 1401 Dover, DE 19903
The Honorable S. Quinton Johnson Delaware Senate District 8 P.O. Box 1401 Dover, DE 19903	The Honorable Karen Peterson Delaware Senate District 9 P.O. Box 1401 Dover, DE 19903
The Honorable Bethany Hall-Long Delaware Senate District 10 P.O. Box 1401 Dover, DE 19903	The Honorable Anthony DeLuca Senate Majority Leader Delaware Senate District 11 P.O. Box 1401 Dover, DE 19903
The Honorable Dorinda A. Conner Delaware Senate – 12th District PO Box 1401 Dover, DE 19903	The Honorable David McBride Delaware Senate District 13 P.O. Box 1401 Dover, DE 19903

The Honorable Bruce C. Ennis Delaware Senate – 14th District PO Box 1401 Dover, DE 19903	The Honorable Colin R.J. Bonini Delaware Senate – 16th District PO Box 1401 Dover, DE 19903
The Honorable Brian Bushweller Delaware Senate – 17th District PO Box 1401 Dover, DE 19903	The Honorable F. Gary Simpson Senate Minority Leader Delaware Senate – 18th District PO Box 1401 Dover, DE 19903
The Honorable Thurman Adams Jr. President Pro Tempore Delaware Senate District 19 P.O. Box 1401 Dover, DE 19903	The Honorable George H. Bunting, Jr. Delaware Senate – 20th District PO Box 1401 Dover, DE 19903
The Honorable Robert Venables Delaware Senate District 21 P.O. Box 1401 Dover, DE 19903	The Honorable Dennis Williams Delaware House of Representatives Legislative District 1 P.O. Box 1401 Dover, DE 19903
Representative Hazel D. Plant Delaware House – 2nd District PO Box 1401 Dover, DE 19903	The Honorable Helene Keeley House Minority Whip Delaware House of Representatives Legislative District 3 P.O. Box 1401 Dover, DE 19903
The Honorable Gerald Brady Delaware House of Representatives Legislative District 4 P.O. Box 1401 Dover, DE 19903	The Honorable Melanie Marshall Delaware House of Representatives Legislative District 5 P.O. Box 1401 Dover, DE 19903
The Honorable Bryon Short Delaware House of Representatives Legislative District 7 P.O. Box 1401 Dover, DE 19903	The Honorable Bethany Hall-Long Delaware House of Representatives Legislative District 8 P.O. Box 1401 Dover, DE 19903
The Honorable Deborah Hudson Delaware House of Representatives Legislative District 12 P.O. Box 1401 Dover, DE 19903	The Honorable John Mitchell Delaware House of Representatives Legislative District 13 P.O. Box 1401 Dover, DE 19903
The Honorable Terry Spence Speaker of the House Delaware House of Representatives Legislative District 18 P.O. Box 1401 Dover, DE 19903	The Honorable Robert Gilligan House Minority Leader Delaware House of Representatives Legislative District 19 P.O. Box 1401 Dover, DE 19903

The Honorable Nick Manolakos Delaware House of Representatives Legislative District 20 P.O. Box 1401 Dover, DE 19903	The Honorable Michael Ramone Delaware House of Representatives Legislative District 21 P.O. Box 1401 Dover, DE 19903
The Honorable Joseph Miro Delaware House of Representatives Legislative District 22 P.O. Box 1401 Dover, DE 19903	The Honorable Teresa Schooley Delaware House of Representatives Legislative District 23 P.O. Box 1401 Dover, DE 19903
The Honorable William Oberle Delaware House of Representatives Legislative District 24 P.O. Box 1401 Dover, DE 19903	The Honorable John Kowalko Delaware House of Representatives Legislative District 25 P.O. Box 1401 Dover, DE 19903
The Honorable John Viola Delaware House of Representatives Legislative District 26 P.O. Box 1401 Dover, DE 19903	The Honorable Earl Jaques, Jr. Delaware House of Representatives Legislative District 27 P.O. Box 1401 Dover, DE 19903
The Honorable William Carson Delaware House of Representatives Legislative District 28 P.O. Box 1401 Dover, DE 19903	The Honorable Pamela Thornburg Delaware House of Representatives Legislative District 29 P.O. Box 1401 Dover, DE 19903
The Honorable William Outten Delaware House of Representatives Legislative District 30 P.O. Box 1401 Dover, DE 19903	The Honorable Darryl Scott Delaware House of Representatives Legislative District 31 P.O. Box 1401 Dover, DE 19903
The Honorable Donald Blakey Delaware House of Representatives Legislative District 34 P.O. Box 1401 Dover, DE 19903	The Honorable David Wilson Delaware House of Representatives Legislative District 35 P.O. Box 1401 Dover, DE 19903
The Honorable Daniel Short Delaware House of Representatives Legislative District 39 P.O. Box 1401 Dover, DE 19903	The Honorable Clifford Lee House Majority Whip Delaware House of Representatives Legislative District 40 P.O. Box 1401 Dover, DE 19903
Representative John C. Atkins Delaware House – 41st District PO Box 1401 Dover, DE 19903	Representative Richard C. Cathcart House Majority Leader Delaware House – 9th District PO Box 1401 Dover, DE 19903

Representative Thomas Kovach Delaware House – 6th District PO Box 1401 Dover, DE 19903	Representative Dennis Williams Delaware House – 10th District PO Box 1401 Dover, DE 19903
Representative Gregory F. Lavalle Delaware House – 11th District PO Box 1401 Dover, DE 19903	Representative Peter C. Swartzkopf Delaware House – 14th District PO Box 1401 Dover, DE 19903
Representative Valerie Longhurst House Majority Whip Delaware House – 15th District PO Box 1401 Dover, DE 19903	Representative James Johnson Delaware House – 16th District PO Box 1401 Dover, DE 19903
Representative Michael P. Mulrooney Delaware House – 17th District PO Box 1401 Dover, DE 19903	Representative William Carson Delaware House – 28th District PO Box 1401 Dover, DE 19903
Representative E. Bradford Bennett Delaware House – 32nd District PO Box 1401 Dover, DE 19903	Representative Robert Walls Delaware House – 33rd District PO Box 1401 Dover, DE 19903
Representative V. George Carey Delaware House – 36th District PO Box 1401 Dover, DE 19903	Representative Joseph W. Booth Delaware House – 37th District PO Box 1401 Dover, DE 19903
Representative Gerald W. Hocker Delaware House – 38th District PO Box 1401 Dover, DE 19903	
Maryland	
Governor Martin O'Malley Office of the Governor 100 State Circle Annapolis, MD 21401	The Honorable Brian E. Frosh Maryland State Senate District 16 2E Miller Office Bldg. Annapolis, MD 21401
Representative James E. Mathia, Jr. Maryland House, 38th B District House Office Building, Room 307 6 Bladen Street Annapolis, MD 21401	The Honorable J. Lowell Stoltzfus Maryland Senate, 38th District James Senate Office Building, Room 323 11 Bladen Street Annapolis, MD 21401
Representative Norman H. Conway Maryland House, 38th B District House Office Building, Room 121 6 Bladen Street Annapolis, MD 21401	The Honorable Larry E. Haines Maryland Senate, 5th District James Senate Office Building, Room 316 110 College Avenue Annapolis, MD 21401

The Honorable Alex X. Mooney Maryland Senate, 3rd District James Senate Office Building, Room 402 110 College Avenue Annapolis, MD 21401	The Honorable Donald F. Munson Maryland Senate, 2nd District James Senate Office Building, Room 401 110 College Avenue Annapolis, MD 21401
The Honorable George C. Edwards Maryland Senate, 1st District James Senate Office Building, Room 323 110 College Avenue Annapolis, MD 21401	The Honorable James W. Hubbard Maryland House, District 23A 208 Lowe House Office Bldg. Annapolis, MD 21401
The Honorable Michael H. Weir Jr. Maryland House, District 6 Lowe House Office Bldg., Room 307 Annapolis, MD 21401	The Honorable Galen R. Clagett Maryland House, District 3A Lowe House Office Building, Room 410A 84 College Avenue Annapolis, MD 21401
The Honorable Wendell R. Beitzel Maryland House, District 1A Lowe House Office Building, Room 320 84 College Avenue Annapolis, MD 21401	The Honorable Kevin Kelly Maryland House,District 1B Lowe House Office Building, Room 320 84 College Avenue Annapolis, MD 21401
The Honorable LeRoy E. Myers Maryland House, District 1C Lowe House Office Building, Room 320 84 College Avenue Annapolis, MD 21401	The Honorable Andrew A. Serafini Maryland House, District 2A Lowe House Office Building, Room 321 84 College Avenue Annapolis, MD 21401
The Honorable Christopher B. Shank Maryland House, District 2B Lowe House Office Building, Room 302 84 College Avenue Annapolis, MD 21401	The Honorable John P. Donoghue Maryland House, District 2C Lowe House Office Building, Room 151 84 College Avenue Annapolis, MD 21401
The Honorable Sue C. Hecht Maryland House, District 3A Lowe House Office Building, Room 324 84 College Avenue Annapolis, MD 21401	The Honorable Richard B. Weldon Maryland House, District 3B Lowe House Office Building, Room 324 84 College Avenue Annapolis, MD 21401
The Honorable Tanya Thornton Shewell Maryland House, District 5A Lowe House Office Building, Room 322 84 College Avenue Annapolis, MD 21401	The Honorable Nancy R. Stocksdale Maryland House, District 5A Lowe House Office Building, Room 322 84 College Avenue Annapolis, MD 21401
The Honorable A. Wade Kach Maryland House, District 5B Lowe House Office Building, Room 308 84 College Avenue Annapolis, MD 21401	

Virginia	
Governor Tim Kaine Office of the Governor Patrick Henry Building, 3rd Floor 111 East Broad Street Richmond, VA 23219	Mr. Scott L. Lingamfelter Virginia Delegate—District 31 General Assembly Building P.O.Box 406 Richmond, VA 23218
Delegate Lynwood W. Lewis, Jr. Virginia Delegate – 100th District PO Box 406 Richmond, VA 23218	The Honorable John C. Miller Senate of Virginia—District 1 P.O. Box 396 Richmond, VA 23218
The Honorable Mamie E. Locke Virginia Senate – 2nd District PO Box 396 Richmond, VA 23218	The Honorable Thomas K. Norment, Jr. Virginia Senate – 3rd District PO Box 396 Richmond, VA 23218
The Honorable Yvonne B. Miller Virginia Senate – 5th District PO Box 396 Richmond, VA 23218	The Honorable Ralph S. Northam Senate of Virginia—District 6 P.O. Box 396 Richmond, VA 23218
The Honorable Frank W. Wagner Virginia Senate – 7th District PO Box 396 Richmond, VA 23218	The Honorable Patricia S. Ticer Virginia Senate – 30th District PO Box 396 Richmond, VA 23218
The Honorable Mary Margaret Whipple Virginia Senate – 31st District PO Box 396 Richmond, VA 23218	Delegate Barry Knight Virginia Delegate – 81st District PO Box 406 Richmond, VA 23218
Mr. John A. Cosgrove Virginia Delegate—District 78 General Assembly Building P.O.Box 406 Richmond, VA 23218	The Honorable Emmett W. Hangar Jr. Senate of Virginia—District 24 District 24 P.O. Box 396 Richmond, VA 23218
The Honorable Albert C. Pollard Jr. Virginia Delegate - District 99 General Assembly Building, P.O. Box 406 Richmond, VA 23218	
North Carolina	
Governor Beverly Perdue Office of the Governor 20301 Mail Service Center Raleigh, NC 27699	The Honorable Marc Basnight North Carolina Senate – 1st District Legislative Office Building, Room 2007 Raleigh, NC 27601
The Honorable Harry Brown North Carolina Senate – 6th District Legislative Office Building, Room 515 Raleigh, NC 27603	The Honorable Jean Preston North Carolina Senate – 2nd District Legislative Office Building, Room 1121 Raleigh, NC 27603

The Honorable R.C. Soles, Jr. North Carolina Senate – 8th District Legislative Office Building, Room 2022 Raleigh, NC 27601	The Honorable Julia Boseman North Carolina Senate – 9th District Legislative Office Building, Room 309 Raleigh, NC 27603
Representative Bill Owens North Carolina House – 1st District Legislative Office Building, Room 635 Raleigh, NC 27603	Representative Timothy L. Spear North Carolina House – 2nd District Legislative Office Building, Room 402 Raleigh, NC 27603
The Honorable Annie W. Mobley North Carolina House – 5th District 300 N. Salisbury Street, Room 638 638 Legislative Office Building Raleigh, NC 27603-5925	The Honorable Russell E. Tucker North Carolina House – 4th District Legislative Office Building, Room 416B Raleigh, NC 27603-5925
The Honorable Alice Graham Underhill North Carolina House – 3rd District Legislative Building, Room 1206 Raleigh, NC 27601-1096	The Honorable William L. Wainwright North Carolina House – 12th District Legislative Office Building, Room 301F Raleigh, NC 27603-5925
The Honorable Sandra Spaulding Hughes North Carolina House – 18th District 300 N. Salisbury Street, Room 537 Raleigh, NC 27603-5925	The Honorable Dewey L. Hill North Carolina House – 20th District Legislative Building, Room 1309 Raleigh, NC 27601-1096
The Honorable Arthur Williams North Carolina House – 6th District Legislative Office Building, Room 637 Raleigh, NC 27603-5925	The Honorable Ed Jones North Carolina Senate – 4th District Legislative Office Building, Room 623 Raleigh, NC 27603-5925
Representative Pat McElraft North Carolina House – 13th District Legislative Office Building, Room 603 Raleigh, NC 27603	Representative George G. Cleveland North Carolina House – 14th District Legislative Office Building, Room 504 Raleigh, NC 27603
Representative W. Robert Grady North Carolina House – 15th District Legislative Office Building, Room 302 Raleigh, NC 27603	Representative Carolyn H. Justice North Carolina House – 16th District Legislative Office Building, Room 306A3 Raleigh, NC 27603
Representative Bonner L. Stiller North Carolina House – 17th District Legislative Office Building, Room 306A2 Raleigh, NC 27603	Representative Daniel F. McComas North Carolina House – 19th District Legislative Office Building, Room 506 Raleigh, NC 27603
Representative Paul Stam North Carolina House – 37th District Legislative Office Building, Room 613 Raleigh, NC 27601	Representative Joe Hackney North Carolina House – 54th District Legislative Office Building, Room 2304 Raleigh, NC 27601
The Honorable Hugh Holliman North Carolina House – 81st District Legislative Office Building, Room 2301 Raleigh, NC 27601	

CITY OFFICIALS	
Virginia	
The Honorable Paul Fraim Mayor of Norfolk 1109 City Hall Building 810 Union Street Norfolk, VA 23510	The Honorable William D. Sessoms, Jr. Mayor of Virginia Beach City Manager's Office; Municipal Center, BLDG 1 2401 Courthouse Drive Virginia Beach, VA 23456
The Honorable John Tarr Mayor of Chincoteague 6150 Community Drive Chincoteague Island, VA 23336	Mr. Steven B. Miner County Administrator, Accomack County 23296 Courthouse Ave, Suite 203 P.O. Box 388 Accomack, VA 23301
North Carolina	
The Honorable Gerald Jones, Jr. Mayor of Morehead City Town of Morehead City 706 Arendell Street Morehead City, NC 28557	Mr. John Langdon Carteret County Manager 302 Courthouse Square Beaufort, NC 28516
The Honorable Renee Cahoon Mayor of Nags Head P.O. Box 714 Nags Head, NC 27959	Mr. Rick Benton County Manager, Pender County P.O. Box 661 Burgaw, NC 28425
Maryland	
The Honorable Richard W. Meehan Mayor of Ocean City 301 Baltimore Ave. Ocean City, MD 21842	
FEDERAL AGENCIES	
U.S. Department of the Interior	
Mr. H. Dale Hall Director US Fish and Wildlife Service 1849 C Street, NW Washington, DC 20240	Mr. Sam Hamilton Director, Southeast Region US Fish and Wildlife Service 1875 Century Blvd., Suite 400 Atlanta, GA 30345
Mr. John Wolflin US Fish and Wildlife Service Chesapeake Bay Field Office Chesapeake Bay Program 177 Admiral Cochrane Drive Annapolis, MD 21401	Ms. Karen Mayne US Fish and Wildlife Service Virginia Field Office 6669 Short Lane Gloucester, VA 23061

Mr. Jared Brandwein US Fish and Wildlife Service Back Bay National Wildlife Refuge 4005 Sandpiper Road Virginia Beach, VA 23456	Ms. Sue Rice US Fish and Wildlife Service Chincoteague National Wildlife Refuge P.O. Box 62 Chincoteague Island, VA 23310
Ms. Susan Rice US Fish and Wildlife Service Eastern Shore and Fisherman Island National Wildlife Refuge Fisherman Island National Wildlife Refuge 5003 Hallet Circle Cape Charles, VA 23310-9725	Mr. Gregory J. Weiler US Fish and Wildlife Service Mason Neck, Featherstone and Occoquan Bay National Wildlife Refuges 14344 Jefferson Davis Highway Woodbridge, VA 22191
Mr. Mike Bryant US Fish and Wildlife Service Alligator River and Pea Island National Wildlife Refuges P.O. Box 1969 Manteo, NC 27954	Mr. Mike Hoff US Fish and Wildlife Service Mackay Island and Currituck National Wildlife Refuges P.O. Box 39 Knotts Island, NC 27950
Mr. Bruce Freske US Fish and Wildlife Service Mattamuskeet, Cedar Island and Swan Quarter National Wildlife Refuge 38 Mattamuskeet Road Swan Quarter, NC 27885	Mr. Howard A. Phillips US Fish and Wildlife Service Pocosin Lakes National Wildlife Refuge PO Box 329 Columbia, NC 27925
Mr. Stephen C. Jackson US Fish and Wildlife Service Edenton National Fish Hatchery 1102 West Queen Street Edenton, NC 27932	
National Aeronautics and Space Administration (NASA)	
CPO M. L. Zapawa NASA Wallops Flight Facility 337 Skeeter Lane Wallops Island, VA 23337	Joshua A. Bundick NASA, Goddard Space Flight Center Wallops Environmental Office, Code 250W Bldg F-160, Rm W160 Wallops Island, VA 23337
Walter D. Cruickshank Acting Director Minerals Management Service 1849 C Street, NW Washington, DC 20240	Shari B. Silbert NEPA and Natural Resource Programs NASA WFF, Environmental Office Bldg F-160, Rm C165 Wallops Island, VA 23337

Department of Commerce	
Ms. Patricia Kurkul Regional Administrator, Northeast Regional Office National Oceanic & Atmospheric Administration National Marine Fisheries One Blackburn Drive Gloucester, MA 01930	Dr. Roy E. Crabtree Regional Administrator, Southeast Regional Office National Oceanic & Atmospheric Administration NOAA Fisheries 263 13th Avenue, South St. Petersburg, FL 33701
Mr. Jim Lecky Director NOAA Fisheries Service Office of Protected Resources 1315 East West Highway Silver Spring, MD 20910	Dr. James W. Balsiger Assistant Administrator NOAA Fisheries Service 1315 East West Highway, SSMC3 Silver Spring, MD 20910
Mr. Ford Cross Director NOAA Fisheries Service P.O. Box 570 Beaufort, NC	Mr. Karen Kohanowich Director NOAA Fisheries Service Office of Habitat Conservation 1315 East West Highway Silver Spring, MD 20910
Mr. Lowell Bahner Special Assistant to the Director National Oceanic and Atmospheric Administration Office of Habitat Conservation 410 Severn Avenue, Suite 107A Annapolis, MD 21403	Ms. Maggie Kerchner Chesapeake Bay Program National Oceanic and Atmospheric Administration 410 Severn Avenue, Suite 107A Annapolis, MD 21403
Mr. John O'Shea Executive Director Atlantic States Marine Fisheries Commission 1444 Eye Street NW, 6th Floor Washington, D.C. 20005	David Alberg, Sanctuary Superintendent NOAA, National Ocean Service Monitor National Marine Sanctuary 100 Museum Drive Newport News, VA 23606
Mr. Peyton Robertson Chesapeake Bay Program National Oceanic and Atmospheric Administration 410 Severn Avenue Annapolis, MD 21403	

U.S. Department of Transportation	
Admiral Thad W. Allen Commandant (G-MWV) US Coast Guard – Headquarters 2100 Second Street, SW Washington, DC 20593	Rear Admiral Fred Rosa US Coast Guard – 5th District 431 Crawford Street Portsmouth, VA 23704
Ms. Shelley Meyer Sylivant Naval Surface Warfare Center (NSWC) 2202 Cambridge Downs Drive Morehead City, NC 28557	
Native Americans	
The Honorable Natalie Proctor Chairman, American Indian Cultural Center Cedarville Band of Piscataway Indians, American Indian Cultural Center 16816 Country Lane Waldorf, MD 20601	The Honorable Mervin Savoy Chairman, Piscataway Conoy Confederacy and Subtribes P.O. Box 1484 LaPlata, MD 20646
The Honorable Misty Dawn Thomas Chairman, Ani-Stohini/Unami Nation P.O. Box 979 Fries, VA 24330	Chief Stephen Adkins Chickahominy Indian Tribe 8200 Lott Cary Road Providence Forge, VA 23140
Eastern Chickahominy Indian Tribe, Eastern Division c/o Chief Gene Adkins 3120 Mt. Pleasant Rd. Providence Forge, VA 23140	Chief Barry W. Bass Nansemond Indian Tribe P.O. Box 2515 Suffolk, VA 23432
Chief Anne Richardson Rappahonnock Tribe 5036 Indian Neck Road Indian Neck, VA 23148	Chief William Miles Pamunkey Indian Tribe Route 1, Box 2220 King William, VA 23086
Chief Carl Lone Eagle Custalow Mattaponi Tribe 1467 Mattaponi Reservation Circle West Point, VA 23181	Chief Kenneth Adams Upper Mattaponi Tribe 13383 King William Road King William, VA 23086

STATE AGENCIES	
Delaware	
Mr. David Small Acting Secretary Department of Natural Resources & Environmental Control 89 Kings Highway Dover, DE 19901	Mr. Roy Miller Environmental Program Administrator - Fisheries DE Department of Natural Resources & Environmental Control Soil and Water Coastal Management Program 89 Kings Highway Dover, DE 19901
The Honorable Ed Key Secretary of Department of Agriculture 2320 South DuPont Highway Dover, DE 19901	Mr. Timothy Slavin Director Delaware Division of Historical and Cultural Affairs 21 The Green Dover, DE 19901
Mr. Alan Levin Director Delaware Economic Development Office 99 Kings Highway Dover, DE 19901	Mr. Paul Bauernschmidt Director Delaware Heritage Commission 121 Duke of York Street, Suite 206 Dover, DE 19901
Mr. F. Michael Parkowski Chairperson, Delaware Commissioners Delaware River and Bay Authority P.O. Box 71 New Castle, DE 19720	
Maryland	
Mr. John R. Griffin Secretary Department of Natural Resources Tawes State Office Building 580 Taylor Avenue Annapolis, MD 21401	Ms. Shari T. Wilson Secretary Department of Environment Montgomery Park Business Center 1800 Washington Blvd. Baltimore, MD 21230
Mr. Christian Johansonn Secretary Maryland Department of Business and Economic Development 217 East Redwood Street Baltimore, MD 21202	Mr. Frank W. Dawson Acting Asst. Secretary, Chesapeake Bay Program MD Department of Natural Resources Tawes State Office Bldg., D-2 Annapolis, MD 21401
Mr. Robert C. Brennan Executive Director Maryland Economic Development Corporation 100 North Charles Street, 6th Floor Baltimore, MD 21201	Mr. James M. Harkins Director Maryland Environmental Service 259 Najoles Road Millersville, MD 21108

Mr. Roger Richardson Secretary MD Department of Agriculture 50 Harry S. Truman Parkway Annapolis, MD 21401	Mr. Matt Fleming MD Department of Natural Resources Tawes State Office Bldg., E-2 Annapolis, MD 21401
MAJ. GEN. Bruce F. Tuxill Adjutant General Maryland National Guard 5th Regiment Armory 29th Division Street Baltimore, MD 21201	Ms. Noreen L. Eberly Seafood Marketing Advisory Commission Maryland Department of Agriculture Aquaculture Development and Seafood Marketing Program 50 Harry S. Truman Parkway Annapolis, MD 21401
Mr. Bernie Fowler Maryland Citizen Representative Chesapeake Bay Commission P.O.Box 459 Prince Frederick, MD 20678	Mr. William C. Baker President Chesapeake Bay Foundation Phillip Merrill Environmental Center 6 Herndon Avenue Annapolis, MD 21403
Mr. Jeffrey L. Lape Director Chesapeake Bay Program Office 410 Severn Ave.,Suite 109 Annapolis, MD 21402	Mr. Russell Brinsfield Executive Director Chesapeake Bay Trust 60 West Street, Suite 405 Annapolis, MD 21401
Noreen L. Eberly Maryland Seafood Marketing and Aquaculture Development Department of Agriculture 50 Harry S. Truman Parkway Annapolis, MD 21401	Ms. Ann V. Pesiri Swanson Executive Director Chesapeake Bay Commission 60 West Street, Suite 406 Annapolis, MD 21401
Virginia	
Mr. Steven G. Bowman Commissioner Marine Resources Commission 2600 Washington Avenue, 3rd Floor Newport News, VA 23607	Ms. Ellie Irons Program Manager Office of Environmental Impact Review VA Department of Environmental Quality 629 East Main Street, Suite 901 PO Box 10009 Richmond, VA 23240
Mr. Daniel Timberlake Director Department of Planning & Budget Patrick Henry Executive Office Building 1111 East Broad Street, Room 5040 Richmond, VA 23219	Mr. Bill Hayden Virginia Department of Environmental Quality 629 East Main Street P.O. Box 1105 Richmond, VA 23240

Mr. Carl E. Garrison, III. State Forester Department of Forestry 900 Natural Resources Drive, Suite 800 Charlottesville, VA 22903	Mr. Jerry Bridges Executive Director Virginia Port Authority 600 World Trade Center Norfolk, VA 23510
Ms. Kathleen Kilpatrick Director Department of Historic Resources 2801 Kensington Avenue Richmond, VA 23221	Mr. W. Bob Duncan Executive Director Department of Game & Inland Fisheries 4010 West Broad Street Richmond, VA 23230
Major General Robert B. Newman, Jr. Adjutant General Department of Military Affairs VA National Guard 202 North 9th Street, 4th Floor Richmond, VA 23219	J.T. Holland Chairman Potomac River Fisheries Commission 222 Taylor Street, P.O. Box 9 Colonial Beach, VA 22443
The Honorable C.T. Hill Chairman Department of Game and Inland Fisheries 4010 West Broad Street Richmond, VA 23230	Claude A. Williams Adjutant General Department of Military Affairs Virginia National Guard Fort Pickett Blackstone, VA 23824
The Honorable Robert S. Bloxom Secretary of Agriculture and Forestry Patrick Henry Building, 4th Floor 1111 East Broad Street Richmond, VA 23219	The Honorable L. Preston Bryant Jr. Secretary of Department of Natural Resources Patrick Henry Building 1111 East Broad Street Richmond, VA 23219
Mr. Jack E. Frye Director, Soil and Water Conservation Division VA Department of Conservation and Recreation 203 Governor Street, Suite 206 Richmond, VA 23219	Mr. Jeff Corbin Assistant Secretary VA Department of Natural Resources Richmond, VA 23218
Mr. Carl Hershner VA Institute of Marine Science Route 1208 Greate Road, P.O.Box 1346 Gloucester Point, VA 23062	Joseph H. Maroon Director Virginia Department of Conservation and Recreation 203 Governor Street, Suite 213 Richmond, VA 23219
John Wells Director, Virginia Institute of Marine Science College of William and Mary P.O. Box 1346 Gloucester Point, VA 23062	Ms. Suzan Bulbulkaya Virginia Director Chesapeake Bay Commission 502B General Assembly Building P.O. Box 406 Richmond, VA 23218

Dr. Sheryl Bailey Executive Director, Virginia Resources Authority 707 East Main, Suite 1350 Richmond, VA 23219	Demetrios Peratsakis Executive Director Western Tidewater Community Services Board 5268 Godwin Blvd. Suffolk, VA 23434
Ms. Irvine B. Hill Virginia Citizen Representative Chesapeake Bay Commission 215 Brooke Avenue, #805 Harbour Place Norfolk, VA 23510	
North Carolina	
Dee Freeman Secretary North Carolina Department of Environmental & Natural Resources 1601 Mail Service Center Raleigh, NC 27699	Mr. Reuben Young Secretary NC Department of Crime Control & Public Safety 4701 Mail Service Center Raleigh, NC 27699
Ms. Linda Carlisle Secretary NC Department of Cultural Resources 109 East Jones Street 4601 Mail Service Center Raleigh, NC 27699	Mr. Gordon Myers Executive Director NC Wildlife Resources Commission 1701 Mail Service Center Raleigh, NC 27699
Mr. Wes Seegars Chairman NC Wildlife Resources Commission PO Box 1756 Goldsboro, NC 27533	Southern Environmental Law Center (SELC) Ms. Anna Davis 200 W. Franklin Street, Suite 330 Chapel Hill, NC 27516
Charlan Owens North Carolina Department of Environment and Natural Resources Division of Coastal Management 1367 US 17 South Elizabeth City, NC 27909	Mr. Steven H. Everhart NC Wildlife Resources Commission 127 Cardinal Drive Wilmington, NC 28405
ORGANIZATIONS	
Southern Environmental Law Center (SELC) Ms. Michele Nowlin 200 W. Franklin St., Suite 300 Chapel Hill, NC 27516	Pender Watch & Conservancy Mr. Jack Spruill 1836 Corcus Ferry Road Hampstead, NC 28443
The Humane Society of the United States Ms. Naomi Rose, PhD, marine mammal scientist 2100 L. Street, NW Washington, DC 20037	Marine Acoustics, Inc. Ms. Kimberly Skrupky 4100 Fairfax Drive, Suite 730 Arlington, VA 22203

North Carolina Coastal Federation Ms. Christine Miller 813 S. Yaupon Terrace Morehead City, NC 28557	Save the Whales Rick, Pam, Victoria, & Veronica Arma 113 Holman Road Williamsburg, VA 231850
Carteret County Crossroads P.O. Box 155 Beaufort, NC 28443	Neuse River Foundation 220 S. Front Street New Bern, NC 28560
Pamlico-Tar River Foundation P.O. Box 1854 Washington, NC 27889	Sierra Club of North Carolina Capital Group P.O. Box 6076 Raleigh, NC 27628
Environmental Defense 4000 Westchase Boulevard Suite 510 Raleigh, NC 27607	Carteret Fisherman Association 652 Seashore Atlantic, NC 28511
NC Wildlife Resources Wendy Cluse 211 Virginia Avenue Morehead City, NC 28557	NEEF Richard Bierly 213 Brandywine Park Drive Morehead City, NC 28557
Individuals (Public Scoping Meeting Attendees)	
Mr. Donald Bosch Cambridge, MD	Mr. William C. Dennison Cambridge, MD
Mr. William M. Dryden Salisbury, MD	Mr. Jim Eaton Salisbury, MD
Ms. Kelly Griffin Greenbackville, VA	Mr. Murray Barkley Chincoteague, VA
Ms. Dawn Joyce Atlantic, VA	Mr. Frank Joyce Atlantic, VA
Mr. Arch Walpole Virginia Beach, VA	Mr. Jim Dawson Chincoteague, VA
Mr. Larry McMurry Chincoteague, VA	Mr. Raymond Rosenberger Chincoteague, VA
Ms. Nancy Rosenberger Chincoteague, VA	Ms. Babette Gordon Chesapeake, VA
Mr. James Fletcher Mann's Harbor, NC	Mr. Sammie Gard Mann's Harbor, NC
Ms. Janet T. Craddock Mann's Harbor, NC	Ms. Shannon L. Gard Mann's Harbor, NC
Mr. & Mrs. Roger Jerrell Kitty Hawk, NC	Mr. & Mrs. Dick Watson Kitty Hawk, NC
Mr. Bill Flournoy Raleigh, NC	Mr. Jim Dawson Chincoteague, VA
Ms. Brandi Simpson Lexington Park, MD	Ms. Stephanie McManus Norfolk, VA
Mr. Bob Swiader Virginia Beach, VA	Ms. Claire Jones Chesapeake, VA

Ms. Charlan Owens Elizabeth City, NC	Ms. Sandy Simmons Chesapeake, VA
William Regula Windsor VA	Pete Nixon Norfolk, VA
Individuals (Public Hearing Attendees)	
Sharon Stewart Ocean View, DE	Margaret Pillas Ocean City, MD
Larry Jock Ocean City, MD	David G. Aydelotte Salisbury, MD
Bill Baker, Jr. Millsboro, DE	Eric Clarke Millsboro, DE
Thomas J. Szatkuwski Ocean City, MD	Ellen White Millsboro, DE
Randall Johnson Milton, DE	Dr. Julie Hattier Millville, DE
Gregory T. Szatkowski Ocean City, MD	Charles R. Bussey Ocean City, MD
Ron Gladowski Ocean City, MD	Louise Gulyers Ocean City, MD
Jenny Hopkinson Ocean City, MD	Roman Jesien Ocean City, MD
Brian Tinkler Ocean City, MD	Steve Habeger Ocean Pines, MD
John B. Stewart Ocean View, DE	John Kumer Berlin, MD
Dave Blazer Berlin, MD	Thomas McClure Millsboro, DE
John McFalls Berlin, MD	Christine Cullen Ocean City, MD
Charles Erbe Frankfor, DE	Claudia Alesi W. Fenwick, DE
David Johnson Chincoteague, VA	Joan Kean Chincoteague, VA
Jeff Lef Greenbackville, VA	Larry McMurry Chincoteague, VA
Rich Bittiney Chincoteague, VA	Terri Booth Virginia Beach, VA
Lauren Heesemann Williamsburg, VA	Debora Mosher Norfolk, VA
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VACAPES Range Complex EIS/OEIS

The U.S. Navy is announcing public hearings and a public comment period for the VACAPES Draft Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). This document assesses the potential environmental consequences associated with Navy Atlantic Fleet training and research, development, testing, and evaluation (RDT&E) activities, and associated range capabilities enhancements (including infrastructure enhancements) in the VACAPES Range Complex.

Public hearings will be held on the following dates:

July 14, 2008 Princess Royale Oceanfront Hotel; 9100 Coastal Hwy.; Ocean City, MD 21842
July 15, 2008 Chincoteague Center; 6155 Community Dr.; Chincoteague, VA 23336
July 16, 2008 Virginia Beach Resort & Conference Ctr.; 2800 Shore Dr.; Virginia Beach, VA 23451
July 17, 2008 Hilton Garden Inn; 5353 N. Va. Dare Trail; Kitty Hawk, NC 27949

Copies of the draft document can be found at the following locations:

Ocean City Branch Library; 10003 Coastal Highway; Ocean City, MD 21842
Rehoboth Beach Public Library; 226 Rehoboth Avenue Rehoboth Beach, DE 19971
Wicomico Public Library; 122 South Division Street; Salisbury, MD 21801
Island Library; 4077 Main Street; Chincoteague, VA 23336
Central Library; 4100 Virginia Beach Blvd; Virginia Beach, VA 23452
Kill Devil Hills Branch Library; 400 S. Mustian St; Kill Devil Hills, NC 27948
The document is also available for download at http://www.vacapesrangecomplexeis.com

Each hearing will begin with an open house poster session from 5-7 p.m.
A formal presentation and public comment period will be held from 7-9 p.m.

Comments on the Draft VACAPES EIS/OEIS can be sent via U.S. mail or fax, as well as through the VACAPES Range Complex EIS/OEIS website. The mailing address is: Naval Facilities Engineering Command, Atlantic Division; Attention: Code EV22ES (VACAPES EIS/OEIS PM); 6506 Hampton Blvd; Norfolk, VA 23508-1278. Fax: (757) 322-4894.
Website: http://www.vacapesrangecomplexeis.com
Please submit comments by August 11, 2008