4 Cumulative Impacts

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4 CUMULATIVE IMPACTS

4.1 INTRODUCTION

The analysis of cumulative impacts (or cumulative effects)[1] presented in this section follows the requirements of the National Environmental Policy Act (NEPA) and Council on Environmental Quality guidance (Council on Environmental Quality 1997). The Council on Environmental Quality regulations (40 Code of Federal Regulations [C.F.R.] §§ 1500-1508) provide the implementing regulations for NEPA. The regulations define cumulative impacts as:

> "…the impact on 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 (40 C.F.R. § 1508.7)."

While a single project may have minor impacts, overall impacts may be collectively significant when the project is considered together with other projects on a regional scale. A cumulative impact is the additive effect of all actions in the geographic area. The Council on Environmental Quality provides guidance on cumulative impact analysis in *Considering Cumulative Impacts under the National Environmental Policy Act* (Council on Environmental Quality 1997). This guidance further identifies cumulative impacts as those environmental impacts resulting "from spatial and temporal crowding of environmental perturbations. The impacts of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the impacts of the first perturbation." This guidance observes that "no universally accepted framework for cumulative impacts analysis exists…" while noting that certain general principles have gained acceptance. The Council on Environmental Quality provides guidance on the extent to which agencies of the federal government are required to analyze the environmental impacts of past actions when they describe the cumulative environmental effect of an action. This guidance provides that an analysis of cumulative impacts might encompass geographic boundaries beyond the immediate area of an action and a timeframe that includes past actions and foreseeable future actions. Thus, the Council on Environmental Quality guidelines observe, "[it] is not practical to analyze cumulative impacts of an action on the universe; the list of environmental impacts must focus on those that are truly meaningful."

4.2 APPROACH TO ANALYSIS

4.2.1 OVERVIEW

Cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the No Action Alternative, Alternative 1, and Alternative 2 (the alternatives) in combination with past, present, and reasonably foreseeable future actions. The cumulative impacts analysis included the following steps, described in more detail below:

1. Identify appropriate level of analysis for each resource.
2. Define the geographic boundaries and timeframe for the cumulative impacts analysis.
3. Describe current resource conditions and trends.

[1] Council on Environmental Quality regulations provide that the terms "cumulative effects" and "cumulative impacts" are synonymous (40 C.F.R. § 1508.8[b]); the terms are used interchangeably by various sources, but the term "cumulative impacts" will be used in this document except for quotations, for continuity.

4. Identify potential impacts of each alternative that might contribute to cumulative impacts.
5. Identify past, present, and other reasonably foreseeable future actions that affect each resource.
6. Analyze potential cumulative impacts.

4.2.2 Identify Appropriate Level of Analysis for Each Resource

In accordance with guidance set forth by the Council on Environmental Quality, the cumulative impacts analysis focused on impacts that are "truly meaningful" (Council on Environmental Quality 1997). The level of analysis for each resource was commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences). The rationale for the level of analysis applied to each resource is described in Section 4.4 (Resource-Specific Cumulative Impacts).

4.2.3 Define the Geographic Boundaries and Timeframe for Analysis

The geographic boundaries for the cumulative impacts analysis include the entire Northwest Training and Testing (NWTT) Study Area (Study Area) (see Figure 2.1-1). The geographic boundaries for cumulative impacts analysis for marine mammals and sea turtles were expanded to include activities outside the Study Area that might impact migratory marine mammals and sea turtles. Primary considerations from outside the Study Area include impacts associated with maritime traffic (e.g., vessel strikes and underwater noise) and commercial fishing (e.g., bycatch and entanglement).

Determining the timeframe for the cumulative impacts analysis requires estimating the length of time the impacts of the Proposed Action would last and considering the specific resource in terms of its history of degradation (Council on Environmental Quality 1997). The Proposed Action includes ongoing and anticipated future training and testing activities. While United States (U.S.) Department of the Navy (Navy) training and testing requirements change over time in response to world events and several other factors, the general types of activities addressed by this Environmental Impact Statement (EIS)/Overseas EIS (OEIS) are expected to continue indefinitely, and the associated impacts would occur indefinitely. Likewise, some reasonably foreseeable future actions and other environmental considerations addressed in the cumulative impacts analysis are expected to continue indefinitely (e.g., gravel production, maritime traffic, commercial fishing). Therefore, the cumulative impacts analysis is not bounded by a specific future timeframe. For past actions, the cumulative impacts analysis only considers those actions or activities that have ongoing impacts.

While the cumulative impacts analysis is not limited by a specific timeframe, it should be recognized that available information, uncertainties, and other practical constraints limit the ability to analyze cumulative impacts for the indefinite future. Navy environmental planning and compliance for training and testing activities is an ongoing process. The Navy intends to submit applications to the National Marine Fisheries Service (NMFS) for Marine Mammal Protection Act (MMPA) authorizations supported by this EIS/OEIS. The anticipated effective dates for these MMPA authorizations would be a 5-year period from October 2015 through October 2020. If the Navy intends to conduct similar testing and training activities beyond October 2020 and impacts to marine mammals are anticipated, the Navy would need to seek a new MMPA authorization for training and testing activities beyond October 2020. Similarly, and in accordance with 40 C.F.R. § 1502.9, if the Navy makes substantial changes in the preferred alternative or there are significant new circumstances or information that are relevant to environmental concerns, the Navy must supplement the Final Environmental Impact Statement. Future environmental planning documents will include cumulative impacts analysis based on information available at that time.

4.2.4 DESCRIBE CURRENT RESOURCE CONDITIONS AND TRENDS

Chapter 3 (Affected Environment and Environmental Consequences) describes current resource conditions and trends, and they discuss how past and present human activities influence each resource. The aggregate impacts of past and present actions are reflected in the baseline information presented in Chapter 3 (Affected Environment and Environmental Consequences). This information is used in the cumulative impacts analysis to understand how past and present actions are currently impacting each resource and to provide the context for the cumulative impacts analysis.

4.2.5 IDENTIFY POTENTIAL IMPACTS OF THE ALTERNATIVES THAT MIGHT CONTRIBUTE TO CUMULATIVE IMPACTS

Direct and indirect impacts of the alternatives, presented in Chapter 3 (Affected Environment and Environmental Consequences), were reviewed to identify impacts relevant to the cumulative impacts analysis. Key factors considered included the current status and sensitivity of the resource and the intensity, duration, and spatial extent of the impacts for each stressor. In general, long-term rather than short-term impacts and widespread rather than localized impacts were considered more likely to contribute to cumulative impacts. For example, for biological resources, population-level impacts were considered more likely to contribute to cumulative impacts than were individual-level impacts. Negligible impacts were not considered further in the cumulative impacts analysis. For marine mammals, any stressor that is expected to result in Level A harassment or Level B harassment, as defined by MMPA, was considered in the cumulative impacts analysis. For Endangered Species Act (ESA)-listed species, any stressor that may affect and is likely to adversely affect the species was considered in the cumulative impacts analysis. Stressors that were determined by the Navy to have no effect or that may affect but are not likely to adversely affect ESA-listed species were not analyzed in detail in the cumulative impacts analysis.

4.2.6 IDENTIFY OTHER ACTIONS AND OTHER ENVIRONMENTAL CONSIDERATIONS THAT AFFECT EACH RESOURCE

A list of other actions was compiled for the Study Area and surrounding areas based on information obtained during the scoping process (Appendix E, Public Participation), communications with other agencies, a review of other military activities, literature review, previous NEPA analyses for actions not included in this document, and other available information. Identified future actions were reviewed to determine if they should be considered further in the cumulative impacts analysis. Factors considered when identifying other actions to be included in the cumulative impacts analysis included the following:

- Whether the other action is reasonably foreseeable, rather than merely possible or speculative
- The timing and location of the other action in relation to proposed training and testing activities
- Whether the other action and each alternative would affect the same resources
- The current conditions, trends, and vulnerability of resources affected by the other action
- The duration and intensity of the impacts of the other action
- Whether the impacts have been truly meaningful, historically significant, or identified previously as a cumulative impact concern

In addition to identifying reasonably foreseeable future actions, other environmental considerations for the cumulative impacts analysis were identified and described. These other considerations include major stressors or issues (e.g., ocean pollution, ocean noise, coastal development, etc.) that tend to be widespread and arise from routine human activities and multiple past, present, and future actions.

Including these other environmental considerations allows an analysis of the current aggregate impacts of past and present actions, as well as reasonably foreseeable actions.

4.2.7 Analyze Potential Cumulative Impacts

The impacts of past and present actions and the anticipated impacts of reasonably foreseeable future actions were characterized and summarized. The incremental impacts of each alternative were then added to the combined impacts of all other actions to describe the cumulative impacts that would result if the No Action Alternative, Alternative 1, or Alternative 2 were implemented. The cumulative impacts analysis considered additive, synergistic, and antagonistic impacts. A qualitative analysis was conducted in most cases based on the available information. The analysis in Chapter 3 (Affected Environment and Environmental Consequences) indicates that the direct and indirect impacts of the No Action Alternative, Alternative 1, and Alternative 2 would be similar for many of the stressors. Therefore, much of the cumulative impacts discussion applies to all three alternatives. Specific differences between the alternatives are discussed when appropriate.

4.3 Other Actions Analyzed in the Cumulative Impacts Analysis

4.3.1 Overview

Table 4.3-1 lists the other actions and other environmental considerations identified for the cumulative impacts analysis. Descriptions of each action and environmental consideration carried forward for analysis are provided in the following sections. The Keyport and Northwest Training Range Complex activities and analysis are incorporated into the NWTT proposed action and analysis. Thus, the Keyport and Northwest Training Range Complex are not considered or analyzed as cumulative impacts.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Offshore Power Generation					
1	Marine Hydrokinetic Projects	Federal Energy Regulatory Commission	Admiralty Inlet, Puget Sound	Present and future	Retained
Restoration, Research, and Conservation Projects and Programs					
2	The Crescent Harbor Salt Marsh and Salmon Restoration Project	U.S. Department of the Navy	Crescent Harbor Marsh on Whidbey Island in Puget Sound	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
3	Maylor Beach Restoration Program	U.S. Department of the Navy	Crescent Harbor and Maylor Beach	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
4	Hood Canal Dissolved Oxygen Program	Partnership of 28 Organizations (local, state, federal, and tribal government)	Hood Canal	Past, present, and future	Dismissed because this is a program and not a specific action
5	Deep Sea Corals Study	National Center for Coastal Ocean Science	Olympic Coast National Marine Sanctuary	Past, present, and future	Dismissed because this is a study which does not have any associated actions
6	Washington Islands National Wildlife Refuge Comprehensive Conservation Plan	U.S. Fish and Wildlife Service	Flattery Rocks National Wildlife Refuge, Quillayute Needles National Wildlife Refuge, Copalis National Wildlife Refuge	Past	Dismissed because the actions associated with this plan will not affect resources affected by the Proposed Action
7	Olympic Coast National Marine Sanctuary Management Plan Update	Olympic Coast National Marine Sanctuary	Olympic Coast National marine Sanctuary	Past	Retained
8	Surveillance Towed Array Sensor System Low Frequency Active Sonar	U.S. Department of the Navy	Pacific-Indian Ocean	Past, present, and future	Retained
9	U.S. Coast Guard Training	U.S. Coast Guard	Washington, Oregon, and California	Past, present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Military Activities					
10	Oregon Air National Guard Flight Training	Oregon Air National Guard	Offshore Area (W-93, W-570)	Past, present, and future	Retained
11	Pile Repair and Replacement Program	U.S. Department of the Navy	Inland Waters (various locations in Puget Sound)	Past, present, and future	Retained
12	NAVBASE Kitsap Bangor, Indian Island, Whidbey, Everett, and Bremerton Waterfront Facilities Maintenance	U.S. Department of the Navy	Bangor, Indian Island, Whidbey, Everett, and Bremerton waterfront	Past, present, and future	Dismissed. Maintenance of facilities includes pressure washing of piers, and repair and replacement of structures as needed; however, measures that would cause cumulative impacts are not projected.
13	Force Protection and Weapons Security Measures	U.S. Department of the Navy	Waterfront Restricted Area of NAVBASE Kitsap Bangor and other Navy waterfront facilities	Past, present, and future	Retained
14	Barge Mooring Project Environmental Assessment/Incidental Harassment Authorization	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present and future	Retained
15	Underwater Surveillance System	U.S. Department of the Navy	Restricted Area at NAVBASE Kitsap Bangor	Past, present, and future	Dismissed. The system operates at the same frequency and range (generally 50–200 kHz—similar to FA3 bin from Table 3.0-8) as a commercial “fish finder” and has been in operation since April 2006. Therefore, impacts should be negligible.
16	Waterfront Restricted Area Land-Water Interface, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Military Activities (continued)					
17	Waterfront Restricted Area Service Pier Extension, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present and future	Retained
18	Explosives Handling Wharf 2, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present, and future	Retained
19	Tribal Mitigation for Explosive Handling Wharf 2	U.S. Department of the Navy	Hood Canal and Gamble Bay	Present and Future	Retained
20	Explosives Handling Wharf 1 Maintenance	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Past, present, and future	Retained
21	NAVBASE Kitsap Bangor Test Pile Program	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Past	Dismissed because the duration of this project spanned only a month, and pile programs at Kitsap Bangor are discussed in the analysis of the Explosives Handling Wharf 1 Maintenance (Section 4.3.4.10).
22	Electromagnetic Measurement Ranging System Project	U.S. Department of the Navy	Hood Canal	Future	Retained
23	Breakwater Construction and Pier Demolition at Naval Air Station Whidbey Island	U.S. Department of the Navy	Crescent Harbor	Future	Retained
24	Swimmer Interdiction Security System EIS, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present, and future	Retained
25	Transit Protection System Facilities, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor, Magnetic Silencing Facility; Port Angeles	Present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Military Activities (continued)					
26	P-8A Multi-Mission Aircraft (MMA) Supplemental EIS	U.S. Department of the Navy	Naval Air Station Whidbey Island	Present and future	Retained. However, their training is covered in the proposed action of this EIS/OEIS, and other activities are not in the Study Area (e.g., take offs and landings at Ault Field).
27	EA-18G Growler Environmental Assessment	U.S. Department of the Navy	Naval Air Station Whidbey Island	Present and future	Retained. However, their training is covered in the proposed action of this EIS/OEIS, and other activities are not in the Study Area (e.g., take offs and landings at Ault Field).
28	VAQ Expeditionary Wing Environmental Assessment	U.S. Department of the Navy	Naval Air Station Whidbey Island	Past, present, and future	Dismissed because their training is covered in the proposed action of this EIS/OEIS, and other activities are not in the Study Area (e.g., take offs and landings at Ault Field).
29	U.S. Navy Climate Change Roadmap	U.S. Department of the Navy	All of Study Area	Present and future	Retained
Environmental Regulations and Planning					
30	Coastal and Marine Spatial Planning	Regional Ocean Commissions	All of Study Area	Future	Dismissed because action involves only planning and policy-related activities (discussed in Chapter 6, Additional Regulatory Considerations).
31	Marine Mammal Protection Act incidental take authorizations	National Marine Fisheries Service	All of Study Area	Past, present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Environmental Considerations					
32	Fred Hill Materials Thorndyke Resource (pit-to-pier) Project	Fred Hill Materials	West shore of Hood Canal, to south of the Highway 104 Hood canal Bridge	Present and future	Retained
33	Hood Canal In Lieu Fee Mitigation Program	Hood Canal Coordinating council	Hood Canal	Past, present, and future	Retained
34	Jefferson County Black Point Master Planned Resort	Statesman Group of Companies, LTD, and Black Point Properties, LLC	Black Point, Brinnon, and Navy Range Dabob Bay	Present and future	Dismissed because construction takes place on land and there are no plans for in-water construction in the marina, as current slips will be retained. Therefore, this activity should not have a significant impact on resources in the study area.
35	Trans-Pacific fiber optic cable	Pacific Crossing Ltd.	Olympic Coast National Marine Sanctuary/Whidbey Island	Past, present, and future	Dismissed. The trans-Pacific fiber optic cable was laid in 1999–2000 and re-buried in 2005 to comply with existing permits and mitigation. Therefore, the cable's existence in the Study Area should not have a significant impact on resources.
36	Commercial and Recreational Fishing	National Marine Fisheries Service and private industry	All of Study Area and open ocean areas	Past, present, and future	Retained
37	Maritime Traffic	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained
38	Shoreline Development	Local regulatory agencies	Inland Areas, Puget Sound	Past, present, and future	Retained
39	Oceanographic Research	Numerous	All of Study Area and open ocean areas	Past, present, and future	Retained
40	Ocean Noise	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Environmental Considerations (continued)					
41	Ocean Pollution	U.S. Environmental Protection Agency Applicable State Agencies	All of Study Area and open ocean areas	Past, present, and future	Retained
42	Washington State Department of Transportation Manette Bridge Replacement Project	Washington State Department of Transportation	Bremerton, Olympic Peninsula, Washington	Past	Dismissed, as the Bridge Replacement Project was completed in February 2012, and there are no present or future impacts to contribute to the cumulative impacts in the analysis.
43	Washington State Department of Transportation Hood Canal Bridge West-Half Retrofit and East-Half Replacement Project	Washington State Department of Transportation	Between Kitsap and Jefferson counties at the mouth of the Hood Canal	Past	Dismissed, as the Bridge Retrofit and Replacement Project was completed in June 2009 and there are no present or future impacts to contribute to the cumulative impacts in the analysis.
44	Marine Tourism and Recreation	Numerous	All of Study Area	Past, present, and future	Retained
45	Commercial and General Aviation	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained
46	2013 Bremerton Ferry Terminal Construction by the Washington State Department of Transportation	Washington State Department of Transportation	Bremerton ferry terminal	Future	Retained

Notes: EIS = Environmental Impact Statement, kHz = kilohertz, NAVBASE = Naval Base, NAVSEA = Naval Sea Systems Command, NUWC = Naval Undersea Warfare Center, NWTRC = Northwest Training Range Complex, OEIS = Overseas EIS, U.S. = United States, W = Warning Area

4.3.2 OFFSHORE POWER GENERATION

4.3.2.1 Marine Hydrokinetic Projects

Emerging water power technologies offer the potential to capture energy from waves, thermal gradients, tides, and ocean currents. Once developed, these new technologies will offer alternatives to fossil fuels. At the present time, there is significant research dedicated to the performance and economic viability of hydropower technologies. Because no fully developed marine hydrokinetic projects exist in the North American region, the impact on marine species and ecosystems in the region remains largely speculative. Concerns raised include the potential for collisions, noise, physical disturbance, disruption of marine species' behavioral patterns, impacts on local community and fishing industry, ability to monitor projects, cumulative impacts of multiple hydrokinetic projects along the coasts, habitat alteration due to anchors and cables, and release of toxins and chemicals by the projects or by vessels servicing the project. Other considerations include habitat disturbance and the displacement of benthic organisms. These concerns provide the potential for habitat loss and changes to the ecology of a region (Pacific Fishery Management Council 2011); however, initial studies have indicated that, with appropriate protocols for siting and design, these impacts are likely to be minimal (Union of Concerned Scientists 2008).

As of June 2011, the Federal Energy Regulatory Commission has issued 70 preliminary permits for hydrokinetic projects and 147 preliminary permits are pending. In west coast waters, 22 projects are currently being considered (Pacific Fishery Management Council 2011).

The Puget Sound Pilot Tidal Energy Project (TRL 7/8) is headed up by Snohomish County Public Utility District and its partners, such as the University of Washington. They propose to deploy two tidal energy turbines in Admiralty Inlet, Puget Sound, Washington. The site is one of the largest tidal hydrokinetic resources in the United States, and requires deep water technology (> 164 feet [ft.] [> 50 meters {m}]). The purpose of the project is to gather data to advance the technical, economic, social, and environmental viability of commercial-scale tidal energy. According to a tentative schedule, the turbine and foundation fabrication shipping and staging should be done in 2013, while the project installation and commissioning would occur by 2014, followed by project operations and testing through 2018 (Polagye 2011). Recently, the Japanese Company Pacific Crossing has voiced concerns about the project with the Federal Energy Regulatory Commission (Federal Energy Regulatory Commission 2011). Pacific Crossing owns a fiber optic cable that passes approximately 328 ft. (100 m) away from the proposed installation area near Whidbey Island, and says that the turbines are being installed too close to the cable, which would make maintenance difficult to achieve with the presence of turbines. In January 2013, a Draft Environmental Assessment (EA) was released and found that placing the two turbines in Admiralty Inlet would not harm the environment or nearby fiber optic cables. Pacific Crossing Company disagrees and plans to challenge the report's findings. There are also concerns about the effects on killer whales and native plants. Snohomish County Public Utility District is now planning to have the turbines installed by mid-2014 (Pacific Fishery Management Council 2013).

4.3.3 RESTORATION, RESEARCH, AND CONSERVATION PROJECTS AND PROGRAMS

4.3.3.1 Olympic Coast National Marine Sanctuary Management Plan Update

The Olympic Coast National Marine Sanctuary Management Plan was updated in 2011. This update to the Sanctuary's management plan is dismissed from further cumulative analysis because the update did not alter regulations to Navy actions within the Sanctuary. The Management Plan Update also does not contribute to the overall cumulative impact of activities on marine resources in the Study Area, and

therefore results in negligible to minor impacts on resources in the area affected by the activity and the Proposed Action. The Management Plan update is discussed further in Section 6.1.2.1.1.

4.3.4 OTHER MILITARY ACTIVITIES

4.3.4.1 Surveillance Towed Array Sensor System Low Frequency Active Sonar

In August 2011, the Navy released a Draft Supplemental EIS/Supplemental OEIS that evaluated the potential environmental impacts of employing the Surveillance Towed Array Sensor System Low Frequency Active Sonar (U.S. Department of the Navy 2011). The Navy currently plans to operate up to four Surveillance Towed Array Sensor System Low Frequency Active Sonar systems for routine training, testing, and military operations. Based on current Navy national security and operational requirements, routine training, testing, and military operations using these sonar systems could occur in the Pacific Ocean (including the Study Area).

4.3.4.2 United States Coast Guard

The U.S. Coast Guard (USCG) conducts training throughout the Study Area. In California, District 11 conducts search and rescue, homeland security, law enforcement, marine safety, and aids to navigation missions over 3.3 million square miles ($mi.^2$) of water. The District 13 Coast Guard unit is located in the Pacific Northwest along the coasts of Oregon and Washington. District 13 conducts the same operational duties as the units in District 11 and covers more than 460,000 $mi.^2$ of the Pacific Ocean.

U.S. Coast Guard training includes small- and medium-caliber weapons firing from ships, similar to the Navy's Gunnery Exercise (Surface-to-Surface) Ship. The USCG conducts much of this training in the Offshore Area of the Study Area, primarily in Warning Area 237 (W-237). None of the USCG's weapons firing occurs in the Olympic Coast National Marine Sanctuary. These gunnery exercises, which are described in Chapter 2 (Description of Proposed Action and Alternatives), are analyzed in this EIS/OEIS for direct impacts (not cumulative impacts). Those USCG activities analyzed only for their cumulative impact include:

- Flight training in W-237. This flight training includes low-altitude helicopter flights but does not include expenditure of munitions or any other materials.
- Shipboard aircraft operations, such as deck landing qualification training.
- Shipboard maneuvering and engineering training (e.g., abandon ship, anchoring, full power trials, man overboard, and flooding).
- Search and rescue training.

4.3.4.3 Oregon Air National Guard Flight Training

The Oregon Air National Guard is the primary user of W-93 and W-570 special use airspace in the Offshore Area. Oregon Air National Guard flights in W-93 and W-570 are primarily air combat maneuver training flights, similar to those conducted by the Navy and described in Chapter 2 (Description of Proposed Action and Alternatives). These flights occur throughout the year but do not include any weapons firing or release of chaff. On rare occasions, self-defense flares may be used during training.

4.3.4.4 Pile Repair and Replacement Program

The Navy proposes to repair or replace up to 1,001 structurally unsound piles at various Puget Sound installations over a 5-year period, beginning in October 2013. Various piers, wharves, and other marine pile-supported structures are located at the installations. The potential environmental impacts of this action are analyzed in EAs, such as the EA for the Breakwater Construction and Pier Demolition at Naval

Air Station Whidbey Island (U.S. Department of the Navy 2013). The Proposed Action involves pile removal, pile installation, pile disposal, and in-place pile repair, and includes individual actions currently planned and estimates for contingency requirements at Naval Air Station Whidbey Island (NASWI), NAVSTA Everett, Naval Base (NAVBASE) Kitsap Bangor, NAVBASE Kitsap Bremerton, NAVBASE Kitsap Keyport, NAVBASE Kitsap Manchester, and Zelatched Point.

4.3.4.5 Force Protection and Weapons Security Measures

The Force Protection and Weapons Security Measures project involves installation and operation of facilities, including 14 ft. (4.3 m) high above-water fencing on pontoons along the Waterfront Restricted Area. It also involves the construction of an Auxiliary Reaction Force Facility (14,000 square feet [ft.^{2}] [1,300 square meters {m^2}]) and an Armored Fighting Vehicle Operational Storage Facility (16,146 ft.^{2} [1,500 m^2]). It also includes the alteration of two buildings for a new armory (2,500 ft.^{2} [232 m^2]) and the replacement of an Alert Force Garage (2,530 ft.^{2} [235 m^2]) that includes a new paved access road (U.S. Department of the Navy 2012a).

4.3.4.6 Barge Mooring Project Environmental Assessment/Incidental Harassment Authorization

The Navy proposes to replace an existing research barge at the Service Pier in order to support the mission and operations of Commander, Submarine Development Squadron Five, at NAVBASE Kitsap Bangor. The action includes vibratory installation of up to 20 hollow steel piles that range in diameter from 18 inches (in.) (46 centimeters [cm] to 48 in. (122 cm). The 36 in. (91 cm) diameter and 48 in. (122 cm) diameter piles will be used to moor the new 260 ft. (79 m) by 85 ft. (26 m) barge, which is replacing a 115 ft. (35 m) by 35 ft. (11 m) barge that is currently located at the Service Pier. To allow space for the larger barge, the existing floating pier sections used by Port Operations will be relocated to the opposite side of the Service Pier trestle. Additional floating sections will be attached and supported by 18 in. (46 cm) and 24 in. (61 cm) diameter steel piles. Existing infrastructure that is not needed to support the new Service Pier configuration will be removed. The infrastructure includes a gangway, fenders, pedestals, and a mooring dolphin. The mooring dolphin has a concrete platform supported by eight 24–30 in. (61–76 cm) diameter steel piles. The platform will be carefully cut into sections and removed. One 24 in. (61 cm) steel pile will be removed using vibratory pile driving equipment. The remaining piles will be cut off at the mudline and extracted. The duration of the in-water construction activities is expected to be 8 weeks and will occur between 16 July and 30 September 2013 (U.S. Department of the Navy 2012b).

4.3.4.7 Waterfront Restricted Area Land-Water Interface, Naval Base Kitsap Bangor

The Navy proposes to construct two land-water interface structures and modify the existing floating port security barrier system for improved protection of TRIDENT submarines. Construction of the land-water interface structures would enclose the Navy waterfront restricted area on NAVBASE Kitsap Bangor by constructing security barriers in the intertidal zone at the Bangor waterfront. Construction is anticipated to take 2 years. Construction activities occurring in the water during the first year may involve pile driving and would be conducted from July 2015 through February 2016. Once the pile driving is complete, activities other than pile driving may occur in the water up until February 2017.

4.3.4.8 Waterfront Restricted Area Service Pier Extension, Naval Base Kitsap Bangor

The Navy proposes to extend the existing service pier, construct associated support facilities, and relocate two SEAWOLF Class submarines from NAVBASE Kitsap Bremerton to join a third SEAWOLF Class submarine at NAVBASE Kitsap Bangor. The existing service pier would be extended; land-based associated support facilities would be constructed, including a maintenance support facility; and utility

upgrades would include an emergency power generator and a parking lot. Shore-based facilities constructed on the pier would include a pier services and compressor building and a pier crane. Construction would occur from April 2015 to March 2017. Construction in the water is planned for July through February of each year, beginning in July 2015 and concluding in February 2017. The relocation would result in the consolidation of berthing and support for the SEAWOLF Class submarines at NAVBASE Kitsap Bangor.

4.3.4.9 Explosives Handling Wharf 1 Maintenance

The Navy is continuing a construction project to conduct necessary repairs and maintenance on the Explosive Handling Wharf 1 (EHW-1) facility. This multiyear project involves removal and replacement of deteriorated steel and/or concrete piles. The most recent phase, which began in July 2011 and will continue through 2013, is the installation of twenty-nine, 30 in. (76 cm) steel piles, and is covered in two findings of no significant impact (2011 and 2012), the Final Environmental Assessment Explosives Handling Wharf 1 Pile Replacement Project Naval Base Kitsap at Bangor Silverdale, WA, and two incidental harassment authorizations (2011 and 2012). Past activities were covered by Categorical Exclusions as actions did not individually or cumulatively have a significant effect on the human environment. Phased repair of this structure is expected to continue until 2024 (U.S. Department of the Navy 2012a). The wharf is a U-shaped concrete structure built in 1977 for ordnance handling operations in support of the TRIDENT Submarine squadron, which is home ported at the NAVBASE Kitsap Bangor. The EHW-1's structural integrity is compromised due to deterioration of the wharf's piling sub-structure. The purpose of the project is to maintain the structural integrity of the wharf and ensure its continued functionality to support the operational requirements of the TRIDENT program (U.S. Department of the Navy 2012a).

4.3.4.10 Electromagnetic Measurement Ranging System, Hood Canal

An EA is being prepared for the construction and operation of an Electromagnetic Measurement Ranging System located on NAVBASE Kitsap Bangor lands and adjacent waters in Hood Canal (Hood Canal Military Operating Area North) Bangor, Washington.

Construction would occur between July and October 2014. Project construction includes construction of a 15 ft. by 15 ft. (4.5 m by 4.5 m) offshore platform with utilities, requiring installation of five 24 in. (61 cm) square batter precast concrete piles (one for each corner and one in the center of the platform). The five piles would be impact driven. The project also includes installation of the sensor array system and approximately 8,000 ft. (2,438 m) of cable on the bottom of Hood Canal.

4.3.4.11 Breakwater Construction and Pier Demolition at Naval Air Station Whidbey Island

The Navy proposes to construct a new pile-supported breakwater; demolish an existing 536 ft. (163 m) long by 50 ft. (15 m) wide finger pier breakwater; install a fuel pier sheet pile cut-off wall at the existing fuel pier; install new anchor buoys; and dredge a 3.9-acre (ac.) (1.6-hectare [ha]) access channel at NASWI's Seaplane Base at Whidbey Island, Washington. The Proposed Action would take place within Crescent Harbor. The new breakwater would replace the existing structurally unsound finger pier breakwater to ensure continued safe and uninterrupted jet fuel delivery for NASWI. Dredging would improve access to the fuel pier during low tides, reduce the frequency of future maintenance dredging, and enable fuel pier access for vessels with drafts of up to 16 ft. (5 m) (U.S. Department of the Navy 2012c). The Navy is applying for Incidental Harassment Authorization under the MMPA of 1972, as amended. The proposed in-water work would occur between 16 July 2014 and 15 February 2015 (U.S. Department of the Navy 2012d).

4.3.4.12 Swimmer Interdiction Security System, Naval Base Kitsap Bangor

The Navy implemented a Swimmer Interdiction Security System at NAVBASE Kitsap Bangor, Silverdale, WA, after an EIS written in 2009 followed by the Record of Decision (74 Federal Register [FR] 60244) in November 2009, in order to meet the increased U.S. security requirements for military installations in response to the terrorist attacks of September 11, 2001. The Marine Mammal Alternative (the preferred alternative) is composed of human/marine mammal teams that support Navy operations and respond rapidly to security alerts. The Swimmer Interdiction Security System protects waterside Navy assets and will remain in operation as long as valuable naval assets are at NAVBASE Kitsap Bangor (U.S. Department of the Navy 2009).

4.3.4.13 Explosives Handling Wharf 2, Naval Base Kitsap Bangor

The Navy is building and will operate a second Explosives Handling Wharf (EHW-2) immediately south of the existing EHW at NAVBASE Kitsap Bangor. EHW-2 will be a large pile-supported structure to support TRIDENT submarines homeported at Bangor. The in-water facility will cover 6.3 ac. (2.5 ha), and will be supported by up to 1,250 hollow steel piles. Construction began in fall 2012, and completion is expected in 2016. EHW-2 consists of in-water structures and onshore support facilities including roads, utilities, and security features. Approximately 20 existing facilities and/or structures in proximity of EHW-2 will be modified or demolished, and 4 new on-shore facilities will be constructed. Environmental impacts during construction include: disturbance to fish, bird, and marine mammals from pile driving noise; turbidity; air pollutant emissions; and temporary loss of brush and forest. Long-term impacts include shading of marine habitat, loss of seafloor due to pile placement, interference with migration of juvenile salmon, and loss of upland wetlands. The Navy obtained permits and authorizations for impacts to aquatic habitats, ESA-listed species, and marine mammals. Mitigation measures include purchase of aquatic habitat credits from the Hood Canal In Lieu Fee Program, use of bubble curtains and equipment procedures to reduce species impacts from pile driving noise, marine species monitoring and reporting, revegetation of temporarily disturbed upland areas, public and mariner notification of upcoming construction activities, and specific mitigation actions to compensate for impacts to tribal treaty resources (U.S. Department of the Navy 2012a).

4.3.4.14 Tribal Mitigation for Explosive Handling Wharf 2

The Navy will implement the following mitigation actions in the form of funded programs to compensate for impacts to tribal treaty resources.

4.3.4.14.1 Fishery Improvements

The Navy will provide funding for infrastructure improvements at three existing hatcheries owned and operated by Washington Department of Fish and Wildlife (Hoodsport, McKernan, and George Adams) and one existing fish capture facility owned and operated by the Skokomish Indian Tribe (Enetai Creek) to improve salmon production and associated harvest opportunities in Hood Canal. Improvements to the Washington Department of Fish and Wildlife facilities may include repair or restoration, but will not include recurring annual costs. These projects, funded by the Navy, will help improve the fisheries in the Skokomish tribal facilities, and increase the number of spawned fish available for harvest.

4.3.4.14.2 Shore and Benthic Improvements

Beach Enhancement

The Navy will provide funding for beach enhancements to include substrate improvements and 3 years of shellfish seeding on 24 ac. (9.7 ha) of beach. This action will occur on lands owned by the Skokomish

Tribal Nation that will be transferred to the Department of Interior, Bureau of Indian Affairs to be held in trust for the tribe.

Shellfish Enhancement

The Navy will provide funding for a 5-year program for seeding of shellfish including manila clams, bagged and single Pacific oyster seed, and Olympia oysters on priority shellfish enhancement areas in Hood Canal and adjacent Admiralty Inlet. The Tribes are solely responsible for selecting the beaches to be seeded and coordinating these efforts with the land owners and responsible agencies.

Shellfish Nursery, Floating Upweller System

The Navy will provide funding for construction and operation of a 75 ft. by 30 ft. (23 m by 9 m) Shellfish Nursery, Floating Upweller System, a 30 ft. by 100 ft. (9 m by 31 m) grated work-deck attached to the Port Gamble S'Klallam Tribe's existing net pens in Port Gamble Bay, associated mooring and underwater power supply systems, and four 50 ft. by 50 ft. (15 m by 15 m) steel net pen cages to replace the existing deteriorated cages. The nursery will be capable of accommodating approximately 8–12 million shellfish seed annually. The Port Gamble S'Klallam Foundation or designated entity pursuant to the Memorandum of Agreement will acquire and comply with all required permits, leases, and entitlements as part of this project.

Subtidal Geoduck Enhancement Survey and Study

The Navy will provide funding for geoduck enhancement surveys within the Tribes' usual and accustomed fishing grounds and stations, and for a pilot research study to provide information on new locations for geoduck planting, and to develop sustainable geoduck growing, planting, and other enhancement methodologies. The majority of surveys will occur on tracts having limited survey information. Some surveys will occur on previously harvested tracts. The pilot study will include a literature review and testing of long-term geoduck production processes and enhancement through systematic trials and a comparison of techniques. The Tribes are solely responsible for coordinating survey efforts with land owners.

4.3.4.14.3 Wet Lab Building and Research, Education, and Training

The Navy will provide funding to construct a shellfish wet lab, education, and training building in an upland location at Port Gamble. The research, education, and training program will be developed by the Port Gamble S'Klallam Tribe and will provide education and training for members of the Tribes and the community and research on the health of Hood Canal and marine systems and on shellfish and finfish management. The program may include field training, outreach, shoreline habitat projects, shellfish seed production, and other activities. The wet lab building will be a minimum of 40 ft. by 80 ft. (12 m by 24 m) and will provide a space for facilitating the shellfish seed planting, for equipment storage, and for the Education and Training program, including a small classroom and public meeting space and staff offices.

4.3.4.14.4 Land Conservation

The Navy will provide funding for the acquisition and conservation of lands on the west shore of Port Gamble Bay. The funds for the purchase of lands may be used within two designated blocks of land. The two areas include the 566 ac. (229 ha) shoreline block which includes approximately 26 parcels and the 678 ac. (274 ha) Maritime Forest Block which includes approximately 34 parcels.

4.3.4.15 Transit Protection System Facilities, Naval Base Kitsap Bangor

This project provided berthing for three types of Transit Protection System vessels and various Port Operations tugs and small craft. In addition, the project provided the necessary support facilities ashore for the command, administrative operations, and support functions of the crews and command personnel of associated escort vessels and craft. This project occurred in Fiscal Year (FY) 2011 and involved the demolition of an existing pier and the installation of piles for the new pier. The development involved several potentially significant issues, including impacts to endangered and threatened species, storm water runoff, demolition material disposal, and the avoidance of impacts on valuable upland natural resources.

4.3.4.16 P-8A Multi-Mission Aircraft

The Navy decided in 2008 to provide facilities and functions to support homebasing 12 P-8A Multi-Mission Maritime Aircraft (MMA) squadrons and one Fleet Replacement Squadron into the U.S. Navy Fleet. The P-8A MMA will replace the current maritime patrol aircraft, the P-3C Orion, at existing maritime patrol homebases. The action will result in the homebasing of four fleet squadrons (24 aircraft) at NASWI, Washington. The introduction of the MMA squadrons in the U.S. Navy Fleet is projected to begin no later than 2012 and be completed by 2019 and was analyzed in an EIS (U.S. Department of the Navy 2008). Since the completion of the original EIS, the Navy has prepared a Supplemental EIS to analyze homebasing an additional three squadrons at NASWI, Washington. The change in aircraft stationed at NASWI has been incorporated in the Alternative 1 and 2 activity levels of this NWTT EIS/OEIS.

4.3.4.17 Electronic Attack Squadron Expeditionary Wing Environmental Assessment

The Navy has prepared an EA proposing to transition the Expeditionary Electronic Attack squadrons at NASWI from the aging EA-6B Prowler to the newer EA-18G Growler in the 2012–2014 timeframe (U.S. Department of the Navy 2012e). The action discussed in this EA includes the addition of up to 11 EA-18G aircraft at NASWI. Training for this aircraft is included in the Alternative 1 and 2 numbers in the NWTT EIS/OEIS.

4.3.4.18 United States Department of the Navy Climate Change Roadmap

The Navy Climate Change Roadmap outlines the Navy's approach to observing, predicting, and adapting to climate change by providing a chronological list of Navy-associated action items, objectives, and desired effects for FY 2010–2014. The Navy Climate Change Roadmap focuses on strategy, policy, and plans; operations and training; investments in capability and infrastructure; strategic communications and outreach; and EA and prediction. The Roadmap has five main objectives. The first is that the Navy is fully mission-capable through changing climatic conditions, while actively contributing to national requirements for addressing climate change. The second is that Naval force structure and infrastructure are capable of meeting combatant commander requirements in all probable climatic conditions over the next 30 years. The third is that the Navy understands the timing, severity, and impact of current and projected changes in the global environment. The fourth is that the media, public, government, Joint, interagency, and international community understand how and why the Navy is effectively addressing climate change. Finally, the last objective of the Navy Climate Change Roadmap is for the Navy to be recognized as a valuable joint, interagency, and international partner in responding to climate change (U.S. Department of the Navy 2010).

The roadmap specifies Navy Actions over three phases. Phase 1 was in FY 2010 where Naval War College coursework included climate change impacts on national security, and the requirements of a next

generation operational and climatic environmental prediction capability were defined. Phase 2 was from FY 2011 to 2013 and has four significant actions:

1) Incorporate climate change considerations in strategic guidance documents, such as the Navy Strategic Guidance in support of Program Review 2013 and the Navy Strategic Plan in support of the Navy's Program Objective Memorandum for FY 2014.
2) Develop recommendations to address climate change requirements in Sponsor Program Proposals for the Navy's Program Objective Memorandum for FY 2014.
3) Formalize new cooperative relationships that increase the Navy's capability to assess, predict, and adapt to climate change.
4) Include climate change considerations in fleet training and planning.

The third and final phase will include the execution of the Navy Program Objective Memorandum for FY 2014 budget initiatives that address climate change, and the initiation of intergovernmental, multilateral, and bilateral activities, which increase the Navy's ability to assess, predict, and adapt to climate change. The third and final phase is occurring in FY 2013–2014, and includes the execution of the Navy Program Objective Memorandum FY 2014 budget initiatives that address climate change, as well as the initiation of intergovernmental, multilateral, and bilateral activities that increase the Navy's ability to assess, predict, and adapt to climate change (U.S. Department of the Navy 2010). Every 4 years, the director of Task Force Climate Change will review and revise the roadmap following promulgation of the Quadrennial Defense Review, and will incorporate the review's guidance as appropriate.

4.3.5 Environmental Regulations and Planning

4.3.5.1 Coastal and Marine Spatial Planning

Dismissed because action involves only planning and policy-related activities.

4.3.5.2 Marine Mammal Protection Act Incidental Take Authorizations

The MMPA generally prohibits "takes" of marine mammals in U.S. waters by any person and by U.S. citizens in international waters. The National Oceanic and Atmospheric Administration (NOAA) can authorize "takes" for specific activities (National Oceanic and Atmospheric Administration 2012c). Take authorizations will be issued for the proposed action in the NWTT Study Area, and for other actions occurring inside and outside of the Study Area.

4.3.6 Other Environmental Considerations

4.3.6.1 Fred Hill Materials Thorndyke Resource (Pit-to-Pier) Project

Fred Hill Materials, a materials supply firm based in Poulsbo, constructed a 4-mile (mi.) (6.4-kilometer [km]) conveyor belt connecting a 781 ac. (316 ha) inland gravel mine to 1,100 ft. (335 m) long, 80 ft. (24 m) high pier and 900 ft. (274 m) long moorage dock. The shipping facility is on the west shore of Hood Canal, 5 mi. (8 km) south of the Highway 104 Hood Canal Bridge. When fully operational the "pit to pier" operation would mine, transport, and ship an estimated 60,000 tons (54,432 metric tons) of gravel loading into barges and ships bound for domestic and foreign ports. Operations would be 24 hours a day and each vessel would travel under or through the opening of the floating Hood Canal Bridge. There is considerable uncertainty as to whether this project will be implemented.

4.3.6.2 Hood Canal In Lieu Fee Mitigation Program

The Hood Canal In Lieu Fee Mitigation Program is a voluntary program sponsored by the Hood Canal Coordinating Council, where entities can purchase mitigation credits to offset unavoidable adverse impacts to aquatic resources within the Hood Canal watershed. The primary goal of the Hood Canal Coordinating Council in Lieu Fee Program for Hood Canal is to increase aquatic resource functions in the Hood Canal watershed. The Hood Canal Coordinating Council in Lieu Fee Program is intended to ensure no net loss through the preservation, enhancement, establishment, and restoration of ecological functions within target watersheds through the establishment and management of mitigation sites. The service area for the Hood Canal Coordinating Council In Lieu Fee Program encompasses Hood Canal and those portions of Water Resource Inventory Areas 14, 15, 16, and 17 draining to Hood Canal, defined by a line extending from Foulweather Bluff to Tala Point, south through the Great Bend to its terminus near the town of Belfair, Washington. The service area is divided into two components for the In Lieu Fee Program: Freshwater Environment, which generally includes areas landward of the marine riparian zone including freshwater and estuarine wetlands and streams up to and excluding any National Park or National Forest Lands; and Marine/Nearshore Environment, which extends from the marine riparian area at the top of the coastal bluffs to the adjacent aquatic intertidal and subtidal zones. The mitigation strategy selected for each permitted impact will be based on an assessment of type and degree of disturbance at the landscape and/or drift cell.

4.3.6.3 Commercial and Recreational Fishing

Commercial and recreational fishing constitutes an important and widespread use of the ocean resources throughout the Study Area. Fishing can adversely affect fish populations, other species, and habitats. Potential impacts of fishing include overfishing of targeted species, bycatch, entanglement, and habitat destruction, all of which negatively affect fish stocks and other marine resources. Bycatch is the capture of fish, marine mammals, sea turtles, seabirds, and other nontargeted species that occur incidentally to normal fishing operations. Use of mobile fishing gear such as bottom trawls disturbs the seafloor and reduces habitat structural complexity. Indirect impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), habitat destruction, and the generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats and have the potential to entangle or be ingested by marine animals.

Fishing can also have a profound influence on individual targeted species populations. In a study of retrospective data, Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before the present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer-term data and information, they concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climatic change. Fisheries bycatch has been identified as a primary driver of population declines in several marine species, including sharks, mammals, seabirds, and sea turtles (Wallace et al. 2010). For example, entanglement in nets from the Pacific Northwest coastal salmon fisheries has been shown to increase mortality in seabirds (Hamel et al. 2009). Habitat destruction caused by bottom trawling and other fishing methods also contributes to the negative effects of commercial and recreation fishing on multiple species, such as the North American groundfish (Melnychuk et al. 2013).

4.3.6.4 Maritime Traffic

Portions of the Study Area are heavily traveled by commercial, recreational, and government marine vessels, with several commercial ports occurring in or near the Study Area. Several harbor facilities of interest to the U.S. Navy are located in the Puget Sound: Naval Station Everett; NAVBASE Kitsap Bremerton, NAVBASE Kitsap Bangor, Naval Undersea Warfare Center Keyport, Naval Magazine Indian Island, NASWI, the Port of Seattle, and the Port of Tacoma. Maritime traffic on the Puget Sound is heavy, many large commercial vessels use the Ports of Everett, Seattle, Tacoma, and others in the area, and they enter and depart Puget Sound each day. Additional traffic on the Sound is created by the frequent runs of large Washington State vehicle and passenger ferries as they cross the Sound on generally east-west traffic routes that are perpendicular to normal inbound and outbound maritime traffic channels. Additionally, many recreational and commercial small craft operate throughout the Puget Sound and adjacent waters. The United States has grown increasingly dependent on international trade over the past 50 years. Section 3.12 (Socioeconomic Resources) provides additional information for marine vessel traffic in the Study Area. Primary concerns for the cumulative impacts analysis include vessels striking marine mammals and sea turtles, introduction of non-native species through hull fouling and ballast water, and underwater sound from ships and other vessels.

4.3.6.5 Shoreline Development

Shoreline development adjacent to the Study Area is both intensive and extensive. Development has impacted and continues to impact coastal resources through point and nonpoint source pollution; concentrated recreational use; and intensive ship traffic using major port facilities. The Study Area also includes extensive coastal tourism development (hotels, resorts, restaurants, food industry, residential homes, etc.) and the infrastructure supporting coastal development (retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, recreational fishing facilities, etc.). The focus of this analysis is on shoreline development in Washington because of the close proximity of the Study Area to the shores of Washington. The offshore portion of the Study Area is 12 nm off the coast of Oregon, and California, and therefore shoreline development in that part of the Study Area will have minimal impact on resources in the Study Area.

Coastal development intensifies use of coastal resources, resulting in potential impacts on water quality, marine habitat, and air quality. Coastal development is therefore closely regulated by Washington, Oregon, and California through the Coastal Zone Management Act. New development in the coastal zone requires a permit from the state or local government to which permitting authority has been delegated (Chapter 6, Additional Regulatory Considerations, provides additional information on coastal zone management in each state).

4.3.6.6 Oceanographic Research

There are currently scientific research permits and General Authorizations for research issued by NMFS for cetacean work in the North Pacific. The most invasive research involves tagging or biopsy while the remainder focuses on vessel and aerial surveys and close approach for photo-identification. Species covered by these permits and authorizations include small odontocetes, sperm whales and large mysticetes. One permit issued to the Office of Protected Resources of NMFS allows for responses to strandings and entanglements of listed marine mammals. NMFS has also issued General Authorizations for commercial photography of non-listed marine mammals, provided that the activity does not rise to Level A Harassment of the animals. These authorizations are usually issued for no more than 1 or 2 years, depending on the project.

Three consecutive marine geophysical (seismic) surveys are authorized to be conducted in the Northeast Pacific Ocean, for the time period of June–August 2012. Three Level B harassment incidental take authorizations for marine mammals are issued to the Lamont-Doherty Earth Observatory, a part of Columbia University. The Observatory with research funding from the U.S. National Science Foundation, plans to conduct three research studies on the Juan de Fuca Plate, the Cascadia thrust zone, and the Cascadia subduction margin in waters off the Oregon and Washington coasts. The Observatory will use one source vessel, a seismic airgun array, a single hydrophone streamer, and the ocean bottom seismometers to conduct the seismic surveys. They also intend to operate a multibeam echosounder and a subbottom profiler continuously throughout the surveys (FR 77: 136 2012).

These acoustic stimuli generated during the operation of the seismic airgun arrays may have the potential to cause a short-term behavioral disturbance for marine mammals in the survey area. The surveys should provide data to characterize the evolution and state of hydration of the Juan de Fuca plate at the Cascadia subduction zone, provide information on the buried structures in the region, and assess the location, physical state, fluid budget, and methane systems of the Juan de Fuca plate boundary and overlying crust. The results of the three studies will also provide background information for generating improved earthquake hazards analyses and a better understanding of the processes that control megathrust earthquakes, which are produced by a sudden slip along the boundary between a subducting and an overriding plate (FR 77: 136 2012).

The impacts of this type of research are largely unmeasured. However, given the analysis and scrutiny given to permit applications, it is assumed that any adverse effects are largely transitory (e.g., inadvertent harassment, biopsy effects, etc.). Data to assess population level effects from research are not currently available, and it is uncertain that research effects could be separately identified from other adverse effects on cetacean populations in Pacific Northwest waters.

4.3.6.7 Ocean Noise

Noise is generally described as unwanted sound—sound that clutters and masks other sounds of interest (Richardson et al. 1995). Anthropogenic sources of noise that are most likely to contribute to increases in ocean noise are vessel noise from commercial shipping and general vessel traffic, oceanographic research, oil and gas exploration, underwater construction, and naval and other use of sound navigation and ranging (sonar).

Any potential for cumulative impact should be put into the context of recent changes to ambient sound levels in the world's oceans as a result of anthropogenic activities. However, there is a large and variable natural component to the ambient noise level as a result of events such as earthquakes, rainfall, waves breaking, and lightning hitting the ocean as well as biological noises such as those from snapping shrimp and the vocalizations of marine mammals.

Andrew et al. (2002) compared ocean ambient sound from the 1960s to the 1990s from a receiver approximately 25 mi. (40 km) west of Point Sur, California. The data showed an increase in ambient noise of approximately 10 decibels (dB) in the frequency ranges of 20–80 Hertz (Hz) and 200–300 Hz, and about 3 dB at 100 Hz over a 33-year period. Each 3 dB increase is noticeable to the human ear as a doubling in sound level. A possible explanation for the rise in ambient noise is the increase in shipping noise. There are approximately 11,000 supertankers worldwide, each operating 300 days per year, producing constant broadband noise at source levels of 198 dB (Hildebrand 2004).

Appendix G (Acoustic Primer) provides additional information about sources of anthropogenic sound in the ocean and other background information about underwater noise. This appendix describes the different types of effects that are possible and the potential relationships between sound stimuli and long-term consequences for individual animals and populations. A variety of impacts may result from exposure to sound-producing activities. The severity of these impacts can vary greatly between minor impacts that have no real cost to the animal, to more severe impacts that may have lasting consequences. The major categories of potential impacts are: behavioral reactions, physiological stress, auditory fatigue, auditory masking, and direct trauma.

4.3.6.8 Ocean Pollution

Pollution is the introduction of harmful contaminants that are outside the norm for a given ecosystem. Ocean pollution has and will continue to have serious impacts on marine ecosystem. Common ocean pollutants include toxic compounds such as metals, pesticides, and other organic chemicals; excess nutrients from fertilizers and sewage; detergents; oil; plastics; and other solids. Pollutants enter oceans from non-point sources (i.e., storm water runoff from watersheds), point sources (i.e., wastewater treatment plant discharges), other land-based sources (i.e., windblown debris), spills, dumping, vessels, and atmospheric deposition.

4.3.6.8.1 Non-Point Sources, Point Sources, and Atmospheric Deposition

Storm water runoff, wastewater, and nonpoint source pollution, are considered major causes of impairment of ocean waters. Storm water runoff from coastal urban areas and beaches carries waste such as plastics and Styrofoam into coastal waters. Sewer outfalls also are a source of ocean pollution. Sewage can be treated to eliminate potentially harmful releases of contaminants; however, releases of untreated sewage occur due to malfunctions or overloads to the infrastructure, resulting in releases of bacteria usually associated with feces, such as *Escherichia coli* and *Enterococci spp*. Bacteria levels are used routinely to determine the quality of water at recreational beaches and as indicators of the possible presence of other harmful microorganisms. In the past, toxic chemicals have been released into sewer systems. While such dumping has long been forbidden by law, the practice left ocean outflow sites contaminated. Sewage treatment facilities generally do not treat or remove persistent organic pollutants, such as polychlorinated biphenyl (PCB) and dichlorodiphenyltrichloroethane (DDT), or other toxins.

Hypoxia (low dissolved oxygen concentration) is a major impact associated with point and non-point sources of pollution. Hypoxia occurs when waters become overloaded with nutrients from pesticides such as nitrogen and phosphorus, which enter oceans from non-point source runoff, wastewater treatment plants, and atmospheric deposition. Too many nutrients can stimulate algal blooms—the rapid expansion of microscopic algae (phytoplankton). When excess nutrients are consumed, the algae population dies off and the remains are consumed by bacteria. Bacterial consumption causes dissolved oxygen in the water to decline to the point where marine life that depends on oxygen can no longer survive (Boesch et al. 1997).

Almost 200 million tons of criteria pollutants (sulfur dioxide, nitrogen dioxide, carbon monoxide, lead, volatile organic compounds, and particulate matter) were emitted into the United States Atmosphere in 1997 (U.S. Environmental Protection Agency 1998). Through the process of wet and dry atmospheric deposition, these and other pollutants can return to the earth and the waters. Wet deposition removes gases and particles from the atmosphere and deposits them on the surface of the earth through rain, sleet, snow, and fog. While dry deposition is a process through which particles and gases are deposited in the absence of precipitation, such as through dust (U.S. Geological Survey 2000). This atmospheric

deposition also contributes to the buildup of pollutants in the Study Area. Non-point sources, point sources, and atmospheric deposition also contribute toxic pollutants such as metals, pesticides, and other organic compounds to the marine environment. Toxic pollutants may cause lethal or sublethal effects if present in high concentrations, and can build up in tissues over time and suppress immune system function, resulting in disease and death for marine organisms. The main causes of pollution in the Study Area are oil spills, stormwater run-off, dairy farm run-off, hazardous waste sites, combined sewer overflows, and highway stormwater outfalls (Puget Soundkeeper Alliance 2012).

4.3.6.8.2 Marine Debris

Marine debris is any anthropogenic object intentionally or unintentionally discarded, disposed of, or abandoned in the marine environment. Common types of marine debris include various forms of plastic and abandoned fishing gear, as well as clothing, metal, glass, and other debris. Marine debris degrades marine habitat quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service 2006).

Plastic marine debris is a major concern because it degrades slowly and many plastics float, allowing the debris to be transported by currents throughout the oceans. Currents in the oceanic convergence zone in the North Pacific Subtropical Gyre act to accumulate the floating plastic marine debris. These debris carrying currents include the south-flowing California Current, and the north-flowing Gulf of Alaska Current. These currents distribute debris throughout the Study Area. Debris found in the Puget Sound (inland waters) portion of the Study Area, include pieces of hard plastic, insulation, pre-production plastic pellets, pieces of bags or wrappers, fishing line, rope, or synthetic cloth, cigarette butts and filters, glass fragments and shards, rubber, metal, and “other” unclassified debris (Kingfisher 2011).

Additionally, plastic waste in the ocean chemically attracts hydrocarbon pollutants such as PCB and DDT, which accumulate up to one million times more in plastic than in ocean water (Mato et al. 2001). Fish, marine animals, and birds can mistakenly consume these wastes containing elevated levels of toxins instead of their prey. In the North Pacific Subtropical Gyre it is estimated that the fishes in this area are ingesting 12,000–24,000 U.S. tons (10,886,216–21,772,433 kilograms [kg]) of plastic debris a year (Davison and Asch 2011).

Debris that sinks to the seafloor is also a concern for ingestion and entanglement by fish, invertebrates, sea turtles, marine mammals, and marine vegetation. Sunken debris is also a contributor to marine habitat degradation. Military expended materials will also contribute to the marine debris loading of the seafloor in the Study Area. In the U.S. west coast Groundfish Bottom Trawl Surveys of 2007 and 2008, anthropogenic debris was observed at depths of 55–1,280 m (180.5–4,199.5 ft.). The density of debris increased with depth, and the majority of the debris was plastic and metallic, while the rest of it was fabric and glass (Keller et al. 2010).

4.3.6.9 Marine Tourism

Tourism is Alaska’s second biggest industry in terms of employment, and is the main industry of many small and isolated communities. The coast and some major rivers are the center of Alaska’s tourism. Sport fishing is one of the biggest industries along with the growing number of ecotourists visiting the state. In the summer of 2011 alone, there were a total of 1,556,800 visitors to the state. Cruise ship visitors make up a majority of 57 percent or 883,000 of those visitors. The second most popular activity of tourists in Alaska is wildlife viewing (52 percent), much of which occurs on the coast. Between 2006 and 2011, the percentage of visitors from the United States fell by 2 percent, while Canada and the other International categories each increased by 1 percent.

In 2009, visitors to Washington spent $14.2 billion; although this is a decrease from 2008 it was reflective of national trends at the time. Travel and tourism is Washington's fourth largest export industry which supports jobs, bolsters local economies and small businesses and contributes tax revenue for state and local governments. Seattle itself attracts about 9.9 million visitors annually, which contributes about $463 million in state and local tax revenues. Washington attracts tourists through water trails, the Cascadia Marine Trail, and other ocean tourism ventures that are based on conservation, environmental impact, visitor management, and community relations and education (Labor 1999).

The total overnight trips to the Oregon Coast totaled 9.6 million visitors, which was about 35 percent of the total visitors in 2009. Spending on the coast in 2009 totaled $1.37 billion, with only 10 percent of that total being spent on Recreation and 36 percent on Lodging. Sixty-seven percent of visitors spent their time at the Beach or Waterfront, while 16 percent spent time swimming and 11 percent went fishing (Regional Visitor Research, Oregon 2009). The majority of the tourism industry's employment in Oregon is in accommodation and food services, while 15 percent are in travel and transportation, and the remaining 25 percent is divided between retail trade and arts, entertainment, and recreation. In 2010 there were approximately 161,900 workers in the leisure and hospitality industry, the majority of which were service workers whose wages are low, resulting in a lower average wage. The most recent employment projections forecast that leisure and hospitality will grow about 19 percent from 2010 to 2020. This $2 billion travel and tourism industry plays an important role in Oregon's economy (Jackson-Winegardner 2012).

Between 1990 and 2000, the ocean-related gross state product for California grew by 10.6 percent with one of the largest growth trends experienced in coastal recreation and tourism. California's trend reflects the international trend of coastal tourism and recreation growth which has continued in past decades while other industries have declined. Additionally, the growth is seen in the development of "services" rather than "goods-related" activities (Kildow and Colgan 2005). Stakeholders in tourism services have economical motivation to ensure positive management of marine resources on which their industries are based, therefore the impacts of marine tourism is generally localized and of small magnitude. Rapid expansion of tourism could increase pressure for additional coastal and urban development which would result in potential indirect and cumulative effects on marine resources (Harriott 2002). The Marine Institute found that the issues relating to tourism included visitor pressures on coastal ecology; carrying capacity; information gap (i.e., insufficient data to assess impacts of tourism); anthropogenic impacts (i.e., displacement of seabirds, habitat and roosting opportunities, conflicts with users and wildlife, altering food sources); threats to ecology; development pressure; infrastructural support; user conflicts; and motorized crafts (Connolly et al. 2001).

4.3.6.10 Commercial and General Aviation

Commercial and general aviation are retained for analysis and discussion in Section 4.4.4.1 (Greenhouse Gases).

4.3.6.11 2013 Bremerton Ferry Terminal Construction by the Washington State Department of Transportation

To improve, maintain, and preserve the terminals, Washington State Department of Transportation conducts construction, repair and maintenance activities as part of its regular operations. One of these projects is the replacement of wingwall structures at the Bremerton ferry terminal. The project has submitted an Incidental Harassment Authorization request. The proposed project will occur in marine waters that support several marine mammal species. The project's timing and duration and specific

types of activities (such as pile driving) may result in the incidental taking by acoustical harassment (Level B take) of marine mammals protected under the MMPA. The Washington State Department of Transportation is requesting an Incidental Harassment Authorization for the six marine mammal species (harbor seal, California sea lion, Steller sea lion, killer whale, gray whale, humpback whale) that may occur in the vicinity of the projects. The current timber wingwalls at the Bremerton terminal are near the end of their design life and must be replaced with steel wingwalls to ensure safe and reliable functioning of the terminal (Washington State Ferries 2012).

4.4 RESOURCE-SPECIFIC CUMULATIVE IMPACTS

4.4.1 RESOURCE AREAS DISMISSED FROM CUMULATIVE IMPACTS ANALYSIS

In accordance with Council on Environmental Quality guidance (Council on Environmental Quality 2010), the cumulative impacts analysis focused on impacts that are "truly meaningful." The level of analysis for each resource was commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences). The analysis focused on marine mammals, sea turtles, and cultural resources. While each of the following resources is discussed briefly in the following sections, detailed analysis of cumulative impacts on the following resources was not necessary as the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low. Further analysis of cumulative impacts is not warranted on the following resources:

- Sediments and water quality
- Marine habitats
- Marine vegetation
- Marine invertebrates
- Socioeconomic resources
- Public health and safety

4.4.2 SEDIMENTS AND WATER QUALITY

The analysis in Section 3.1 (Sediments and Water Quality) indicates that the alternatives could result in local, short- and long-term changes in sediment and water quality. However, chemical, physical, or biological changes to sediments or water quality would be below applicable standards, regulations, and guidelines and would be within existing conditions or designated uses (Section 3.1.1.2, Methods, lists applicable standards, regulations, and guidelines). The short-term impacts would arise from explosions and the byproducts of explosions and combusted propellants. It is unlikely these short-term impacts would overlap in time and space with other future actions that produce similar constituents. For example, training and testing with explosives would not be expected to occur near operations like the 2013 Bremerton Ferry Terminal Construction, where explosives are already being used. Therefore, the short-term impacts described in Section 3.1 (Sediments and Water Quality) are not expected to contribute to cumulative impacts.

The long-term impacts would arise from unexploded ordnance, noncombusted propellant, metals, and other materials. Long-term impacts of each alternative would be cumulative with other actions that cause increases in similar constituents. However, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to long-term cumulative impacts would be negligible because

- most training and testing activities are widely dispersed in space and time;
- most components of expended materials are inert or corrode slowly;

- numerically, most of the metals expended are small- and medium-caliber projectiles; metals of concern comprise a small portion of the alloys used in expended materials, and metal corrosion is a slow process that allows for dilution;
- most of the components are subject to a variety of physical, chemical, and biological processes that render them benign; and
- potential areas of impacts would be limited to small zones immediately adjacent to the explosive, metals, or chemicals other than explosives.

Furthermore, none of the alternatives would result in long-term and widespread changes in environmental conditions, such as nutrient loading, turbidity, salinity, or pH (a measure of the degree to which a solution is either acidic [pH less than 7.0] or basic [pH greater than 7.0]).

Based on the analysis presented in Section 3.1 (Sediments and Water Quality) and the reasons summarized above, the changes in sediment or water quality would be measurable, but would still be below applicable state, federal, and U.S. Environmental Protection Agency (USEPA) standards and guidelines; therefore the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low and further analysis of cumulative impacts is not warranted.

4.4.3 AIR QUALITY

As detailed in Section 3.2 (Air Quality), increased training and testing activities conducted under Alternatives 1 and 2 would result in increased criteria pollutant emissions and hazardous air pollutant emissions throughout the Study Area. Sources of the increased emissions would include vessels and aircraft, and to a lesser extent munitions. Potential impacts include localized and temporarily elevated pollutant concentrations. Recovery would occur quickly as emissions disperse, and there would be no significant impact on air quality. The impacts of Alternatives 1 or 2 would be cumulative with other actions that involve criteria air pollutant and hazardous air pollutant emissions. However, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be low for the following reasons:

- Few stationary offshore air pollutant emission sources exist within the Study Area and few are expected in the foreseeable future.
- International regulations by the International Maritime Organization require commercial shipping vessels to switch to lower-sulfur fuel near U.S. and international coasts beginning in 2012 (National Oceanic and Atmospheric Administration 2011a). The Department of Defense (DoD) has released the Operational Energy Strategy: Implementation Plan which will reduce demand, diversify energy sources, and integrate energy consideration into planning (U.S. Department of Defense 2012). The U.S. Department of the Navy policy commits to a reduction of oil consumption by 50 percent by 2015, 40 percent of the Navy's total energy will come from fossil fuel alternatives and 50 percent of its onshore energy will come from renewable sources by 2020 (Environmental and Energy Study Institute 2009; Paige 2009). Similar low-sulfur fuel regulations in California, including a voluntary state slowdown policy, were found to reduce several pollutants, including sulfur dioxide and particulate matter by as much as 90 percent (Lack et al. 2011).

Based on the analysis presented in Section 3.2 (Air Quality) and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be low and would still be below applicable state, federal, and USEPA standards and guidelines. Therefore, further analysis of

cumulative impacts on air quality is not warranted. Regulatory framework for greenhouse gases that are related to air quality are discussed below in Section 4.4.4.1.1 (Regulatory Framework).

4.4.4 CLIMATE CHANGE

This section provides background information and an analysis of the cumulative impacts of climate change and greenhouse gas emissions for the Proposed Action. Climate change is also considered in the overall cumulative impacts analysis as another environmental consideration. The Intergovernmental Panel on Climate Change (2007) reports that physical and biological systems on all continents and in most oceans are already being affected by recent climate changes. Global-scale assessment of observed changes shows that it is likely that the increase in greenhouse gas emissions from anthropogenic activities over the last three decades has resulted in an increased temperature, which had a discernible influence on many physical and biological systems. Some of the major potential concerns for the marine environment include sea temperature rise, melting of polar ice, rising sea levels, changes to major ocean current systems, and ocean acidification.

4.4.4.1 Greenhouse Gases

Greenhouse gases are compounds that contribute to the greenhouse effect. The greenhouse effect is a natural phenomenon in which these gases trap heat within the surface-troposphere (lowest portion of the earth's atmosphere) system, causing heating (radiative forcing) at the surface of the earth. The projected warming and more extensive climate-related changes could dramatically alter the region's economy, landscape, character, and quality of life (Le Treut et al. 2007). Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in greenhouse gas emissions from human activities (U.S. Environmental Protection Agency 2012). Without greenhouse gases the planet's surface would be about 60 degrees Fahrenheit (°F) cooler than present; according to the NOAA and National Aeronautics and Space Administration data, the average surface temperature has increased by about 1.2–1.4°F since 1900. If greenhouse gases continue to increase, models predict that the average temperature at the earth's surface could increase from 2.0 to 11.5°F above the 1990 levels by the end of this century (Le Treut et al. 2007).

Predictions of long-term negative environmental impacts due to global warming include sea level rise, changing weather patterns with increases in the severity of storms and droughts, changes to local and regional ecosystems (including the potential loss of species), melting glaciers and sea ice, thawing permafrost, a longer growing season, and shifts in plant and animal ranges.

In 2009, the United States generated about 6,633.2 teragrams (Tg) (or million metric tons) of carbon dioxide (CO_2) equivalents (Co_2e) (U.S. Environmental Protection Agency 2012). The 2009 inventory data (U.S. Environmental Protection Agency 2012) show that greenhouse gases (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) contributed from fossil fuel combustion processes from mobile and stationary sources (all sectors) include approximately:

- 5,505.2 Tg of CO_2
- 686.3 Tg CH_4
- 295.6 Tg N_2O

The 6,633.2 Tg CO_2e generated in 2009 was a decrease from the 7,263.4 Tg CO_2e generated in 2007 (U.S. Environmental Protection Agency 2011). Among domestic transportation sources, light-duty vehicles (including passenger cars and light-duty trucks) represented 64 percent of CO_2 emissions, medium- and

heavy-duty trucks 20 percent, commercial aircraft 6 percent, and other sources 9 percent. Across all categories of aviation, CO_2 emissions decreased by 21.6 percent (38.7 Tg) between 1990 and 2009, including a 59 percent (20.3 Tg) decrease in emission from domestic military operations. To place military aircraft in context with other aircraft CO_2 emissions, in 2009, commercial aircraft generated 111.4 Tg CO_2e, military aircraft generated 14.1 Tg CO_2e, and general aviation aircraft generated 13.3 Tg CO_2e. Military aircraft represent roughly 10 percent of emissions from the overall jet fuel combustion category (U.S. Environmental Protection Agency 2012).

This section begins by providing the background and regulatory framework for greenhouse gases. It then provides a quantitative evaluation of changes in greenhouse gas emissions that would occur under the Proposed Action and analyzes the cumulative impacts of greenhouse gas emissions.

4.4.4.1.1 Regulatory Framework

Federal agencies address emissions of greenhouse gases by reporting and meeting reductions mandated in laws, executive orders and policies. The most recent of these are Executive Order (EO) 13514 *Federal Leadership in Environmental, Energy, and Economic Performance* of 5 October 2009 and EO 13423 *Strengthening Federal Environmental, Energy, and Transportation Management* of 26 January 2007.

Executive Order 13514 shifts the way the government operates by (1) establishing greenhouse gases as the integrating metric for tracking progress in federal sustainability, (2) requiring a deliberative planning process, and (3) linking to budget allocations and Office of Management and Budget scorecards to ensure goal achievement.

The targets for reducing greenhouse gas emissions discussed in EO 13514 for Scope 1 (direct greenhouse gas emissions from sources that are owned or controlled by a federal agency) and Scope 2 (direct greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency) have been set for the DoD at a 34 percent reduction of greenhouse gas from the 2008 baseline by 2020. Scope 3 targets (greenhouse gas emissions from sources not owned or directly controlled by a federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting) were set at a 13.5 percent reduction. Executive Order 13514 *Strategic Sustainability Performance Plan* submitted to the Council on Environmental Quality on 2 June 2010 contains a guide for meeting these goals.

Executive Order 13423 established a policy that federal agencies conduct their environmental, transportation, and energy-related activities in support of their respective missions in an environmentally economic way. It included a goal of improving energy efficiency and reducing greenhouse gas emissions of the agency through reduction of energy intensity by 3 percent annually through the end of FY 2015, or 30 percent by the end of FY 2015, relative to the baseline of the agency's energy use in FY 2003.

The *Draft NEPA Guidance on Consideration of the Impacts of Climate Change and Greenhouse Gas Emissions* states that "if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2e greenhouse gas emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public" (Council on Environmental Quality 2010).

The Navy is committed to improving energy security and environmental stewardship by reducing reliance on fossil fuels. The Navy is actively developing and participating in energy, environmental, and

climate change initiatives that will increase use of alternative energy and help conserve the world's resources for future generations. The Navy Climate Change Roadmap identifies actions the Environmental Readiness Division is taking to implement EO 13514 (U.S. Department of the Navy 2010). The Navy's Task Force Energy is responding to the Secretary of the Navy Energy Goals through energy security initiatives that reduce the Navy's carbon footprint. The Climate Change Roadmap (5-year roadmap) action items, objectives, and desired impacts are organized to focus on strategies, policies and plans; operations and training; investments; strategic communications and outreach; and EA and prediction.

4.4.4.2 Cumulative Greenhouse Gas Impacts

Climate change is a global issue, and greenhouse gas emissions are a concern from a cumulative perspective because individual sources of greenhouse gas emissions are not large enough to have an appreciable impact on climate change. This greenhouse gas analysis considers the incremental contribution of Alternatives 1 and 2 to total estimated U.S. greenhouse emissions and their significance on climate change as compared to the No Action Alternative.

To estimate total greenhouse gas emissions, each greenhouse gas was assigned a global warming potential; that is, the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of one. For example, CH_4 has a global warming potential of 21, which means that it has a global warming effect 21 times greater than CO_2 on an equal-mass basis (Intergovernmental Panel on Climate Change 2007). To simplify greenhouse gas analyses, total greenhouse gas emissions from a source are often expressed as CO_2 Eq. The CO_2 Eq is calculated by multiplying the emissions of each greenhouse gas by its global warming potential and adding the results together to produce a single, combined emission rate representing all greenhouse gases. While CH_4 and N_2O have much higher global warming potentials than CO_2, CO_2 is emitted in much higher quantities, so it is the overwhelming contributor to CO_2 Eq from both natural processes and human activities. Global warming potential-weighted emissions are presented in terms of equivalent emissions of CO_2, using units of Tg (1 million metric tons, or 1 billion kg) of carbon dioxide equivalents (Tg CO_2 Eq).

Greenhouse gas emissions were calculated (Appendix D, Air Quality Example Calculations) for ships and aircraft, which contribute the majority of emissions associated with training and testing in the Study Area. Greenhouse gas emissions from minor sources such as munitions, weapons platforms, and auxiliary equipment are considered negligible and were not calculated. Ship greenhouse gas emissions were estimated by determining annual ship fuel (typically diesel) use based on proposed activities and multiplying total annual ship fuel consumption by the corresponding emission factors for CO_2, CH_4, and N_2O. Aircraft greenhouse gas emissions were calculated by multiplying jet fuel use rates by the total operating hours, by the corresponding jet fuel emission factors for CO_2, CH_4, and N_2O, and by the total annual sorties. Ship and aircraft greenhouse gas emissions are compared to U.S. 2010 greenhouse gas emissions in Table 4.4-1. The estimated CO_2 Eq emissions from the No Action Alternative and Alternative 1 are 0.0007 percent of the total CO_2 Eq emissions generated by the United States in 2010. The estimated CO_2 Eq emissions from Alternative 2 would increase as a result of increased training and testing activities to about 0.0009 percent of the total CO_2 Eq emissions generated by the United States in 2010.

Based on the analysis presented in Section 3.2 (Air Quality) and the reasons summarized above, the changes in air quality would be measurable, but would still be below applicable standards and

guidelines; therefore the incremental contribution of Alternatives 1 and 2 to cumulative greenhouse gas impacts would be low and further analysis of cumulative impacts is not warranted.

Table 4.4-1: Comparison of Ship and Aircraft Greenhouse Gas Emissions to United States 2010 Greenhouse Gas Emissions

Alternative	Annual Greenhouse Gas Emissions (teragrams CO_2 Eq)	Percentage of U.S. 2010 Greenhouse Gas Emissions
No Action Alternative	0.05	0.0007
Alternative 1	0.05	0.0007
Alternative 2	0.06	0.0009
U.S. 2010 Greenhouse Gas Emissions	6,821.8	

Notes: CO_2 Eq = carbon dioxide equivalent, U.S. = United States
Source: U.S. Environmental Protection Agency 2012

4.4.5 MARINE HABITATS

The analysis presented in Section 3.3 (Marine Habitats) indicates that marine habitats would be affected by acoustic stressors (underwater detonations) and physical disturbance or strikes (interactions with vessels and in-water devices, military expended materials, or seafloor devices). Potential impacts include localized disturbance of the seafloor, cratering of soft-bottom sediments, and structural damage to hard-bottom habitats. Impacts on soft-bottom habitats would be short-term, and impacts on hard bottom would be long-term. The impacts of Alternatives 1 and 2 would be cumulative with other actions that cause similar disturbances. However, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be low for the following reasons:

- Most of the proposed activities that might affect marine habitats would occur in areas where hard bottom does not occur.
- Impacts on soft-bottom habitats would be confined to a limited area, and recovery would occur quickly.

Based on the analysis presented in Section 3.3 (Marine Habitats) and the reasons summarized above, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low. Further analysis of cumulative impacts on marine habitats is not warranted.

4.4.6 MARINE MAMMALS

4.4.6.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Based on the analysis presented in Section 3.4 (Marine Mammals) impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on marine mammals include mortality, injury (Level A harassment under the MMPA), and disturbance or behavioral modification (MMPA Level B harassment). Mortality or injury could be caused by underwater explosions or vessel strikes. Injury, in the form of Permanent Threshold Shift (PTS), could also be caused by sonar use. Underwater explosions and sonar use would result in disturbance that meets the definition of MMPA Level A and B harassment. Other relatively short-term activities that might inadvertently harass marine mammals meet the definition of MMPA Incidental Harassment Authorizations. The remaining stressors analyzed in Section 3.4 (Marine Mammals) are not expected to result in mortality or Level A or B harassment. The incremental contribution of these remaining stressors discussed in Sections 3.4.3.3 through 3.4.3.7, to cumulative impacts on marine mammals, would be negligible. The impacts of Alternatives 1 and 2 considered in the

cumulative impacts analysis of this Section 4.4.6 are summarized in Chapter 3, Section 3.4 (Marine Mammals).

4.4.6.2 Impacts of Other Actions

4.4.6.2.1 Overview

The potential impacts of other actions that are relevant to the cumulative impact analysis for marine mammals include the following:

- Mortality associated with vessel strikes, bycatch in fisheries, and entanglement in fishing and other gear
- Injury associated with vessel strikes, bycatch, entanglement, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with water pollution

Most of the other actions and considerations retained for analysis in Table 4.3-1 would include operation of marine vessels. Exceptions include the actions listed under environmental regulations and permitting. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis includes vessel strikes and underwater noise. Many of the actions would also result in underwater noise from sources other than vessels, seismic surveys, and construction activities. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations" in the maritime traffic and ocean noise subsections. Similarly, many of the actions would result in water pollution. The aggregate impacts of water pollution are addressed in the ocean pollution section (Section 4.4.6.2.5). Bycatch is associated with commercial fishing, and the primary cause of entanglement is commercial fishing. Therefore, these stressors are discussed in the commercial fishing section (Section 4.4.6.3.1).

4.4.6.2.2 Surveillance Towed Array Sensor System Low Frequency Active Sonar

Potential impacts on marine mammals from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations include (1) nonauditory injury,[2] (2) permanent loss of hearing, (3) temporary loss of hearing, (4) behavioral change, and (5) masking. The potential effects from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations on any stock of marine mammals from injury (nonauditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any marine mammal from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Any auditory masking in marine mammals due to low-frequency active sonar signal transmissions is not expected to be severe and would be temporary. The operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar with monitoring and mitigation would result in no mortality. The likelihood of low-frequency active sonar transmissions causing marine mammals to strand is negligible (U.S. Department of the Navy 2011).

[2] Nonauditory injury can be defined as not relating to or functioning in hearing (Merriam-Webster 2012); this includes mortality, strike, and lung injury.

4.4.6.2.3 Maritime Traffic and Vessel Strikes

Vessel strikes have been and will continue to be a cause of marine mammal mortality and injury throughout the Study Area. A review of the impacts of vessel strikes on marine mammals is presented in Section 3.4.3.4.1 (Impacts from Vessel Strikes). In particular, certain large whales, such as the blue whale, are more prone to vessel strikes (Berman-Kowalewski et al. 2010; Betz et al. 2011). The most vulnerable marine mammals are thought to be those that spend extended periods at the surface or species whose unresponsiveness to vessel sound makes them more susceptible to vessel collisions (Gerstein 2002; Laist and Shaw 2006; Nowacek et al. 2004). Marine mammals such as dolphins, porpoises, and pinnipeds that can move quickly throughout the water column are not as susceptible to vessel strikes. Most vessel strikes of marine mammals reported involve commercial vessels and occur over or near the continental shelf (Laist et al. 2001). The literature review by Laist et al. (2001) concluded that vessel strikes likely have a negligible impact on the status of most whale populations, but that for small populations, vessel strikes may have considerable population-level impacts. The conservation status and abundance of the species struck would determine in large part whether the injury would have population-level impacts on that species (Laist et al. 2001; Vanderlaan and Taggart 2009). There has never been a Navy vessel strike to a marine mammal in the Study Area during any previous training or testing activities.

Mysticetes

Virtually all of the rorqual whale species have been documented to have been hit by vessels. This includes blue whales (Berman-Kowalewski et al. 2010; Van Waerebeek et al. 2007; Calambokidis 2012), fin whales (as recently as November 2011 in San Diego) (Van Waerebeek et al. 2007; Douglas et al. 2008), sei whales (Felix and Van Waerebeek 2005; Van Waerebeek et al. 2007), Bryde's whales (Felix and Van Waerebeek 2005; Van Waerebeek et al. 2007), minke whales (Van Waerebeek et al. 2007), and humpback whales (Lammers et al. 2003; Van Waerebeek et al. 2007; Douglas et al. 2008).

Odontocetes

Sperm whales may be exceptionally vulnerable to vessel strikes as they spend extended periods of time "rafting" at the surface in order to restore oxygen levels within their tissues after deep dives (Jaquet and Whitehead 1996; Watkins et al. 1999). There were also instances in which sperm whales approached vessels too closely and were cut by the propellers (Aguilar de Soto et al. 2006). In general, odontocetes move quickly and seem to be less vulnerable to vessel strikes than other cetaceans; however, most small whale and dolphin species have at least occasionally suffered from vessel strikes including: killer whale (Visser and Fertl 2000; Van Waerebeek et al. 2007); short-finned and long-finned pilot whales (Aguilar et al. 2000; Van Waerebeek et al. 2007); bottlenose dolphin (Bloom and Jager 1994; Wells and Scott 1997; Van Waerebeek et al. 2007); white-beaked dolphin, short-beaked common dolphin, striped dolphin, Atlantic spotted dolphin, and pygmy sperm whales (*Kogia breviceps*) (Van Waerebeek et al. 2007); and spinner dolphin (Camargo and Bellini 2007; Van Waerebeek et al. 2007). Beaked whales documented in vessel strikes include: Arnoux's beaked whale (Van Waerebeek et al. 2007), Cuvier's beaked whale (Aguilar et al. 2000; Van Waerebeek et al. 2007), and several species of *Mesoplodon* (Van Waerebeek et al. 2007). However, evidence suggests that beaked whales may be able to hear the low-frequency sounds of large vessels and thus avoid collision (Ketten 1998).

Pinnipeds

Pinnipeds in general appear to suffer fewer impacts from ship strikes than do cetaceans. This may be due, at least in part, to the large amount of time they spend on land (especially when resting and breeding), and their high maneuverability in the water. However, California sea lions are often attracted to fishing vessels or when food is available onboard or nearby (Hanan et al. 1989), and this may make

them somewhat more at risk of being hit by a vessel during these times. Ship strikes are not a major concern for pinnipeds in general (Antonelis et al. 2006; Marine Mammal Commission 2002; National Marine Fisheries Service 2007).

Sea Otter

Sea otter are not expected to be at risk from vessel strike since they spend the majority of time in the water in nearshore and shallow water areas where Navy vessels generally are not present.

4.4.6.2.4 Ocean Noise

As summarized by the National Academies of Science, the possibility that anthropogenic sound could harm marine mammals or significantly interfere with their normal activities is an issue of concern (National Research Council of the National Academies 2005). Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, and communicating with other individuals. Noise can cause behavioral disturbances, mask other sounds (including their own vocalizations), result in injury, and in some cases, even lead to death (Tyack 2009a; Tyack 2009b; Würsig and Richardson 2008). Human-caused noises in the marine environment come from shipping, seismic and geologic exploration, military training, and other types of pulses produced by government, commercial, industry, and private sources. In addition, noise from whale-watching vessels near marine mammals has received a great deal of attention (Wartzok 2009).

NMFS currently states that underwater sound pressure levels (SPLs) above 190 dB root mean square (rms) could cause injury (Level A harassment) in pinnipeds and SPLs above 180 dB rms could cause injury (Level A harassment) in cetaceans. Federal Register Notice (Vol. 70 pp. 1871-1875) established thresholds for behavioral harassment of marine mammals (Level B harassment) at 160 dB rms for pulsed sounds, such as those produced by impact pile driving, and at 120 dB rms for continuous sounds, such as those produced by vibratory pile driving. The pile driving and construction noise from projects in the Hood Canal and Puget Sound would have a cumulative impact on pinniped species as well as cetaceans in the area.

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 near the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation, and foraging, there are many unknowns in assessing the specific effects and significance of responses by marine mammals to sound exposures such as what activity the animal is engaged in at the time of the exposure (National Research Council of the National Academies 2003, 2005; Nowacek et al. 2007; Southall et al. 2007). Potential impacts on marine mammals from ocean noise include behavioral reactions, hearing loss in the form of Temporary Threshold Shift (TTS) or PTS, auditory masking, injury, and mortality. Section 3.4.3.1 (Acoustic Stressors) discusses these and other possible impacts of ocean noise on marine mammals.

4.4.6.2.5 Ocean Pollution

As discussed in Section 3.4.3 (Environmental Consequences), pollutants from multiple sources are present in, and continue to be released into, the oceans. Elevated concentrations of certain compounds have been measured in tissue samples from marine mammals. Long-term exposure to pollutants poses potential risks to the health of marine mammals, although for the most part, the impacts are just starting to be understood (Reijnders et al. 2008). Section 3.4.3 (Environmental Consequences) provides an overview of these potential impacts, which include organ anomalies and impaired reproduction and immune function (Reijnders et al. 2008).

If the health of an individual marine mammal were compromised by long-term exposure to pollutants, it is possible that this condition could alter the animal's expected response to stressors associated with Alternatives 1 and 2. The behavioral and physiological responses of any marine mammal to a potential stressor, such as underwater sound, could be influenced by a number of other factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, size, and social position. Synergistic impacts are also possible. For example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing sensitivity (Fechter 2005). While the response of a previously stressed animal might be different than the response of an unstressed animal, there are no data available at this time to accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to stressors associated with Alternatives 1 and 2.

4.4.6.3 Coastal Development

Coastal development and increased human populations in coastal areas will continue to have impacts on marine mammals such as increased tourism, non-point source pollution and runoff, power plant entrainment, and degradation of nearshore water quality and seagrass beds (see Section 3.4, Marine Mammals, for more information on impacts on marine mammals).

4.4.6.3.1 Commercial Fishing

Several commercial fisheries operate in the Study Area. Potential impacts from these activities include marine mammal injury and mortality from bycatch and entanglement. Fisheries have also resulted in profound changes to the structure and function of marine ecosystems that adversely affect marine mammals.

Numerous ports in or near the Study Area contain both commercial and commercial passenger vessel (i.e., recreational) fishing fleets that use the ocean areas within the Study Area.

In 1994, the MMPA was amended to formally address bycatch. Estimates of bycatch in the Pacific declined by a total of 96 percent from 1994 to 2006 (Geijer and Read 2013). Cetacean bycatch declined by 85 percent from 342 in 1994 to 53 in 2006, and pinniped bycatch declined from 1,332 to 53 over the same time period. However, fishery bycatch is likely the most impactful problem presently and may account for the deaths of more marine mammals than any other cause (Northridge 2008, Read 2008, Hamer et al. 2010; Geijer and Read 2013).

As discussed in Section 3.4.3.5 (Entanglement Stressors), entanglement in fishing gear is another major threat to marine mammals in the Study Area. In addition, overfishing of many fish stocks has resulted in significant changes in trophic structure, species assemblages, and pathways of energy flow in marine ecosystems (Jackson et al. 2001; Myers and Worm 2003; Pauly et al. 1998). These ecological changes may have important and likely adverse consequences for populations of marine mammals (DeMaster et al. 2001).

In summary, future commercial fishing activities in the Study Area are expected to result in significant impacts on some marine mammal species based on the relatively high injury and mortality rates associated with bycatch and entanglement. This mortality could result in or contribute to population declines for some species. Ecological changes brought about by commercial fishing are also expected to adversely impact marine mammals in the Study Area.

Along the U.S. west coast, from 1982 to 2010, there have been 272 reported entangled whales (Saez et al. 2012). Entanglements were seen throughout the coast with concentrations near areas where there is higher human population. Identified entangling gear types have included: trap/pot, bottom set longline, and gillnets. Gillnets were the entangling gear type in the majority of reports pre-2000 (64 percent) and trap/pot are the majority post-2000 (45 percent). In the late 1990s, California gillnet regulations changed resulting in a shift and reduction of gillnet fishing effort. Gray and humpback whales are the most frequently reported entangled large whale species along the U.S. west coast. In California, there were a reported 150 gray whales, 47 humpback whales, 27 unidentified whales, 14 sperm whales, 6 minke whales, and 3 fin whales entangled in fishing gear (Saez et al. 2012).

4.4.6.4 Cumulative Impacts on Marine Mammals

The aggregate impacts of past, present actions and reasonably foreseeable future actions are expected to result in significant impacts on some marine mammal species in the Study Area. The impacts are considered significant because vessel strikes, bycatch, and entanglement associated with other actions are expected to result in relatively high rates of injury and mortality that could cause population declines in some species. Alternatives 1 and 2 could also result in injury to individuals of some marine mammal species from underwater explosions, sonar, and vessel strikes. Injury that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of the Proposed Action to the overall injury and mortality would be low compared to other actions. The Navy does not anticipate mortalities to marine mammals within the Study Area as a result of training or testing activities under any of the alternatives. While quantitative estimates of marine mammal mortality from other actions are not available, the total bycatch estimate (lethal takes and serious injuries) for marine mammals for 39 fisheries and 54 marine mammal stocks throughout the United States was 1,887 individual animals in 2005 (National Oceanic and Atmospheric Administration 2011c). Some of these mortalities likely occurred in the Study Area or affected individuals that used the Study Area seasonally.

Ocean noise associated with other actions (see Section 4.4.6.2.4, Ocean Noise) and acoustic stressors (underwater explosions and sonar) associated with Alternatives 1 and 2 could also result in additive behavioral impacts on marine mammals. Other future actions such as pier construction would be expected to result in MMPA Level B harassment. However in the Offshore Area, it is unlikely that these actions and underwater explosions or sonar use would overlap in time and space because these activities are dispersed and the sound sources are intermittent. Training and testing Activities in the Hood Canal may overlap with previously discussed construction events, such as the EHW-2 construction activities. The noise from these activities could combine with training and testing events to make impacts more intense, or cause additive impacts over time to the marine mammals in the area. However, most of these other actions are not compatible with or could interfere with training and testing activities that involve underwater explosions and sonar use. The Navy takes appropriate coordination and scheduling steps (described in Section 3.12, Socioeconomic Resources) to avoid activities that interfere with or are not compatible with training and testing.

It is likely that distant shipping noise, which is more universal and continuous, and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on marine mammals.

As discussed in Section 4.4.6.2.5 (Ocean Pollution), the potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is

possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal.

In summary, based on the analysis presented in Section 3.4 (Marine Mammals), the current aggregate impacts of past and present actions and reasonably foreseeable future actions are expected to result in significant impacts on some marine mammal species in the Study Area. Therefore, cumulative impacts on marine mammals would be significant without consideration of the impacts of Alternatives 1 or 2. Alternatives 1 and 2 would contribute to and increase cumulative impacts, but the relative contribution would be low compared to other actions. Further analysis of cumulative impacts on marine mammals is not warranted.

4.4.7 SEA TURTLES

4.4.7.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on sea turtles include mortality, injury, and short-term disturbance or behavioral modification. Mortality or injury could be caused by underwater explosions or vessel strikes. Injury, in the form of PTS, could also be caused by sonar use. Noninjurious impacts of underwater explosions and sonar use would include short-term disturbance or behavioral modification. The Navy's Annual Model-Predicted Impacts on Leatherback Sea Turtles (*Dermochelys coriacea*) from Explosions for Training and Testing Activities under the No Action Alternative, Alternative 1, and Alternative 2 are presented in Table 3.5-5 and are predicted to be zero for TTS, PTS, Gastrointestinal Tract Injury, Slight Lung Injury, and Mortality. Leatherback sea turtles (*Dermochelys coriacea*) are found in the Study Area while other species of sea turtle were found to be extralimital species to the Study Area. Therefore the Leatherback sea turtle would be more likely to be affected, but is still not likely to be adversely affected, by the remaining stressors analyzed in Section 3.5 (Sea Turtles). The incremental contribution of these remaining stressors to cumulative impacts on sea turtles would be negligible. Therefore, these stressors are not considered further in the cumulative impacts analysis.

4.4.7.2 Impacts of Other Actions

The potential impacts of other actions that are relevant to the cumulative impact analysis for sea turtles include the following:

- Mortality associated with vessel strikes, bycatch in fisheries, entanglement, and stressors associated with coastal development and human use of coastal environments (e.g., beach vehicular driving, power plant entrainment [sea turtles being caught in power plant outflow water], etc.)
- Injury associated with vessel strikes, bycatch, entanglement, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with ocean pollution
- Habitat loss related to coastal development

Most of the other actions and considerations retained for analysis in Section 3.5 (Sea Turtles) would include operation of marine vessels. Exceptions include the actions listed under environmental regulations and planning. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis includes vessel strikes and underwater noise. Many of the actions would also result in underwater noise from sources other than vessels. Rather than discussing

these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations" in maritime traffic (see Section 4.4.6.2.3, Maritime Traffic and Vessel Strikes) and ocean noise (see Section 4.4.6.2.4, Ocean Noise). Similarly, many of the actions would result in ocean pollution. The aggregate impacts of water pollution are addressed below in the ocean pollution section (see Section 4.4.6.2.5, Ocean Pollution). Bycatch is associated with commercial fishing, and the primary cause of entanglement is commercial fishing. Therefore, these stressors are discussed below in the commercial fishing section (see Section 4.4.6.3.1, Commercial Fishing).

4.4.7.3 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and continued increases are expected in the future. Vessel strikes have been and will continue to be a cause of sea turtle mortality and injury throughout portions of the Study Area, specifically the offshore area, where sea turtles regularly occur. Because of the wide dispersal of large vessels in open ocean areas and the widespread, scattered distribution of turtles at sea, strikes during open-ocean transits are unlikely.

Some vessel strikes would cause temporary reversible impacts, such as diverting the turtle from its previous activity or causing minor injury. A National Research Council report qualitatively ranked the relative importance of various mortality factors for sea turtles. Vessel strikes were ranked 10th, behind leading factors of shrimp trawling and other fisheries (National Research Council 1990). Major strikes would cause permanent injury or death from bleeding, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition. Much of what is written about recovery from vessel strikes is inferred from observing individuals some time after a strike. Numerous living sea turtles bear scars that appear to have been caused by propeller cuts or collisions with vessel hulls, suggesting that not all vessel strikes are lethal (Hazel et al. 2007, Lutcavage et al. 1997). Conversely, fresh wounds on some stranded animals may strongly suggest a vessel strike as the cause of death. The actual incidence of recovery versus death is not known, given available data.

4.4.7.4 Ocean Noise

Potential impacts on sea turtles from ocean noise include behavioral reactions, hearing loss in the form of TTS or PTS, auditory masking, injury, and mortality. Section 3.5.3.1 (Acoustic Stressors) discusses these and other possible impacts of ocean noise on sea turtles.

4.4.7.5 Ocean Pollution

Marine debris can also be a problem for sea turtles through entanglement or ingestion. Sea turtles can mistake debris for prey; one study found 37 percent of dead leatherbacks to have ingested various types of plastic (Mrosovsky et al. 2009). Other marine debris, including abandoned fishing gear and cargo nets, can entangle and drown turtles in all life stages.

4.4.7.6 Commercial Fishing

Bycatch is one of the most serious threats to the recovery and conservation of sea turtle populations (National Research Council 1990; Wallace et al. 2010). Among fisheries that incidentally capture sea turtles, certain types of trawl, gillnet, and longline fisheries generally pose the greatest threat. One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al. 2010).

Other fisheries that result in sea turtle bycatch in the Study Area include pelagic fisheries for swordfish, tuna, shark, and billfish; purse seine fisheries for tuna; commercial and recreational rod and reel fisheries; gillnet fisheries for shark; driftnet fisheries; and bottom longline fisheries (National Marine Fisheries Service 2009a).

4.4.7.7 Coastal Development

Coastal development and increased human populations in coastal areas will continue to have impacts on sea turtles such as increased tourism, non-point source pollution and runoff, power plant entrainment, and degradation of nearshore water quality and seagrass beds (see Section 3.5, Sea Turtles, for more information on impacts on sea turtles).

4.4.7.8 Cumulative Impacts on Sea Turtles

The current aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect, but are not likely to adversely affect sea turtles. These aggregate impacts are considered significant because bycatch, vessel strikes, entanglement and other stressors associated with other actions may result in high rates of injury and mortality that could cause population declines to ESA-listed species, such as the leatherback sea turtle (*Dermochelys coriacea*), the loggerhead (*Caretta caretta*), the olive ridley (*Lepidochelys olivacea*), and the green turtle (*Chelonia mydas*), or inhibit species recovery. Alternatives 1 and 2 could also result in injury and mortality to individual sea turtles from underwater explosions, sonar, and vessel strikes. Injury and mortality that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 and 2 to the overall injury and mortality would be low compared to other actions.

Ocean noise associated with other actions and acoustic stressors (underwater explosions and sonar) associated with Alternatives 1 and 2 could also result in additive behavioral impacts on sea turtles. Other future actions such as operation of wave and tidal energy facilities would be expected to result in similar impacts. However, it is unlikely that these actions and underwater explosions or sonar use would overlap in time and space because all of these activities are widespread and the sound sources are intermittent. Furthermore, most of these other actions are not compatible with or could interfere with training and testing activities that involve underwater explosions and sonar use. The Navy takes appropriate steps to avoid activities that interfere with or are not compatible with training and testing.

It is likely that distant shipping noise (which is more pervasive and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on sea turtles.

The potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal. However, there are no data indicating that a sea turtle affected by ocean pollution would be more susceptible to stressors associated with Alternatives 1 and 2.

In summary, based upon the analysis in Section 3.5 (Sea Turtles), the current aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect, but are not likely to adversely affect sea turtles. Therefore, cumulative impacts on sea turtles would be significant without consideration of the impacts of Alternatives 1 and 2. Alternatives 1 and 2 would contribute to and

increase cumulative impacts, but the relative contribution would be low compared to other actions. Further analysis of cumulative impacts on sea turtles is not warranted.

4.4.8 BIRDS

4.4.8.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on birds include mortality, injury, and short-term disturbance or behavioral modification. Mortality or injury could be caused by underwater explosions, air strikes, or vessel strikes. Noninjurious impacts of underwater explosions and sonar use would include short-term disturbance or behavioral modification. The Navy's ESA determinations presented in Table 3.6-3 are "no effect" or "may affect, not likely to adversely affect" for the remaining stressors analyzed in Section 3.6 (Birds). The incremental contribution of these remaining stressors to cumulative impacts on Birds would be negligible. Therefore, these stressors are not considered further in the cumulative impacts analysis. The impacts of Alternatives 1 and 2 considered in the cumulative impacts analysis are summarized in Table 3.6-10 (Summary of Endangered Species Act Effects Determinations for Birds, for the Preferred Alternative).

4.4.8.2 Impacts of Other Actions

The potential impacts of other actions that are relevant to the cumulative impact analysis for birds include the following:

- Incidental mortality from interactions with commercial and recreational fishing gear
- Predation by introduced species
- Disturbance and degradation of nesting and foraging areas by humans and domesticated animals
- Noise Pollution from construction and other human activities
- Nocturnal collisions with power lines and artificial lights
- Collisions with aircraft
- Pollution such as that from oil spills and plastic debris
- Disease, storms, and harmful algal blooms
- Long-term climate change

Most of the other actions and considerations retained for analysis in Section 3.6 (Birds) would include acoustic stressors (sonar and other underwater active acoustic sources, explosive detonations, vessel noise, and aircraft noise), physical disturbance and strikes (aircraft, vessels and in-water devices, military expended materials [non-explosive]), and ingestion (military expended materials other than ordnance). Exceptions include the actions listed under environmental regulations and planning. Many of the actions would also result in noise from sources other than vessels. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations." Similarly, many of the actions would result in ocean pollution. The aggregate impacts of water pollution are addressed below in the ocean pollution section (Section 4.4.8.2.3, Ocean Pollution).

4.4.8.2.1 Maritime Traffic, Vessel Strikes, Air Traffic, and Air Strikes

Maritime traffic has increased over the past 50 years, and continued increases are expected in the future. Vessel strikes have been and will continue to be a cause of seabird mortality and injury throughout portions of the Study Area. Because of the wide dispersal of large vessels in open ocean areas and the widespread, scattered distribution of seabirds at sea, strikes during open-ocean transits are unlikely.

Some vessel strikes would cause temporary reversible impacts, such as diverting the seabird from its previous activity or causing minor injury. Major strikes would cause permanent injury or death from bleeding, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a seabird's recovery from a strike may be influenced by its age, reproductive state, and general condition. Much of what is written about recovery from vessel strikes is inferred from observing individuals some time after a strike. Fresh wounds on some stranded animals may strongly suggest a vessel strike as the cause of death. The actual incidence of recovery versus death is not known, given available data.

Thousands of birds are struck each year by civilian and military aircraft. The Federal Aviation Administration annually reports at least 2,300 wildlife related strikes involving civilian aircraft, and the Air Force and Navy report at least an additional 3,000 strikes a year. Pilots and crew use the same airspace as large concentrations of birds, and in an effort to provide the safest conditions for flying possible, the DoD continually implements and improves its aviation programs. One program that it implements is called the Bird Aircraft Strike Hazard (BASH) prevention program. Radar is one of the most effective tools for detecting bird movements. Many types of radar are used at different scales; the Doppler capability of weather surveillance can show the direction and speed of migrating bird flocks up to 60 nm from an airfield during the day or the night (U.S. Department of Defense 2010).

In local airfield environments, mobile marine radars can track real-time movements of individual birds or flocks adjacent to and in a 6–8 mi. (9.7–12.9 km) radius of runways. The Air Force and Navy are developing and testing several "bird radars" to determine which models and configurations can best isolate specific locations of birds where aircraft operations can be modified and environmental management strategies applied to reduce air strikes. Computer models use radar data, historic weather conditions, Audubon Society Christmas Bird Count Data, bird strike reports, and other historical data to help predict spatial and temporal patterns of bird movements. One model, a predictive Bird Avoidance Model (BAM), was developed using geographic information system (GIS) technology as a key tool for analysis and correlation of bird habitat, migration, and breeding characteristics, combined with key environmental and geospatial data. Integral to a successful BASH program is a good working relationship with airport managers and the consistent reporting and identification of species involved in strike events. By identifying the wildlife species involved and the location of the strike, researchers and airport managers can better understand why the species is attracted to a particular area of the airport or training route (U.S. Department of Defense 2010).

4.4.8.2.2 Noise

Potential impacts on birds from ocean noise include behavioral reactions, hearing loss in the form of TTS or PTS, auditory masking, injury, and mortality. Section 3.6.3.1 (Acoustic Stressors) discusses these and other possible impacts of ocean noise on seabirds.

4.4.8.2.3 Ocean Pollution

Marine debris can also be a problem for seabirds through entanglement or ingestion. Seabirds can mistake debris for prey and 44 percent of seabirds are affected by plastic marine debris (Cousteau 2012). Other marine debris, including abandoned fishing gear and cargo nets, can entangle and drown seabirds in all life stages.

4.4.8.2.4 Coastal Development

Coastal development and increased human population in coastal areas will continue to have impacts on birds related to increased tourism, non-point source pollution and runoff, habitat encroachment, and degradation of nearshore water quality and seagrass beds (see Section 3.6, Birds, for more information on Coastal Development and its impacts on birds).

4.4.8.3 Cumulative Impacts on Birds

The aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect on birds. These aggregate impacts are considered significant because air strikes, vessel strikes, entanglement and other stressors associated with other actions are expected to result in high rates of injury and mortality that could cause population declines to ESA-listed species or inhibit species recovery. Alternatives 1 and 2 could also result in injury and mortality to individual birds from underwater explosions, sonar, and strikes. Injury and mortality that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 and 2 to the overall injury and mortality would be low compared to other actions such as bycatch, storm runoff, plastic debris, and other non-military activities.

Seabird distribution, abundance, breeding, and other behaviors are affected by cyclical environmental events such as the El Niño Southern Oscillation and Pacific Decadal Oscillation in the Pacific Ocean (Vandenbosch 2000). In the long term, climate change could be the largest threat to seabirds (North American Bird Conservation Initiative 2010). Climate change effects include changes in air and sea temperatures, precipitation, the frequency and intensity of storms, pH level of sea water, and sea level. These changes could affect overall marine productivity, which could affect the food resources, distribution, and reproductive success of seabirds (Aebischer et al. 1990; Congdon et al. 2007). The projection for global sea levels rise from 2090 to 2099 is up to 1 ft. (0.3 m) relative to 1980 to 1999 levels (Church and White 2006; Solomon et al. 2007). As a result, seabird nesting colonies that occur along sections of coastlines undergoing sea level rise may experience a loss of nesting habitat (Congdon et al. 2007; Gilman and Ellison 2009; Gilman et al. 2008; Hitipeuw et al. 2007; Mullane and Suzuki 1997).

Ocean noise associated with other actions and acoustic stressors (underwater explosions and sonar) associated with Alternatives 1 and 2 could also result in additive behavioral impacts on birds. Other future actions, such as construction of wharfs, would be expected to result in similar impacts. These actions and underwater explosions or sonar use may overlap in time and space; however, all of these activities are widespread, and the sound sources are intermittent. Furthermore, most of these other actions are not compatible with or could interfere with training and testing activities that involve underwater explosions and sonar use. The Navy takes appropriate steps to avoid activities that interfere with or are not compatible with training and testing.

It is likely that distant shipping and aircraft noise (which is more pervasive and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping and aircraft noise, and sounds associated with underwater explosions and sonar use, would result in harmful additive impacts on birds.

The potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal. However, there are no data indicating that a seabird affected by ocean pollution would be more susceptible to stressors associated with Alternatives 1 and 2.

In summary, based upon the analysis in Section 3.6 (Birds), and the reasons summarized above, the incremental contribution of Alternatives 1 and 2 to cumulative impacts to bird populations would be low. Therefore, further analysis of cumulative impacts on birds is not warranted.

4.4.9 MARINE VEGETATION

The analysis presented in Section 3.7 (Marine Vegetation) indicates that marine vegetation could be affected by acoustic stressors (underwater explosions) and physical stressors (interactions with vessels and in-water devices, military expended materials, or seafloor devices). Potential impacts include localized disturbance and mortality. Recovery would occur quickly, and population level impacts are not anticipated. The impacts of Alternatives 1 or 2 would be cumulative with other actions that cause disturbance and mortality of marine vegetation. However, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low for the following reasons:

- Most of the proposed activities would occur in areas where seagrasses and other attached marine vegetation do not grow.
- Impacts would be localized, recovery would occur quickly, and no population level impacts would be expected.
- Alternatives 1 and 2 would not result in impacts that have been historically significant to marine vegetation. For example, Alternatives 1 and 2 would not increase nutrient loading, which can cause algal blooms, decrease light penetration, and impact photosynthesis of seagrasses. Furthermore, Alternatives 1 and 2 would not result in long-term or widespread changes in environmental conditions, such as turbidity, salinity, pH, or water temperature that could impact marine vegetation.
- The Proposed Action would have no effect on ESA-listed species of marine vegetation and would not result in the destruction or adverse modification of critical habitat.

Based on the analysis presented in Section 3.7 (Marine Vegetation) and the reasons summarized above, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low. Further analysis of cumulative impacts on marine vegetation is not warranted.

4.4.10 MARINE INVERTEBRATES

The analysis presented in Section 3.8 (Marine Invertebrates) indicates that marine invertebrates could be affected by acoustic stressors (tactical acoustic sonar, other acoustic devices, pile driving, underwater explosions, weapons firing noise, aircraft noise, vessel noise), electromagnetic stressors, physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices), entanglement (cables and wires, parachutes), and ingestion (military expended materials). Potential impacts include short-term behavioral and physiological responses. Some stressors could also result in injury or mortality to a relatively small number of individuals, but not to ESA-listed corals. No population-level impacts are anticipated. Stressors from Alternatives 1 and 2 would have no effect or would be not likely to adversely affect ESA-listed corals.

Based upon the analysis in Section 3.8 (Marine Invertebrates), the invertebrate mortality impacts of Alternatives 1 and 2 would be cumulative with other actions that cause mortality (e.g., commercial fishing). However, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be negligible. Therefore, further analysis of cumulative impacts on marine invertebrates is not warranted.

4.4.11 FISH

4.4.11.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Based on the analysis presented in Section 3.9 (Fish), impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on fish include mortality, injury, and disturbance or behavioral modification. Mortality or injury could be caused by underwater explosions or vessel strikes. Injury, in the form of PTS, could also be caused by sonar use. The remaining stressors analyzed in Section 3.9 (Fish) are not expected to result in mortality. The incremental contribution of these remaining stressors to cumulative impacts on fish would be negligible. These stressors are discussed in Sections 3.9.3.1 through 3.9.3.6. The impacts of Alternatives 1 and 2 considered in the cumulative impacts analysis are summarized in Section 3.9 (Fish).

4.4.11.2 Impacts of Other Actions

4.4.11.2.1 Overview

The potential impacts of other actions that are relevant to the cumulative impact analysis for fish include the following:

- Mortality associated with vessel strikes, commercial fisheries, bycatch, and entanglement in fishing and other gear
- Injury associated with vessel strikes, bycatch, entanglement, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with water pollution

Most of the other actions and considerations retained for analysis in Table 4.3-1 would include operation of marine vessels. Exceptions include the actions listed under environmental regulations and permitting. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis includes vessel strikes and underwater noise. Many of the actions would also result in underwater noise from sources other than vessels, seismic surveys, and construction activities. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as “other environmental considerations” in the maritime traffic and ocean noise subsections. Similarly, many of the actions would result in water pollution. The aggregate impacts of water pollution are addressed in the ocean pollution section (see Section 4.4.6.2.5). Commercial fishing and overfishing is the primary cause of stress and entanglement. Therefore, these stressors are discussed in the commercial fishing section (see Section 4.4.6.3.1).

4.4.11.2.2 Surveillance Towed Array Sensor System Low Frequency Active Sonar

Potential impacts on fish from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations include (1) nonauditory injury, (2) permanent loss of hearing, (3) temporary loss of hearing, (4) behavioral change, and (5) masking.

Studies have examined the effects of the sound exposures from Surveillance Towed Array Sensor System Low-Frequency Active sonar on fish hearing (Kane et al. 2010; Popper et al. 2007). Hearing was measured both immediately post exposure and for several days thereafter. Maximum received sound pressure levels were 193 dB referenced to 1 micropascal for 324 or 628 seconds. Catfish and some specimens of rainbow trout showed 10–20 dB of hearing loss immediately after exposure to the low-frequency active sonar when compared to baseline and control animals; however, another group of rainbow trout showed no hearing loss. Recovery in trout took at least 48 hours, but studies were not

completed. The different results between rainbow trout groups is difficult to understand, but may be due to developmental or genetic differences in the various groups of fish. Catfish hearing returned to, or close to, normal within about 24 hours after exposure to low-frequency active sonar. Furthermore, examination of the inner ears of the fish during necropsy (note: maximum time fish were held post exposure before sacrifice was 96 hours) revealed no differences from the control groups in cilliary bundles or other features indicative of hearing loss (Kane et al. 2010).

The potential effects from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations on any stock of fish from injury (nonauditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any fish from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Any auditory masking in fish due to low-frequency active sonar signal transmissions is not expected to be severe and would be temporary. The operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar with monitoring and mitigation could result in temporary or permanent hearing loss, or could not affect them at all depending on the species and proximity to the Sonar.

4.4.11.2.3 Maritime Traffic and Vessel Strikes

Vessels and in-water devices do not normally collide with adult fish, most of which can detect and avoid them. One study on fishes' behavioral responses to vessels showed that most adults exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders, reducing the potential for vessel strikes (Jørgensen et al. 2004). Misund (1997) found that fishes ahead of a ship that showed avoidance reactions did so at ranges of 160–490 ft. (48.8–149.4 m). When the vessel passed over them, some fishes responded with sudden escape responses that included lateral avoidance or downward compression of the school. Conversely, Rostad et al. (2006) observed that some fishes are attracted to different types of vessels (e.g., research vessels, commercial vessels) of varying sizes, noise levels, and habitat locations. Fish behavior in the vicinity of a vessel is therefore quite variable, depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwartz 1985). Early life stages of most fishes could be displaced by vessels and not struck in the same manner as adults of larger species. However, a vessel's propeller movement or propeller wash could entrain early life stages. The low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses among herring, but avoidance ended within 10 seconds after the vessel departed (Chapman and Hawkins 1973). Because a towed in-water device is continuously moving, most fishes are expected to move away from it or to follow behind it, in a manner similar to their responses to a vessel. When the device is removed, most fishes would simply move to another area.

4.4.11.2.4 Ocean Noise

Underwater noise is a threat to marine fishes. However, the physiological and behavioral responses of marine fishes to underwater noise have been investigated for only a limited number of species (Codarin et al. 2009, Popper 2003, Slabbekoorn et al. 2010, Wright et al. 2010, Popper and Hastings 2009a, b). In addition to vessels, other sources of underwater noise include seismic activity (Popper and Hastings 2009a). Information on fish hearing is provided in Section 3.9.2.1 (Hearing and Vocalization), with further discussion in Section 3.9.3.1 (Acoustic Stressors).

4.4.11.2.5 Ocean Pollution

Pollution primarily impacts coastal fishes that occur near the sources of pollution. However, global oceanic circulation patterns result in a considerable amount of marine pollutants and debris scattered throughout the open ocean (Crain et al. 2009). Pollutants in the marine environment that may impact

marine fishes include organic pollutants (e.g., pesticides, herbicides, polycyclic aromatic hydrocarbons, flame retardants, and oil), inorganic pollutants (e.g., heavy metals), and debris (e.g., plastics and wastes from dumping at sea) (Pews Oceans Commission 2003). High chemical pollutant levels in marine fishes may cause behavioral changes, physiological changes, or genetic damage in some species (Goncalves et al. 2008, Moore 2008, Pews Oceans Commission 2003, van der Oost et al. 2003). Bioaccumulation of pollutants (e.g., metals and organic pollutants) is also a concern, particularly in terms of human health, because people consume top predators with high pollutant loads. Bioaccumulation is the net buildup of substances (e.g., chemicals or metals) in an organism directly from contaminated water or sediment through the gills or skin, from ingesting food containing the substance, or from ingestion of the substance itself (Newman 1998, Moore 2008). Entanglement in abandoned commercial and recreational fishing gear has also caused pollution-related declines for some marine fishes; some species are more susceptible to entanglement by marine debris than others (Musick et al. 2000).

4.4.11.3 Coastal Development

Coastal development and increased human population activities in coastal areas, such as increased tourism, non-point source pollution and runoff, power plant entrainment, and degradation of nearshore water quality and seagrass beds, will continue to have impacts on fish (see Section 3.9, Fish, for more information on impacts on fish).

4.4.11.3.1 Commercial Fishing

Overfishing is the most serious threat that has led to the listing of ESA-protected marine species, with habitat loss also contributing to extinction risk (Crain et al. 2009, Kappel 2005, Cheung et al. 2007, Dulvy et al. 2003, Jonsson et al. 1999, Limburg and Waldman 2009, Musick et al. 2000). Approximately 30 percent of the United States-managed fishery stocks are overfished (National Marine Fisheries Service 2009b). Overfishing occurs when fishes are harvested in quantities above a sustainable level. Overfishing impacts targeted species, and non-targeted species (or "bycatch" species) that often are prey for other fishes and marine organisms. Bycatch may also include seabirds, turtles, and marine mammals. Additionally, in recent decades the marine fishes being targeted have changed such that when higher-level predators become scarce, different organisms on the food chain are subsequently targeted; this has negative implications for entire marine food webs (Crain et al. 2009, Pauly and Palomares 2005). Other factors, such as fisheries-induced evolution and intrinsic vulnerability to overfishing, have been shown to reduce the abundance of some populations (Kauparinen and Merila 2007). Fisheries-induced evolution describes a change in genetic composition of the population that results from intense fishing pressure, such as a reduction in the overall size and growth rates of fish in a population. Intrinsic vulnerability describes certain life history traits (e.g., large body size, late maturity age, low growth rate) that result in a species being more susceptible to overfishing than others (Cheung et al. 2007).

4.4.11.4 Cumulative Impacts on Fish

The aggregate impacts of past, present, and reasonably foreseeable future actions may have a significant impact to fish. These aggregate impacts are considered significant because overfishing, vessel strikes, entanglement and other stressors associated with other actions are expected to result in high rates of injury and mortality that could cause population declines to ESA-listed species or inhibit species recovery. Alternatives 1 and 2 could also result in injury and mortality to individual fish from underwater explosions, sonar, and strikes. Injury and mortality that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 and 2 to the overall injury and mortality would be low compared to other actions.

It is likely that distant shipping and aircraft noise (which is more pervasive and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping and aircraft noise, and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on fish.

The potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal. However, there are no data indicating that a fish affected by ocean pollution would be more susceptible to stressors associated with Alternatives 1 and 2.

In summary, based upon the analysis in Section 3.9 (Fish), the current aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect, but are not likely to adversely affect fish. Therefore, cumulative impacts on fish would be significant without consideration of the impacts of Alternatives 1 and 2. Alternatives 1 and 2 would contribute to, and increase, cumulative impacts, but the relative contribution would be low compared to other actions. Further analysis of cumulative impacts on fish is not warranted.

4.4.12 CULTURAL RESOURCES

4.4.12.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

As discussed in Section 3.10 (Cultural Resources), Alternatives 1 and 2 could result in impacts on submerged prehistoric sites and previously unidentified submerged historic resources if certain training and testing activities are conducted where these resources occur. Stressors that could impact cultural resources include underwater explosions on or near the bottom, use of towed-in-water devices, and use of ocean bottom deployed devices. Because cultural resources are considered nonrenewable resources, these impacts would be considered long-term and permanent.

The Navy routinely avoids locations of known obstructions to prevent damage to sensitive Navy equipment and vessels and to ensure the accuracy of training and testing exercises. Known obstructions include some historic shipwrecks; however, it is unknown if all submerged obstructions, historic shipwrecks, or other cultural resources have yet been discovered in the Study Area.

4.4.12.2 Impacts of Other Actions

With a few exceptions, most of the other actions retained for cumulative impacts analysis (see Table 4.3-1) would involve some form of disturbance to the ocean bottom. Exceptions include environmental regulations and planning actions, ocean pollution, and most forms of ocean noise. Actions that would disturb the ocean bottom could impact submerged cultural resources. For example, ocean bottom disturbance would occur from construction related activities such as ship anchoring, and installation of wind turbine piers. Any physical disturbance on the continental shelf and ocean floor could inadvertently damage or destroy submerged prehistoric sites and submerged historic resources.

The other actions that result in ocean bottom disturbance require some form of federal authorization or permitting. Therefore, requirements of the National Historic Preservation Act apply to actions in territorial waters. Federal agency procedures have been implemented to identify cultural resources, avoid impacts, and mitigate if impacts cannot be avoided. For example, the Bureau of Ocean Energy Management, Regulation and Enforcement has procedures in place to identify the probability for the presence of submerged historic resources and the locations submerged prehistoric sites shoreward from

the 148 ft. (45.1 m) isobath, and for project redesign and relocation to avoid identified resources (Minerals Management Service 2007). Nonetheless, inadvertent impacts could occur if unidentified submerged cultural resources are present.

4.4.12.3 Cumulative Impacts on Cultural Resources

Impacts on submerged cultural resources from other actions would typically be avoided or mitigated through implementing federal agency programs. However, impacts could occur if avoidance or mitigation measures are not implemented or if inadvertent disturbance or destruction of unidentified resources occurs. Disturbance or destruction of submerged prehistoric sites would diminish the overall archaeological record and decrease the potential for meaningful research on Paleomarine traditions (6,500–5,000 Before Present) and early explorers of the Northwest coast (1700s–1800s) occupations. Disturbance or destruction of submerged historic sites, including shipwrecks, would diminish the overall record for these resources and decrease the potential for meaningful research on these resources. Based upon the analysis in Section 3.10 (Cultural Resources), when considered with other actions, Alternatives 1 and 2 would contribute to and increase the cumulative impacts on submerged prehistoric and historic resources. Further analysis of cumulative impacts on cultural resources is not warranted.

4.4.13 Native American and Alaska Native Traditional Resources

As discussed in Section 3.11 (Native American and Alaska Native Traditional Resources), impacts are not expected on traditional resources, such as usual and accustomed fishing areas, because inaccessibility to areas of co-use would be temporary, and impacts to availability of marine species are not expected.

4.4.14 Socioeconomics

The analysis in Section 3.12 (Socioeconomic Resources) indicates that the impacts of Alternatives 1 and 2 on socioeconomic resources would be negligible. Alternatives 1 and 2 are not expected to contribute to cumulative socioeconomic impacts. Therefore, further analysis of cumulative impacts on socioeconomic resources is not warranted.

4.4.15 Public Health and Safety

The analysis presented in Section 3.13 (Public Health and Safety) indicates that the impacts of Alternatives 1 and 2 on public health and safety would be negligible. Alternatives 1 and 2 are not expected to contribute incrementally to cumulative health and safety impacts. Therefore, further analysis of cumulative impacts on public health and safety is not warranted.

4.5 Summary of Cumulative Impacts

Marine mammals, sea turtles, birds, and fish are the primary resources of concern for cumulative impacts analysis:

- Past human and natural activities have impacted these resources to the extent that several marine mammal species, all sea turtles, one bird, and multiple fish species occurring in the Study Area are ESA-listed.
- These resources would be impacted by multiple ongoing and future actions.
- Explosive detonations and vessel strikes under the No Action Alternative, Alternative 1, and Alternative 2 have the potential to disturb, injure, or kill marine mammals, sea turtles, birds, and fish.

The aggregate impacts of past, present, and other reasonably foreseeable future actions are expected to result in significant impacts on some marine mammals, Leatherback sea turtles (*Dermochelys coriacea*), some birds, and some fish species in the Study Area. The No Action Alternative, Alternative 1, or Alternative 2 would contribute to cumulative impacts, but the relative contribution would be low compared to other actions. Compared to the potential mortality, stranding, and injury resulting from commercial ship strikes and bycatch, entanglement, ocean pollution and other human causes, the potential for mortality, strandings or injury resulting from Navy training and testing activities is estimated to be orders of magnitude lower (tens of animals versus hundreds of thousands of animals) (Culik 2004, International Council for the Exploration of the Sea 2005, Read et al. 2006).

The analysis presented in this chapter and Chapter 3 (Affected Environment and Environmental Consequences) indicates that the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts on sediments and water quality, air quality, marine habitats, marine vegetation, marine invertebrates, socioeconomic resources, Native American and Alaska Native, and public health and safety would be negligible. When considered with other actions, the No Action Alternative, Alternative 1, or Alternative 2 might contribute to cumulative impacts on submerged prehistoric and historic resources, if such resources are present in areas where bottom-disturbing training and testing activities take place. The No Action Alternative, Alternative 1, or Alternative 2 would also make an incremental contribution to greenhouse gas emissions, representing approximately 0.0007 percent, 0.0007 percent, and 0.0009 percent of U.S. 2010 greenhouse gas emissions, respectively.

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