U.S. Fish & Wildlife Service

Dungeness National Wildlife Refuge

Comprehensive Conservation Plan

A Vision of Conservation

The forest, shoreline, and wetland habitats of Dungeness National Wildlife Refuge support a rich diversity of wildlife, from the regal peregrine falcon to the boisterous black oystercatcher to the unassuming rough-skinned newt. Fed by a generous offering of ancient glacial sediment from nearby bluffs and anchored by gnarled logs of driftwood, the pristine barrier beach of Dungeness Spit curves seamlessly down from the lush layers of old-growth forest above into the sparkling waters of the Salish Sea. Offshore, sheltered beds of rippling eelgrass provide a wealth of nutrients to a teeming nursery of young salmon and crab. Like the brant and dunlin that rely on this home, people flock to Dungeness seeking a welcome haven for the study of dynamic natural forces, distinctive geologic features, and compelling cultural stories. Visitors are inspired as they meander through the primeval forests and emerge upon the stunning seascape vistas. In accord with our friends and partners, and with sound science as our foremost principle, we will continue to monitor and preserve the integrity of this wonder of the Olympic Peninsula ecosystem. We endeavor to understand more about the delicate balance of nature while fostering in our visitors an abiding sense of stewardship for this irreplaceable sanctuary.

Comprehensive Conservation Plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the U.S. Fish and Wildlife Service's best estimates of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations, and as such, are primarily used for strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Dungeness Spit looking west

Dungeness
National Wildlife Refuge

Comprehensive Conservation Plan

Prepared by:
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U.S. Fish and Wildlife Service
Dungeness National Wildlife Refuge
Comprehensive Conservation Plan
Approval Submission

In accordance with the National Wildlife Refuge System Administration Act, as amended, the U.S. Fish and Wildlife Service completed a Comprehensive Conservation Plan (CCP) for Dungeness National Wildlife Refuge. The purpose of this CCP is to specify a management direction for the Refuge for the next 15 years. The goals, objectives, and strategies for improving Refuge conditions – including the types of habitat we will provide, partnership opportunities, and management actions needed to achieve desired future conditions – are described in the CCP. The Service's preferred alternative for managing the Refuge is described in this CCP and the environmental consequences of implementing the CCP were described in the Draft CCP and Environmental Assessment.

This CCP is submitted for the Regional Director's approval by:

Acting Project Leader — Date: 04/19/2013
Washington Maritime National Wildlife Refuge Complex

Concur: _____ Date: 4/23/13
Bob Flores
Refuge Supervisor

Concur: Rob D. West Date: 4-23-13
Robin West
Regional Chief, National Wildlife Refuge System

Approved: Robyn Thorson Date: APR 25 2013
Regional Director, Region 1
Portland, Oregon

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Finding of No Significant Impact
for the
Dungeness National Wildlife Refuge Comprehensive Conservation Plan

Clallam County, Washington

The U.S. Fish and Wildlife Service (Service) completed a Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) for Dungeness National Wildlife Refuge (Refuge). The CCP will guide management of the Refuge for 15 years. The CCP/EA describes our proposals for managing the Refuge and their effects on the human environment under three alternatives, including a no action alternative.

Decision

Based on our comprehensive review and analysis in the CCP/EA, we selected Alternative B for implementation because it will guide management of the Refuge in a manner that:

- Achieves the mission of the National Wildlife Refuge System, and the purposes, vision, and goals of the Refuge.
- Maintains and restores the ecological integrity of the Refuge's habitats and populations.
- Addresses the important issues identified during the CCP scoping process.
- Addresses the legal mandates of the Service and the Refuge.
- Is consistent with the scientific principles of sound wildlife management and endangered species recovery.
- Facilitates priority public uses appropriate and compatible with the Refuge's purposes and the Refuge System mission.

Summary of the Actions to be Implemented

Implementing the selected alternative will have no significant impacts on the environmental resources identified in the CCP/EA. Refuge management under the selected alternative will protect, maintain, and enhance habitat for priority species and resources of concern, and improve the public's opportunities to enjoy wildlife-dependent recreation.

Management of the Refuge under Alternative B will emphasize protecting and maintaining forested, nearshore, freshwater wetland, and stream-riparian habitats, with an increased level of active habitat management, monitoring, and enhancement. A forest assessment will be conducted within the Dawley Unit and a step-down forest management plan will be completed by 2018. Active forest management techniques will be employed within a core 40-acre area to promote development of mature old-growth forest characteristics. A road inventory and condition assessment for the Dawley Unit will be completed by 2016. The amount of roads maintained will decrease, unneeded logging spur roads outside of the core area will be rehabilitated, and the slope along the main road will be stabilized. A wetland inventory and hydrological assessment will be conducted by 2015. The impoundment at the Dawley Unit will be managed for optimum water levels and benthic layer characteristics for amphibians and other benefiting species.

Public use activities on the Refuge will include saltwater fishing, shell-fishing (clams and crabs), wildlife observation, wildlife photography, hiking, no-wake boating, jogging, horseback riding (should alternative access be obtained per compatibility determination), beach use (wading, beachcombing, other recreational beach uses), environmental education, and environmental

interpretation. Areas that are open or closed to public use year-round, and areas that are open seasonally depending on the needs of Refuge wildlife, will remain the same with some exceptions. Changes will include new limits on boat landing hours and jogging stipulations. Jogging will be allowed on the trail adjacent to the Refuge's parking lots and along the west beach from the end of the upland forested trail to the Refuge's western boundary. Horseback riding will be allowed with stipulations, on the beach west of where the main trail meets Dungeness Spit if a safe and legal alternate access route from the west or east can be obtained. If an alternate access route is obtained from the east, horseback use of a Refuge-owned road to the beach will also be allowed.

Additional wildlife viewing, interpretive, and environmental education programs will be offered. Staff and volunteer time devoted to making visitor contacts and community outreach will increase. New orientation materials, regulatory signage, and volunteer opportunities will be developed.

The effects of climate change will be considered during management activities, and we will reduce the Refuge's carbon footprint. Invasive species will be monitored and controlled. Other management activities will continue, including fire management, maintenance of existing structures, coordination with State, Tribal, and other partners; cultural resources protection, and land protection within the approved Refuge boundary. All proposed actions are subject to funding availability.

Public Involvement and Changes Made to Alternative B Based on Comments

We incorporated a variety of public involvement techniques in developing and reviewing the CCP/EA. This included open houses, several planning updates, numerous meetings with partners and elected officials, and public review and comment on the Draft CCP/EA. The details of our public involvement program are described in the CCP in Appendix K. Based on the public comments we received and considered, Alternative B as described in the CCP/EA has been modified as follows.

- Additional references to coordination with the U.S. Coast Guard regarding the New Dungeness Light Station are included.
- Jogging and horseback riding have been determined to be appropriate and compatible with stipulations. Appropriate use findings have been modified and new compatibility determinations have been added.
- The strategies and rationale to promote opportunities for wildlife observation and photography, jogging, and horseback riding have been modified under Objective 6.5.
- Some maps were updated to reflect the revised public use areas and above-referenced clarifications.
- Some text changes were made to improve readability and accuracy.

Conclusions

Based on review and evaluation of the information contained in the supporting references, I have determined that implementing Alternative B as the CCP for Dungeness National Wildlife Refuge is not a major Federal action that would significantly affect the quality of the human environment, within the meaning of section 102(2)(c) of the National Environmental Policy Act of 1969. Accordingly, we are not required to prepare an environmental impact statement.

Robyn Thorson

Regional Director

APR 25 2013

Date

Supporting References

U.S. Fish and Wildlife Service. 2012. Dungeness National Wildlife Refuge draft Comprehensive Conservation Plan and Environmental Assessment. U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Portland, OR. 520 pp.

Note: This Finding of No Significant Impact and supporting references are available for public review at the Washington Maritime National Wildlife Refuge Complex, 715 Holgerson Road, Sequim, Washington, 98382 and U.S. Fish and Wildlife Service, Division of Planning, Visitor Services, and Transportation, 911 NE 11th Avenue, Portland, Oregon, 97232. These documents can also be found on our Web site: www.fws.gov/pacific/planning/main/docs/wa/docsdungeness.htm. Interested and affected parties are being notified of our decision.

Chapter 1
Introduction and Background

USFWS

Chapter 1. Introduction and Background

1.1 Introduction

Dungeness National Wildlife Refuge (NWR or Refuge) is managed by the U.S. Fish and Wildlife Service (USFWS or Service) as part of the National Wildlife Refuge System (Refuge System). The Washington Maritime National Wildlife Refuge Complex (Complex) comprises six individual National Wildlife Refuges that are located on the coast of Washington and within the Salish Sea (Figures 1-1 and 1-2). The Complex supports a rich diversity of wildlife habitats including coastal rocks, reefs, and islands; forested and grass-covered islands; tidelands; salt and freshwater marshes; barrier and pocket beaches; and riparian areas. The six National Wildlife Refuges include Copalis, Quillayute Needles, Flattery Rocks, Dungeness, Protection Island, and San Juan Islands. This Comprehensive Conservation Plan (CCP) applies only to Dungeness NWR. Comprehensive Conservation Plans for the Complex's other five refuges have been developed under previous planning efforts.

Dungeness NWR consists of the Dungeness Unit, which includes the Graveyard Spit Research Natural Area (RNA), and the Dawley Unit (Figure 1-3). Both these units are within the geographic area known as the Salish Sea (Figure 1-1). The Salish Sea is a single estuarine ecosystem that extends from the north end of the Strait of Georgia to the west end of the Strait of Juan de Fuca and south to the southern extent of Puget Sound. It encompasses the inland marine waters of southern British Columbia, Canada, and northern Washington, USA.

The Dungeness Unit was established to protect and preserve breeding grounds for native birds in 1915. Originally the Unit was part of a lighthouse reservation, on which the New Dungeness Light Station was built in 1857. For the most part, the coastal strand and spit, coastal lagoon, salt marsh, and mudflat habitats associated with the Dungeness and Graveyard spits were not altered by humans, with the exception of the years of 1940-1955, during which time the Navy maintained a small presence for radio communications on Graveyard Spit. Upland habitats at the base of Dungeness Spit, including forests and sandy bluffs, were added with subsequent acquisitions.

The Dawley Unit, located along Sequim Bay, was added to the Refuge in 1973. The residential area was heavily developed with the construction of aviaries, ponds, and gardens while the forested tract was altered by logging over the years. The forested area does have an established logging road system, but due to the topography, some areas were protected from further alterations and are considered second growth forest habitat.

1.2 Significance of the Refuge

Dungeness Spit is the longest sand spit in North America. Extending five miles into the Strait of Juan de Fuca, it provides habitat for a great variety of migratory shorebirds, waterfowl, marine mammals, and marine life. The tranquil waters of Dungeness Bay, with its eelgrass beds, mudflats, and tidelands provide food, shelter, and breeding grounds to support a whole ecosystem teeming with life. Large numbers of brant, wigeon, pintail, mallard, and bufflehead spend their winters here. Surf smelt, herring, Pacific sand lance and other species of marine fish breed and rear within the bay. Anadromous fish such as Chinook, chum, pink, coho salmon and steelhead and cutthroat trout are dependent on nearshore habitats within Dungeness Bay and Harbor during the juvenile rearing

period. The bay also serves as a vital nursery area for commercially important species such as marine invertebrates (e.g., Dungeness crab) which seek these areas for refugia. The rare northern elephant seal hauls out on the spit each year. Graveyard Spit supports some of the best remaining coastal strand habitat within the Salish Sea.

1.3 Proposed Action

We, the U.S. Fish and Wildlife Service (Service), manage wildlife refuges as part of the National Wildlife Refuge System. This document is the Dungeness Refuge's Comprehensive Conservation Plan (CCP). A CCP sets forth management guidance for a refuge for a period of 15 years, as required by the National Wildlife Refuge System Administration Act (16 U.S.C. 668dd -668ee, et seq.) (Refuge Administration Act), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). The Refuge Administration Act requires CCPs to identify and describe:

- The purposes of a refuge;
- The fish, wildlife, and plant populations, their habitats, and the archaeological and cultural values found on a refuge;
- Significant problems that may adversely affect wildlife populations and habitats and ways to correct or mitigate those problems;
- Areas suitable for administrative sites or visitor facilities and opportunities for fish and wildlife-dependent recreation.

The Service developed and examined alternatives for future management of Dungeness Refuge through the CCP process. These were presented in the Draft Comprehensive Conservation Plan and Environmental Assessment (USFWS 2012a). We developed and evaluated three alternatives for the CCP and selected Alternative B as the preferred alternative.

The goals, objectives, and strategies under the preferred alternative best achieve the purpose and need for the CCP while maintaining balance among the varied management needs and programs. Thus, the preferred alternative represents the most balanced approach for achieving the Refuge's purposes, vision, and goals; contributing to the Refuge System's mission; addressing relevant issues and mandates; and managing the Refuge consistently with sound principles of fish and wildlife management. The preferred alternative was slightly modified between the draft and final documents based upon comments received from the public or other agencies and organizations (see Appendix L). The Service's Regional Director for the Pacific Region made the final decision about the alternative to be implemented. For details on the specific components of management direction for the Refuge over the next 15 years, see Chapter 2.

1.4 Purpose and Need for Action

The purpose of developing the CCP is to provide the Refuge manager with a 15-year management plan for the conservation of fish, wildlife, and plant resources and their related habitats, while providing opportunities for compatible, wildlife-dependent recreational uses. The CCP, when fully implemented, should achieve Refuge purposes; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity of the Refuge and the Refuge System; and meet

Figure 1-1. Salish Sea

Data Sources: Populated Places and Country Boundaries from Natural Earth; Imagery from NASA Blue Marble; Elevation from NASA/CGIAR-CSI

The back sides of maps are blank to improve readability.

Figure 1-2. Regional Context

Data Sources: Highways, State and Country Boundaries from ESRI; Cities from USGS; USFWS Ecoregions and Refuge Boundaries from USFWS/R1

The back sides of maps are blank to improve readability.

other mandates. The CCP must be specific to the planning unit and identify the overarching wildlife, public use, or management needs for the Refuge (602 FW 3.4C1d).

The need for the CCP is to provide reasonable, scientifically-grounded guidance for ensuring that over a period of 15 years, Dungeness NWR will achieve the following purposes:

- Enhance, maintain, and protect Refuge habitats (including mixed coniferous forest, wetlands, and nearshore habitats) and other lands for the benefit of migratory birds and other wildlife.
- Gather sufficient scientific information to guide responsible adaptive management decisions.
- Provide visitors compatible wildlife-dependent public use opportunities that foster an appreciation and understanding of the Refuge's fish, wildlife, plants, and their habitats, and have limited impacts to wildlife.
- Initiate and nurture relationships and develop cooperative opportunities to promote the importance of the Refuge's wildlife habitat, and support Refuge stewardship.
- Protect and manage the Refuge's cultural resources, and identify new ways to gain an understanding of the Refuge's history and cultural resources.

1.5 Legal and Policy Guidance

1.5.1 The U.S. Fish and Wildlife Service

All national wildlife refuges are managed by the Service, an agency within the Department of the Interior. The Service is the principal Federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife populations and their habitats.

The mission of the Service is "working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people." Although we share this responsibility with other Federal, state, tribal, local, and private entities, the Service has specific trust responsibilities for migratory birds, endangered and threatened species, and certain anadromous fish and marine mammals. The Service has similar trust responsibilities for the lands and waters we administer to support the conservation and enhancement of fish, wildlife, plants, and their habitats. The Service also enforces Federal wildlife laws and international treaties for importing and exporting wildlife, assists with state fish and wildlife programs, and helps other countries develop wildlife conservation programs.

1.5.2 National Wildlife Refuge System

A refuge is managed as part of the National Wildlife Refuge System within a framework provided by legal and policy guidelines. The Refuge System is the world's largest network of public lands and waters set aside specifically for conserving wildlife and protecting ecosystems.

The needs of wildlife and their habitats come first on refuges, in contrast to other public lands that are managed for multiple uses. Refuges are guided by various Federal laws and executive orders, Service policies, and international treaties. Fundamental are the mission and goals of the Refuge System and the designated purposes of a refuge unit as described in establishing legislation, executive orders, or other documents establishing, authorizing, or expanding a refuge.

National Wildlife Refuge System Mission and Goals

The mission of the Refuge System is "*to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans*" [National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C. 668dd et seq.)]

The goals of the Refuge System, as articulated in our Mission Goals and Purposes policy (601 FW 1), follow.

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- Develop and maintain a network of habitats for migratory birds, anadromous and inter-jurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

Law and Policy Pertaining to the Refuge System

Refuges are guided by various Federal laws and executive orders, Service policies, and international treaties. Fundamental to the management of every refuge are the mission and goals of the Refuge System and the designated purposes of a refuge unit as described in establishing legislation, executive orders, or other documents establishing, authorizing, or expanding a refuge.

Key concepts and guidance of the Refuge System derive from the National Wildlife Refuge System Administration Act of 1966 (Administration Act) as amended (16 U.S.C. 668dd-668ee); the Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4); Title 50 of the Code of Federal Regulations; and the Service Manual. The Administration Act is implemented through regulations covering the Refuge System, published in Title 50, subchapter C of the Code of Federal Regulations and policies contained in the Service Manual. These regulations and policies govern general administration of units of the Refuge System.

Many other laws apply to the USFWS and management of Refuge System lands. Examples include the Endangered Species Act of 1973 (ESA), as amended, and the National Historic Preservation Act of 1966, as amended. Brief descriptions of laws pertinent to Dungeness Refuge are included in this chapter. A complete list of laws pertaining to the Service and the Refuge System can be found at http://laws.fws.gov.

Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4). The Refuge Recreation Act authorized the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. It provided for public use fees and permits, and penalties for violating regulations. It also authorized the acceptance of donated funds and real and personal property, to assist in carrying out its purposes. Enforcement

provisions were amended in 1978 and 1984 to make violations misdemeanors in accordance with the uniform sentencing provisions of 18 U.S.C. 3551-3586.

National Wildlife Refuge System Administration Act (16 U.S.C. 668dd et seq.) as amended by the National Wildlife Refuge System Improvement Act (Public Law 105-57). Of all the laws governing activities on national wildlife refuges, the Refuge Administration Act exerts the greatest influence. The National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act) amended the Administration Act by defining a unifying mission for all refuges, including a new process for determining compatible uses on refuges, and requiring that each refuge be managed under a comprehensive conservation plan. Key provisions of the Refuge Administration Act follow.

- Comprehensive conservation planning. A CCP must be completed for each refuge, as is required by the Refuge Administration Act. Each CCP will be revised every 15 years or earlier if monitoring and evaluation determine that changes are needed to achieve purposes, vision, goals, or objectives. The Refuge Administration Act also requires that CCPs be developed with the participation of the public. Public comments, issues, and concerns are considered during the development of a CCP, and together, with the formal guidance, can play a role in selecting the preferred alternative. Information on public involvement can be found in Appendix K. The CCP provides guidance in the form of goals, objectives, and strategies for refuge programs, but may lack some of the specifics needed for implementation. Therefore, step-down management plans will be developed for individual program areas as needed, following completion of the CCP. The step-down plans are founded on management goals, objectives and strategies outlined in a CCP, and require appropriate NEPA compliance.

- Wildlife conservation; biological diversity, integrity and environmental health. The Refuge Administration Act expressly states that the conservation of fish, wildlife and plants, and their habitats is the priority of Refuge System lands, and that the Secretary of the Interior shall ensure that the biological integrity, diversity, and environmental health of refuge lands are maintained. House Report 105–106 accompanying the Improvement Act states "… the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first."

- Refuge purposes. Each refuge must be managed to fulfill the Refuge System mission and the specific purpose(s) for which the refuge was established. The purposes of a refuge are specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit. When a conflict exists between the Refuge System mission and the purpose of an individual refuge, the refuge purpose may supersede the mission.

- Priority public uses on refuges. The Administration Act superseded some key provisions of the Refuge Recreation Act regarding compatibility, and also provided significant additional guidance regarding recreational and other public uses on units of the Refuge System. The Refuge Administration Act identifies six priority wildlife-dependent recreational uses. These uses are hunting, fishing, wildlife observation and photography, and environmental education and interpretation. The Service is to grant these six wildlife-dependent public uses special consideration during planning for, management of, and establishment and expansion of units

of the Refuge System. When determined compatible on a refuge-specific basis, these six uses assume priority status among all uses of the refuge in question. The Service is to make extra efforts to facilitate priority wildlife-dependent public use opportunities.

Compatibility and Appropriate Refuge Uses Policies (603 FW 2 and 1). With few exceptions, lands and waters within the Refuge System are different from multiple-use public lands in that they are closed to all public access and use unless specifically and legally opened. No refuge use may be allowed or continued unless it is determined to be appropriate and compatible. Generally, an appropriate use is one that contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan. A compatible use is a use that in the sound professional judgment of the refuge manager will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge.

The six wildlife-dependent recreational uses described in the Refuge Administration Act (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) are defined as appropriate. When determined to be compatible, they receive priority consideration over other public uses in planning and management. Other uses on a refuge are reviewed by the refuge manager to determine if the uses are appropriate. If a use is determined appropriate, then a compatibility determination is completed.

When preparing a CCP, refuge managers must re-evaluate all general public, recreational, and economic uses (even those occurring to further refuge habitat management goals) occurring or proposed on a refuge for appropriateness and compatibility. Updated appropriate use and compatibility determinations for existing and planned uses for Dungeness NWR are in Appendices A (Appropriateness) and B (Compatibility) of this CCP.

Biological Integrity, Diversity, and Environmental Health (BIDEH) Policy (601 FW 3). The Refuge Administration Act directs the Service to "ensure that the biological integrity, diversity, and environmental health of the National Wildlife Refuge System are maintained for the benefit of present and future generations of Americans..." The policy is an additional directive for refuge managers to follow while achieving refuge purpose(s) and the Refuge System mission. It provides for the consideration and protection of a broad spectrum of native fish, wildlife, and habitat resources found on refuges and associated ecosystems. When evaluating the appropriate management direction for refuges (e.g., in compatibility determinations), refuge managers will use sound professional judgment to determine their refuge's contribution to biological integrity, diversity, and environmental health at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of refuge resources, an understanding of the refuge's role within an ecosystem, applicable laws, and best available science, including consultation with others both inside and outside the Service. The policy states that "the highest measure of biological integrity, diversity, and environmental health is viewed as those intact and self-sustaining habitats and wildlife populations that existed during historic conditions."

Wildlife-dependent Recreation Policies (605 FW 1-7). The Refuge Administration Act states that "compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System." A series of recreation policies provide additional guidance and requirements to consider after a recreational use has been determined to be compatible. These policies also establish a quality standard for visitor services on national wildlife refuges. Through these policies, we are to simultaneously enhance wildlife-dependent recreational opportunities, provide access to quality visitor experiences, and manage refuge resources to conserve fish, wildlife, plants, and their habitats.

New and ongoing recreational uses should help visitors focus on wildlife and other natural resources, and provide an opportunity to display resource issues, management plans, and how the refuge contributes to the Refuge System and the Service's mission. The policies also require development of a visitor services plan.

1.5.3 Other Laws and Mandates

Many other Federal laws, executive orders, Service policies, and international treaties govern the Service and Refuge System lands. Examples include the Migratory Bird Treaty Act of 1918, Refuge Recreation Act of 1962, National Historic Preservation Act of 1966, and the Endangered Species Act of 1973. For additional information on laws and other mandates, a list and brief description of Federal laws of interest to the Service can be found in the Laws Digest at http://www.fws.gov/laws/Lawsdigest.html.

In addition, over the last few years, the Service has developed or revised numerous policies and Director's Orders to reflect the mandates and intent of the Refuge Administration Act. Some of these key policies include the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3); the Compatibility Policy (603 FW 2); the Comprehensive Conservation Planning Policy (602 FW 3); Mission, Goals, and Purposes (601 FW 1), Appropriate Refuge Uses (603 FW 1); Wildlife-Dependent Public Uses (605 FW 1); wilderness-related policies (610 FW 1-5) and the Director's Order for Coordination and Cooperative Work with State Fish and Wildlife Agency Representatives on Management of the National Wildlife Refuge System. These policies and others in draft or under development can be found at http://refuges.fws.gov/policymakers/nwrpolicies.html.

In developing a CCP, refuges must consider these broader laws and policies as well as Refuge System and ecosystem goals and visions. The CCP must be consistent with these and also with the refuge purpose.

1.6 Refuge Establishment and Purposes

1.6.1 Legal Significance of the Refuge Purpose

The purpose for which a refuge was established or acquired is of key importance in refuge planning. Purposes must form the foundation for management decisions. A refuge's purposes are the driving force in the development of the refuge vision statements, goals, objectives, and strategies in a CCP and are critical to determining the compatibility of existing and planned refuge uses.

The purposes of a refuge are specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.

Unless the establishing law, order, or other document indicates otherwise, purposes dealing with the conservation, management, and restoration of fish, wildlife, plants, and the habitats on which they depend, take precedence over other purposes in the management and administration of any unit. Where a refuge has multiple purposes related to fish, wildlife, and plant conservation, the more specific purpose will take precedence in instances of conflict. When an additional unit is acquired under an authority different from the authority used to establish the original unit, the addition takes on the purpose(s) of the original unit, but the original unit does not take on the purpose(s) of the

newer addition. When a conflict exists between the Refuge System mission and the purpose of an individual refuge, the refuge purpose may supersede the mission of the System.

1.6.2 Purpose and History of Refuge Establishment

Background
Establishment authorities, acquisition history, refuge purposes, and land status are all included here because their research and documentation are intertwined. The Service's Land Record System was reviewed for Dungeness NWR. Realty hardcopy files, Federal Register Archive, county records, Service's Lands Mapper program, and station files were searched in documenting these findings.

Refuge Purposes Statement (*purposes are bold and italicized*)

Dungeness National Wildlife Refuge (NWR) was established by Executive Order (E.O.) 2123 on January 20, 1915 for the land to be ***"…as a refuge, preserve and breeding ground for native birds."*** The original 226.02 acres were known as the Dungeness Spit Reservation. This purpose applies to all portions of Dungeness NWR.

Most of the additional tracts acquired between the years 1972-1999, for a total of 39 acres, that make up the Refuge were authorized by the same Public Law and purchased with funds authorized by the Fish and Wildlife Act of 1956 (FWA) (16 U.S.C. 742a-742j), as amended. This Act authorized the ***"****… **acquisition of refuge lands for the development, advancement, management, conservation**, **and protection of fish and wildlife resources ..."*** 16 U.S.C. 742f(a)(4)) "***... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..."*** 16 U.S.C. § 742f(b)(1) and Section 7(a)(1) of the Land and Water Conservation Fund Act (16 U.S.C. 4601-9) provides authority to use Land and Water Conservation Fund (LWCF) monies for acquisition under this Act. Purposes of the Land and Water Conservation Fund Act of 1965, as amended, include acquisition of **"(d) any areas authorized for the National Wildlife Refuge System by specific Acts (16 U.S.C. 460l-9)."**

Additional land was purchased from willing sellers, received through donations, or easements. One purchase in 1971, for 45 acres, was acquired under the Refuge Recreation Act of 1962 as amended (16 U.S.C. §460k-460k-4) -- Public Law 87-714, ***"…suitable for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered or threatened species…"*** (16 U.S.C. 460 k-1) and ***"... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..."*** (16 U.S.C. § 460k-2). There were two authorities that the donation was made under; the first was the Endangered Species Act of 1973 (16 U.S.C. §1543) as amended of 3.66 acres, "***... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..."*** The second was under the Fish and Wildlife Act of 1956 for 125 acres.

1.6.3 Other Management Direction

The State of Washington conveyed 321 acres as permanent easement on tidelands of the second class to the United States of America, USFWS, on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.

Graveyard Spit was approved as a Research Natural Area on February 21, 1990 for its **"High quality example of 1) low intertidal, high salinity sandy marsh; 2) coastal spit with native vegetation; and 3) high salinity coastal lagoon"** (Memorandum from Deputy Director Richard M. Smith, USFWS Washington Office, to Pacific Region Regional Director).

The Warranty Deed (420707) document pertaining to the donation from Mr. Dawley on March 6, 1973 stated that the land is to be **"…administered as a contiguous unit, as a part of the national wildlife refuge system, and as a sanctuary for wildlife…"**

1.6.4 Land Status and Ownership

The Dungeness National Wildlife Refuge was established by January 20, 1915 by President Woodrow Wilson. Consisting originally of 226.02 acres of barrier beach as an overlay with secondary jurisdiction to lighthouse and military purposes it was known then as the Dungeness Spit Reservation. In 1923, E.O. 3893 gave USFWS primary withdrawal on Tract 1a because the military reservation was removed and there was no lighthouse reservation on that tract (Figure 1-3). On July 25, 1940, Presidential Proclamation 2416 changed the name from Dungeness Spit Reservation to Dungeness National Wildlife Refuge.

Additional land was acquired from willing sellers, donations, or easements. The Refuge received a permanent easement to 321 acres of second class tidelands within the northern portion of Dungeness Bay from the State of Washington in 1943. The first purchase was for 45 acres from Mr. and Mrs. Haugland. This consisted of the forested section and bluffs to the west of the base of the spit. The next was the purchase of 29 acres from Mr. Mellus. These two sales, which now included additional forest and a cabin, actually connected the Refuge to the mainland for the first time. It also included an easement that allowed the Service to maintain vehicle access to the spit.

A year later saw the donation of what is referred to as the Dawley Tract. The donation of 129 acres came from Mr. Dawley on March 6, 1973. This land is divided by U.S. Highway 101 with a potion on Sequim Bay north of the highway. This is the site of the former residence of Mr. Dawley and is about 14 acres. The portion which lies to the south of Highway 101 is the forested unit. This forest was logged over the years by Mr. Dawley and previous owners. There is State and private land bordering this unit and Dean Creek runs through a portion of the site.

The current Refuge administrative site, which is situated on 5.04 acres, was purchased from Mr. and Mrs. Krier on Nov. 20, 1996. This purchase also provided a buffer for the Refuge. The Nature Conservancy of Washington assisted the Service in the purchase of the Weinstein Tract, consisting of 4.56 acres of coastal forest, on May 19, 1999. This tract protected the viewshed to the east from the observation platforms along the main trail. Further details on the chronological legal history related to Refuge land acquisition and status are presented in Table 1-1.

The Nature Conservancy proposed that Graveyard Spit be approved as a Research Natural Area because of its "High quality example of 1) low intertidal, high salinity sandy marsh; 2) coastal spit with native vegetation; and 3) high salinity coastal lagoon." This proposal was approved on February 21, 1990 through a memorandum from Deputy Director Richard M. Smith (USFWS Washington Office) to the Pacific Region Regional Director.

1.7 Relationship to Other Planning Efforts

When developing a CCP, the Service considers the goals and objectives of existing national, regional, state, and ecosystem plans and/or assessments. The CCP is expected to be consistent, as much as possible, with existing plans and assist in meeting their conservation goals and objectives (602 FW 3). This section summarizes some of the key plans reviewed by members of the core team while developing the CCP.

1.7.1 Refuge Plans

Over the years, prior management plans for the Refuge were developed. Being an unfunded Refuge for many years, some of the plans for the Refuge were created through partnerships. The 1974 Dungeness National Wildlife Refuge Interpretive Master Plan was the Master's thesis of Paul Ray Frandsen with the University of Washington (Frandsen 1974). The Wildlife Inventory Plan, Puget Sound National Wildlife Refuges (USFWS 1985), Refuge Management Plan (USFWS 1986), and Fire Management Plan for Dungeness NWR (USFWS 2004a) are older plans now outdated both in terms of Refuge resources and conditions, as well as current policies and mandates. This CCP will serve to update the 1997 Management of Public Use for Dungeness NWR Final Environmental Assessment (EA) by incorporating new requirements to assess appropriateness and compatibility for each public use previously described in the 1997 EA. Information on wildfire risk and suppression options as well as sensitive habitats to be considered in planning for fire risk reduction and suppression actions, is contained in the new step-down Complex-wide fire management plan in draft concurrent with this CCP.

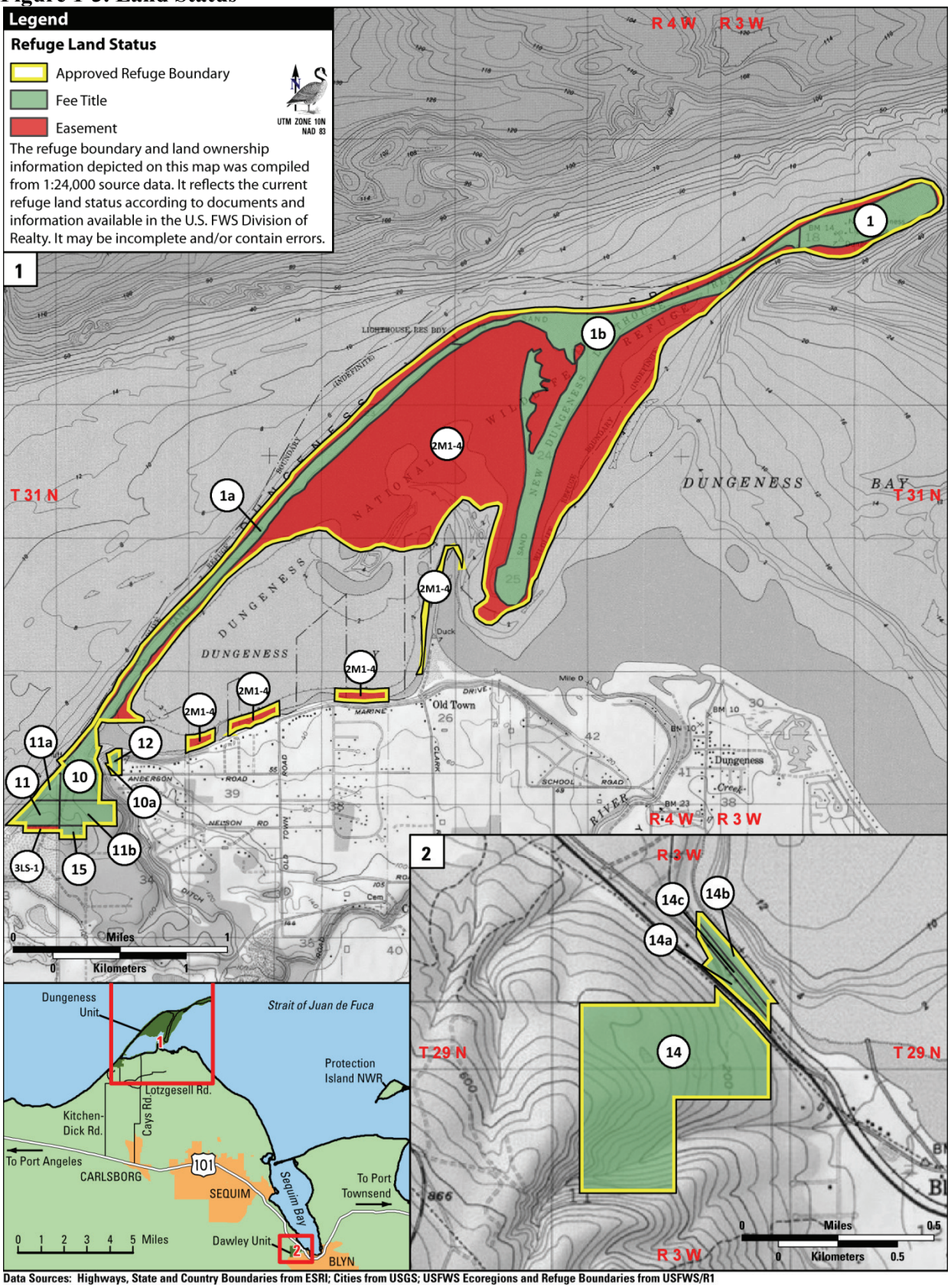
1.7.2 Other Plans and Assessments

When developing a CCP, the Service considers the goals, objectives, strategies, and other information available in existing national, regional, and ecosystem plans, state fish and wildlife conservation plans, and other landscape-scale plans developed for the same watershed or ecosystem in which the refuge is located. To the extent possible, the CCP is expected to be consistent with existing plans and assist in meeting their conservation goals and objectives. The following list identifies some of the key plans or assessments which were reviewed by members of the core team while developing the CCP.

- Management of Public Use for Dungeness National Wildlife Refuge, Final Environmental Assessment (USFWS 1997a)
- Rising to the Challenge: Strategic Plan for Responding to Accelerating Climate Change (USFWS 2010a)
- Strategic Plan for Inventories and Monitoring on National Wildlife Refuges: Adapting to Environmental Change (USFWS 2010b)
- Strait of Juan de Fuca Geographic Response Plan (WDOE 2008)
- Birds of Conservation Concern (USFWS 2008)
- Birds of Management Concern (BMC) – Region 1 (USFWS 2005a)
- North American Waterfowl Management Plan (NAWMP Plan Committee 2004)
- Partners in Flight Species Assessment Database (PIF 2010)
- Willamette Valley, Puget Trough, Georgia Basin Ecoregional Assessment (Floberg et al. 2005)

(continued on page 1-20)

Figure 1-3. Land Status



The back sides of maps are blank to improve readability.

Table 1-1. Dungeness NWR Chronological Legal History of Acquisition and Land Status

Date	Legal[1] document or source	Tract #	Tract Name	Acres	FWS Interest	Acquisition Authority	Funding Authority	Action and Management Direction
10/01/1851	S.O. (See P.L.O. 6161 / 47 FR 7235 for ref. to this S.O.)	Applied to lands currently under Tracts 1 and 1b	New Dungeness Lighthouse Reservation	190 (Based on later calculations)	None	N/A	N/A	Withdrew lands for lighthouse purposes.
09/22/1866	E.O. (See E.O. 3893 and GLO 1894 for ref. to this 1866 E.O.)	Includes 1a, 1b, and probably includes 1 plus other tracts.	North side of New Dungeness Harbor, embracing all of the peninsula to its junction with the mainland, in T 31 N., R 4W.	458.63 (GLO 1894)	None	N/A	N/A	Reserved and set aside for military purposes lands on the North side of New Dungeness Harbor.
01/20/1915	E.O. 2123	1, 1a, and 1b	Dungeness Spit Reservation	226.02	Secondary jurisdiction to lighthouse and military purposes	E.O. 2123	N/A	Established Dungeness Spit Reservation. "This order is not intended to abrogate the orders creating military and lighthouse reservation located in part upon the same lands, rather in addition to such uses, shall insure the protection of the native birds therein."
08/13/1923	E.O. 3893	Includes 1a, 1b, and probably includes 1 plus other tracts.	North side of New Dungeness Harbor, embracing all of the peninsula to its junction with the mainland, in T 31 N., R 4W.		Gave FWS primary withdrawal on Tract 1a because the military reservation was removed and there was no lighthouse reservation on that tract.	E.O. 3893	N/A	Certain lands in WA and CA which were reserved for military purposes but which are no longer needed for military purposes are put under the control of the Secretary of Interior for disposition as provided by the Act of July 5, 1884 (23 Stat. 103). This effectively revokes the E.O. of 9/22/1866 as well as many other E.O.s)
07/25/1940	P.P. 2416 (FR Vol. 5, No. 147 7/30/40)	All Tracts						Changed the name from Dungeness Spit Reservation to Dungeness National Wildlife Refuge.

Date	Legal[1] document or source	Tract #	Tract Name	Acres	FWS Interest	Acquisition Authority	Funding Authority	Action and Management Direction
08/16/1940	E.O. 8518 (FR Vol. 5, No. 162 8/20/40)	Most of 1b, and possibly part of 1a	T 31 N., R 4W, Sec 13, lots 1-4; Sec 14, lot 1; Sec 24, lots 1-5; Sec 25, lot 5; Sec 26, lot 3	147.5		E.O. 8518	N/A	Modifies E.O. 2123 "… to the extent necessary to permit the Navy Department to have primary jurisdiction over the following-described land for naval purposes..."
05/29/1943	Deed # 18251	2M1-4	State of WA Tidelands	321	Permanent Easement	State of WA Laws of 1927	N/A	Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943 for the purpose of "*establishing and maintaining on these lands a wildlife refuge.*"
09/16/1946	(Memo of assistance chief counsel, Chicago, IL. 1946).	2a, 2b, 2c, 2d	State of WA Tidelands	321.47	Permanent Easement		N/A	This memo confirmed the transfer of the tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943 for the purpose of "*establishing and maintaining on these lands a wildlife refuge.*"
02/09/1955	P.L.O. 1068 (FR 2/16/55)	Most of 1b, and possibly part of 1a	T 31 N., R 4W, Sec 13, lots 1-4; Sec 14, lot 1; Sec 24, lots 1-5; sec 25, lot 5; Sec 26, lot 3	147.5		P.L.O. 1068	N/A	Revoked E.O. 8518 thereby terminating the use by the Navy for naval purposes.
12/17/1970 and 01/29/1971		11, 11a, 11b	Hoagland Upper Forested Area	45.44	Fee	Refuge Recreation Act of 1962	LWCF	Purchased from Mr. and Mrs. Hoagland.

Date	Legal[1] document or source	Tract #	Tract Name	Acres	FWS Interest	Acquisition Authority	Funding Authority	Action and Management Direction
03/23/1972		10, 10a,	Mellus/ Upper Forested Area	29.18	Fee	Fish and Wildlife Act of 1956	LWCF	Purchase from Mr. Mellus.
03/06/1973 and 01/27/1989		14, 14a, 14b, and 14c	Dawley Tract	128.66	Fee	FWA 1956 and ESA 1973, respectively	N/A	Donation of land from Mr. Dawley "*to be administered as a contiguous unit, as a part of the national wildlife refuge system, and as a sanctuary for wildlife.*"
02/18/1982	P.L.O. 6161 (FR Vol. 47 No. 33, 2/18/1982) Also see USGS 1976 property disposal map.	All of 1b, and possibly part of 1a	T. 31 N., R, 3W., Sec 18, westerly 2,000 feet of lot 1. T. 31 N., R, 4W., Sec 13, lots 1-4; Sec 14, lot 1; Sec 24, lots 1-5; Sec 25, lot 5; Sec 26, lot 3	157.5	Gives FWS Primary jurisdiction on all of Tracts 1b and 1a.	Special Authorizing Legislation	N/A	Revokes SO of Oct 1, 1851 in part as to lighthouse purposes of 157.50 ac of land. Lands remain withdrawn for Dungeness NWR.
03/08/1988		3LS-1	Clallam County	3.17	Lease	Other	LWCF	Original lease for 20 years for parking lots began.
02/21/1990	Memorandum from Deputy Director Richard M. Smith (USFWS Washington Office) to Regional Director	Part of 1b	Graveyard Spit	173.83	Managers of the RNA	N/A	N/A	Designated Graveyard spit as a Research Natural Area on for its "*High quality example of 1) low intertidal, high salinity sandy marsh; 2) coastal spit with native vegetation; and 3) high salinity coastal lagoon.*"
03/28/1997	Warranty Deed 754589 and 752629	15	Krier	5.04	Fee	Fish and Wildlife Act 1956	LWCF	Land purchase for new administrative site. Deed signed 3/14/97. Two recordations, second one exempted from Excise tax # 752629
05/19/1999		12	TNC/Weinstein	4.56	Fee	FWA 1956	Other	
04/01/2008		3LS-1	Clallam County	3.17	Lease	FWA 1956	Other	
06/30/2009		3M	Clallam County	3.17	Agreement	FW Coordination Act 1934	Other	

[1]S.O. = Secretarial Order; E.O. = Executive Order; P.L.O. = Public Land Order; PP = Presidential Proclamation

- The California Current Marine Bird Conservation Plan (Mills et al. 2005)
- Northern Pacific Coast Regional Shorebird Management Plan (Drut et al. 2000)
- Regional Seabird Conservation Plan (USFWS 2005b)
- State of Washington Comprehensive Wildlife Conservation Strategy (WDFW 2005)
- Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary – Final EIS (USFWS 2005c)
- Conservation Plan for Dunlin with Breeding Populations in North America (*Calidris alpina arcticola*, *C. a. pacifica*, and *C. a. hudsonia*), Version 1.1. (Fernandez et al. 2010)
- Black Oystercatcher (*Haematopus bachmani*) Conservation Action Plan (Tessler et al. 2007)
- National Bald Eagle Management Guidelines (USFWS 2007a)
- Puget Sound Salmon Recovery Plan and NMFS Final Supplement to the Shared Strategy Plan (Shared Salmon Strategy 2007)
- Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern United States and Western Canada (Pilloid and Wind 2008)
- U.S. Forest Service – Management Indicator Species Information Sheet: Pileated Woodpecker (*Dryocopus pileatus*) (Mellen-McLean 2011)
- Clallam County Shoreline Master Program (WDEQ 1992)
- Dungeness Recreation Area Master Plan (Clallam County 2008)
- Elwha-Dungeness Watershed Plan, Water Resource Inventory Area 18 and WRIA 17 (EDPU 2005)
- Banking on Nature 2006: the Economic Benefits to Local Communities from National Wildlife Refuge Visitation (Carver and Caudill 2007)
- Estimates of future participation in outdoor recreation in Washington State (IAC 2002)
- North Olympic Peninsula Resource Conservation & Development Council, Washington State Area Plan 2008-2012, revised December 2009 (RC&DC 2009)
- 2006 Outdoor Recreation Survey Final Report (RCO 2007)
- Defining and Measuring Success: The Role of State Government in Outdoor Recreation, A State Comprehensive Outdoor Recreation Planning Document (RCO 2008)

1.8 Special Designation Lands

1.8.1 Research Natural Area

A 222-acre RNA was established on Graveyard Spit in February 1990 due to its unique coastal strand habitat. The original proposal was put forth by The Nature Conservancy (TNC), Washington Chapter, with research support from the Washington Natural Heritage Program and the U.S. Fish and Wildlife Service. Activities on RNAs are limited to scientific and educational activities that are nondestructive, nonmanipulative, and maintain unmodified conditions. Guidance for the operation of RNAs is provided in Section 8 RM 10 of the Service's Refuge Manual. The objectives of RNAs are:

- To preserve examples of major ecosystem types or other outstanding physical or biological phenomena;
- To provide research and educational opportunities; and
- To preserve a full range of genetic and behavior diversity for native plants and animals, including endangered or threatened species.

1.8.2 Important Bird Areas (IBA)

The Important Bird Areas (IBA) program is a global effort to identify the most important areas for maintaining bird populations and focusing conservation efforts on protecting these sites. Within the U.S., the program has been promoted and maintained by the American Bird Conservancy (ABC) and the National Audubon Society (Audubon). The ABC is coordinating the identification of nationally significant IBAs while Audubon is working to identify sites in individual states. Audubon is working within each state to identify a network of sites across the U.S. that provide critical habitat for birds. This effort recognizes that habitat loss and fragmentation are the most serious threats to birds across North America and around the world. By working through partnerships, principally the North American Bird Conservation Initiative, to identify those places that are critical to birds during some part of their life cycle (breeding, wintering, feeding, migrating), the intent is to minimize the effects that habitat loss and degradation have on bird populations. The IBA program has become a key component of many bird conservation efforts. More information is available at www.audubon.org/bird/iba/index.html.

The goals of the IBA program are to identify the sites that are the most essential for long-term conservation of birds and to take action to ensure the conservation of these sites (Cullinan 2001). An IBA is a site that provides essential habitat for one or more species of birds. The IBA selection process examines sites based on the presence and abundance of birds and/or the condition and quality of habitat. IBAs are chosen using standard biological criteria and expert ornithologists' review. All sites nominated as potential IBAs are rigorously evaluated to determine whether they meet the necessary qualifications. IBAs represent discrete sites, both aquatic and terrestrial, that are critically important to birds during their annual life cycle (e.g., breeding, migration, and/or wintering periods).

The 5,444-acre Dungeness Bay IBA is located on the north shore of the Olympic Peninsula and includes intertidal and subtidal waters of Dungeness Bay, Dungeness Spit, the Dungeness River estuary, and adjacent wetlands. It comprises extensive sandflats and mudflats; some of the largest eelgrass beds in the Northwest; and a network of spits, sandbars, and small islands. Adjacent coastal wetlands contain fresh water and estuarine marshes and ponds maintained by a seasonally high water table. Dungeness Spit and adjacent intertidal areas lie within the Dungeness Refuge.

The Dungeness Bay IBA is used by tens of thousands of shorebirds, gulls, and waterfowl during migration and winter. Its sandflats and mudflats provide extensive feeding areas for shorebirds. Subtidal eelgrass beds and associated fauna support significant populations of brant, diving ducks, seabirds, loons, grebes, and other diving birds.

1.9 Planning Process and Issue Identification

The core planning team evaluated the issues and concerns raised during public scoping. Issues are defined as matters of controversy, dispute, or general concern over resource management activities, the environment, land uses, or public use activities. Issues are important to the planning process because they identify topics to be addressed in the CCP, pinpoint the types of information to gather, and help define alternatives for the Draft CCP/EA. Numerous issues, concerns, and opportunities were raised during the public scoping process; we addressed them all in some manner in the CCP. It is the Service's responsibility to focus planning on the major issues. Major issues typically suggest different actions or alternative solutions, are within the Refuge's jurisdiction, and have a positive or

negative effect upon the resource. The following key issues, concerns, and opportunities were considered during the development of the CCP.

1.9.1 Planning Process

Planning Team: The core planning team for Dungeness NWR includes: a project leader, deputy project leader, conservation planner, biologist, park ranger (Law Enforcement Officer), and office automation clerk. The full list of core and extended team members and their roles is provided in Appendix J. The extended team assisted in the development of this CCP, particularly in providing comments at key milestones.

Resources of Concern: The planning process began when the planning team reviewed Refuge purposes and considered other plans and reports, and sought input from Washington State conservation agencies and nongovernmental organizations. The planning team then identified the top priority species, groups, and communities for the Refuge. A comprehensive list of potential resources of concern was compiled based upon review of the plans referenced above, many of which highlight priority species or habitats for conservation. From this list, those species and habitats that are most representative of Refuge purposes and habitats, BIDEH, as well as other FWS and ecosystem priorities, were chosen as priority resources of concern (habitat types) and focal resources (plant and animal species). This list was then provided to participants in the Wildlife and Habitat Review which was held on February 7-8, 2011 and included extended team members as well as U.S. Forest Service, Washington Department of Fish and Wildlife, and University of Washington biologists. The participants raised important issues and provided feedback that was used to refine the Priority Resources of Concern table. This table includes focal species, also called conservation targets, which were selected as representatives or indicators for the overall condition of important Refuge habitats. Most of the biological emphasis of the CCP is focused on protecting and restoring these species. See Appendix E for the Comprehensive Resources of Concern and Priority Resources of Concern.

Public Use Planning: Public use planning centered on developing goals, objectives, and strategies around the six wildlife-dependent recreational uses that are defined in Service policy as priority, appropriate public uses for refuge lands. The planning team assessed past, current, and future management issues surrounding public use while developing objectives and strategies during the CCP process.

Public Involvement: Public scoping began in October 2011 with a notice in the *Federal Register* [October 4, 2011, Volume 76, Number 192] announcing our intent to complete a CCP and EA for the Refuge and inviting public comments. In October 2011, we distributed Planning Update 1, which included background information on the Refuge; Refuge purposes; preliminary issues, vision, and goals; and a request for public comments. Some scoping comments we received were about broad or long-range issues, while others suggested very specific or detailed strategies that could be used to achieve biological or public use objectives. The comments were categorized into eight general categories: threats to Refuge resources; wildlife and habitat management; wildlife-dependent public use; other public use; law enforcement; cultural resources; land acquisition; and Refuge administration.

We reviewed and evaluated the potential issues, management concerns, and opportunities that we, our partners, and the public identified during scoping and used this information to define the major issues to be addressed in the CCP/EA (See Section 1.9.2). Preliminary draft alternatives were then

developed to address these issues and meet the goals and objectives of the Refuge. In January 2012, we distributed Planning Update 2, which included a summary of the scoping comments we received, a summary of our preliminary draft alternatives, notice of public open house meetings, and information on how and where to comment. On January 19 and February 2, 2012, we held a total of four public open house meetings in Sequim, Washington, to meet the public, present our preliminary draft alternatives, and solicit comments. The meetings were announced through local media outlets, on the Refuge's website, and in Planning Update 2.

Comments we received were considered and evaluated, with many incorporated into the various alternatives addressed in the Draft CCP/EA. The Dungeness NWR Draft Comprehensive Conservation Plan/Environmental Assessment was issued for public review and comment on November 28, 2012. The availability of the plan was announced through a notice in the Federal Register [November 28, 2012, Volume 77, Number 229] and via direct contact with approximately 370 people on our mailing list. The plan was made available for downloading on the USFWS Pacific Region Planning website and was made available upon request in CD or printed format. Printed copies of the Draft CCP/EA were available at local public libraries, and upon request. The public comment period was extended to February 28, 2013, providing a total of 90 days for public review and comment. All changes made as a result of public and agency comments were documented. A summary of public involvement is included in Appendix K; public comments on the Draft CCP/EA and the Service's responses to comments are included in Appendix L.

1.9.2 Key Issues Addressed in the CCP

The Service defines an issue as "Any unsettled matter that requires a management decision, e.g., an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (602 FW 1 1.6 K)." The following issues are within the scope of the CCP and are considered by the Service:

Human-caused Wildlife Disturbance: How can the Service reduce the incidences of human-caused wildlife disturbance on and adjacent to the Refuge and improve compliance with Refuge regulations?

Oil Spills and Other Contaminants: What can the Service do to reduce the risk of oil and other contaminant spills? What can be done about contaminants on Refuge lands?

Marine Debris and Derelict Fishing Gear: What role can the Service play in reducing the presence of marine debris and derelict fishing gear from the Refuge and adjacent areas?

Climate Change: What, if anything, should the Service do about anticipated impacts of sea level rise? What aspects of climate change should be studied at the Refuge, and how can this information be incorporated into wildlife and habitat management on the Refuge?

Forest Habitats: Should forest habitats of the Dawley Unit be actively managed for old-growth characteristics, and if so, how?

Eelgrass Beds: Is there a need to enhance eelgrass beds on the Refuge? Is there anything the Service can do to mitigate anticipated impacts to eelgrass beds from climate change?

Invasive Species: Which invasive species should be the highest priority for monitoring and control measures? What can the Service do to prevent the introduction and dispersal of invasive plants and animals?

Wildlife-dependent Uses: How should Refuge visitors and the community be educated about the Refuge and the natural and cultural resources of the Salish Sea? How can visitor opportunities to observe wildlife be enhanced? What can be done to help visitors understand and appreciate Dungeness Spit's unique geology which results in a culturally important and biologically rich site?

Other General Public Uses: Are jogging and horseback riding appropriate and compatible with Refuge purposes? How can the Service enhance the visitor's cultural appreciation for and experience of the New Dungeness Light Station?

Visitor Orientation: How can the Service help visitors understand they are on a national wildlife refuge and the importance of the National Wildlife Refuge System? How can visitors be helped to understand what activities are appropriate for the Refuge and which areas are open or closed to visitation? How can the Service enhance opportunities for people with disabilities to experience Refuge resources?

Community Outreach: How can the Service enhance community outreach efforts to advance Salish Sea conservation? How can the Service better utilize partnerships to achieve Refuge and regional conservation and education goals?

Research and Monitoring: What research or monitoring studies would assist in answering Refuge management questions? How can impacts to wildlife and habitats from research or monitoring activities be minimized? What research or studies, if any, should be encouraged for Graveyard Spit Research Natural Area?

1.10 Refuge Vision and Goals

1.10.1 Vision Statement

The forest, shoreline, and wetland habitats of Dungeness Refuge support a rich diversity of wildlife, from the regal peregrine falcon to the boisterous black oystercatcher to the unassuming rough-skinned newt. Fed by a generous offering of ancient glacial sediment from nearby bluffs and anchored by gnarled logs of driftwood, the pristine barrier beach of Dungeness Spit curves seamlessly down from the lush layers of old-growth forest above into the sparkling waters of the Salish Sea. Offshore, sheltered beds of rippling eelgrass provide a wealth of nutrients to a teeming nursery of young salmon and crab. Like the brant and dunlin that rely on this home, people flock to Dungeness seeking a welcome haven for the study of dynamic natural forces, distinctive geologic features, and compelling cultural stories. Visitors are inspired as they meander through the primeval forests and emerge upon the stunning seascape vistas. In accord with our friends and partners, and with sound science as our foremost principle, we will continue to monitor and preserve the integrity of this wonder of the Olympic Peninsula ecosystem. We endeavor to understand more about the delicate balance of nature while fostering in our visitors an abiding sense of stewardship for this irreplaceable sanctuary.

1.10.2 Refuge Goals

Refuge management goals are descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose, but do not define measurable units. Goals must support the Refuge vision and describe the desired end result.

Wildlife and Habitat Goals:

1. Protect, maintain, and enhance the structure of forested habitats characteristic of mature to late-successional forest structures on the Olympic Peninsula for the benefit of forest-dependent species.
2. Protect and maintain the diversity of nearshore habitats historically characteristic of the Salish Sea ecosystem for the benefit of native plants and marine-associated wildlife.
3. Enhance and/or protect freshwater wetlands for the benefit of wetland-dependent species.
4. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions under objectives for Goals 1-3.

Public Use Goals:

5. Visitors feel welcomed and know they are on a national wildlife refuge as well as where they can safely explore and learn more about the diversity of wildlife, while being good wildlife stewards. As a result, visitors will have a memorable experience and leave the Refuge with a greater connection between themselves and nature.
6. Visitors have the opportunity to participate in safe, quality wildlife-dependent recreation programs and compatible nonwildlife-dependent recreation activities while minimizing wildlife disturbance in the face of increasing Refuge visitation. Programs and activities, including interpretation, environmental education, wildlife observation and photography, and fishing, will focus on enhancing public understanding and appreciation of wildlife and cultural resources while building support for the Refuge.
7. Through Refuge outreach efforts local residents will have the opportunity to gain an understanding of and appreciation for the Refuge and Refuge System mission.

Cultural Resources Goal:

8. Protect, preserve, evaluate and interpret the cultural heritage and resources of the Refuge while consulting with appropriate Native American groups and preservation organizations, and complying with historic preservation legislation.

Document continues on next page.

Chapter 2 Management Direction

USFWS

Chapter 2. Management Direction

2.1 Overview

During development of this CCP, the Service reviewed and considered a variety of local and regional physical and biological resource conditions, as well as social, economic, and organizational aspects important for managing the Refuge. This background information is described more fully in Chapters 3, 4, and 5. As is appropriate for a national wildlife refuge, natural resource considerations were fundamental in designing alternatives. House Report 105-106 accompanying the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) states "the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first." Toward this end, the Refuge planning team reviewed scientific reports and studies to better understand ecosystem trends and the latest scientific recommendations for species and habitats.

The Refuge's Environmental Assessment on Management of Public Uses (USFWS 1997a) completed in 1997, evaluated the effects of public use activities on wildlife. At that time, the Refuge was divided into zones where public use activities were permitted or prohibited. The Refuge Improvement Act of 1997 defined the criteria used to determine if an activity is an appropriate use of a national wildlife refuge and created a new process for compatibility determination. With the development of this CCP, the Refuge's public use activities were re-evaluated based on the refined criteria outlined under the Service's appropriateness and compatibility policies (16 U.S.C. 668dd-668ee, 50 CFR 25, 26, and 29; and 603 FW 1 and 2).

Public involvement was an important part of the planning process. Local, State, and Federal agencies; Tribes; and elected officials were contacted by the planning team to ascertain priorities and issues as perceived by others. The team also contacted Refuge users, nonprofit groups, and community organizations to ensure that their comments and ideas were considered during the development of alternatives. The planning team then developed preliminary management concepts and strategies, which they presented to the public in a planning update and at public meetings in January and February 2012. Based on all of the information gathered and feedback from others throughout the public involvement process, the Service developed three draft alternatives for the Dungeness National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment (Draft CCP/EA) (USFWS 2012a), which was released in November 2012. Alternative B was selected as the preferred alternative.

The CCP planning team reviewed and evaluated all of the comments received during the Draft CCP/EA 90-day comment period. Alternative B was selected for implementation. In some cases, the management direction in Alternative B was clarified or modified based on public feedback. The details of public participation can be found in Appendix K, Public Involvement; the major changes between the draft and the final CCPs are identified in Appendix L, Comments Received and Service Responses, specifically, Table L-1.

2.2 Management Directions Considered but Not Developed

Early in the alternatives development process, the planning team considered including the following actions in one or more CCP alternatives. These actions were ultimately eliminated from further consideration in this CCP for the reasons provided.

Active Shoreline Erosion Control and Bank Protection
Dungeness NWR's shoreline includes two sand spits, the 5.5 mile long Dungeness Spit, and the 1.4-mile long Graveyard Spit, and approximately 0.5 mile of bluff-backed beach. These shoreline features are dynamic and affected by the natural processes of sediment erosion, littoral transport, and deposition. Both the sand spits and bluff-backed beach are formed of sediment supplied by the erosion of coastal bluffs and moved by wave action and littoral drift.

In their natural state, beaches and their associated bluffs have a certain amount of built-in erosion protection. Gradual beach slopes dissipate wave energy and protect the toe of the bluff from direct wave action except at the highest tides. The movement of beach sediment also dissipates wave energy. The presence of drift logs, other large woody debris, and vegetation helps to retain sediments and absorb wave energy. Nevertheless, intermittent overwash events have occurred on Dungeness Spit during and after large storms. Additionally, due to significant wind and wave exposure, the bluffs at Dungeness NWR are experiencing erosion and recession.

Traditionally, erosion control and bank protection of the shoreline has been achieved through the use of engineered structures such as seawalls, bulkheads, revetments, and upland retaining walls. However, these structures disrupt natural geomorphic processes, reflect wave energy back onto the beach, and cutoff sources of sediment needed to maintain nearby beaches. Alternative measures such as beach nourishment, where sediment is artificially added to the beach, and bank stabilization actions (e.g., vegetation planting and/or large woody debris placement specifically to address erosion and slope stability) have also been used to restore or enhance beach functions. All of these shoreline erosion control and bank protection strategies were not included within the range of alternatives considered within this CCP due their lack of practicability and the Refuge's management emphasis upon allowing natural processes to take place. For example, while a spit breach may limit public access to parts of the spit during extreme high tides, these breaches are the result of natural disturbance processes and the spit would be naturally rebuilt over time in between storms.

2.3 Description of Management Direction

A brief description of the management direction follows. Table 2-1 contains additional details regarding actions associated with the CCP. A map displaying management direction for the Refuge is located at the end of this chapter (Figure 2-1).

Wildlife and Habitat Management
Refuge management actions will emphasize protecting and maintaining forested, nearshore, freshwater wetland, and stream-riparian habitats, with an increased level of active habitat management, monitoring, and enhancement. A forest assessment will be conducted within the Dawley Unit and a step-down forest management plan will be completed by 2018. Active forest management techniques will be employed within a core 40-acre area to promote development of mature old-growth forest characteristics. A road inventory and condition assessment for the Dawley Unit will be completed by 2016. The amount of roads maintained will decrease, unneeded logging spur roads outside of the core area will be rehabilitated, and the slope along the main road will be stabilized. A wetland inventory and hydrological assessment will be conducted by 2015. The impoundment at the Dawley Unit will be managed for optimum water levels and benthic layer characteristics for amphibians and other benefiting species.

Public Use Management
Public use activities on the Refuge will include saltwater fishing, shell-fishing (clams and crabs), wildlife observation, wildlife photography, hiking, no-wake boating, jogging, horseback riding (should alternative access be obtained per compatibility determination), beach use (wading, other recreational beach uses), environmental education, and environmental interpretation. Areas that are open or closed to public use year-round, and areas that are open seasonally depending on the needs of Refuge wildlife, will remain the same with some exceptions. Changes will include new limits on boat landing hours on the beach directly south of the New Dungeness Light Station and jogging stipulations. Jogging will be allowed on the trail adjacent to the Refuge's parking lot and along the west beach from the end of the upland forested trail to the Refuge's western boundary. Horseback riding will be allowed with stipulations, on the beach west of where the main trail meets Dungeness Spit if a safe and legal alternate access route from the west or east can be obtained. If an alternate access route is obtained from the east, horseback use of a Refuge-owned road to the beach will also be allowed.

Additional wildlife viewing, interpretive, and environmental education programs will be offered. Staff and volunteer time devoted to making visitor contacts and community outreach will increase. New orientation materials, regulatory signage, and volunteer opportunities will be developed.

Adaptive Management
Adaptive management is a management philosophy and decision process that incorporates flexibility and continual learning. It involves monitoring and evaluation of Refuge accomplishments, comparing accomplishments to objectives, and changing management strategies or objectives as necessary to achieve desired results. In the presence of accelerated climate change, adaptive management is an increasingly important management decision process. The Refuge will employ adaptive management as a standard operating procedure.

Appropriateness and Compatibility
Consistent with relevant laws, regulations, and policies, prior to allowing any public use of the Refuge (including commercial use), each use must be assessed, found appropriate, and determined compatible (16 U.S.C. 668dd-668ee, 50 CFR 25, 26, and 29; and 603 FW 1 and 2). In the Draft CCP/EA, the Service made preliminary findings and determinations regarding the appropriateness and compatibility of each use included in each alternative. Appropriateness findings and compatibility determinations have been finalized for each use included in the management direction. Appropriateness and compatibility are further discussed in Appendices A and B.

Climate Change
As stated in the Department of the Interior's Secretarial Order 3226 and the Service's Climate Change Strategic Plan (USFWS 2010a), the Service considers and analyzes climate change in its decisions, long-range plans, and other activities. Habitat conditions and wildlife populations are directly and indirectly sensitive to climatic conditions, namely precipitation and temperature and changes to hydrologic conditions, sea level rise, and ocean acidification.

The combined changes can affect the Refuge's habitats and species directly, such as the timing of migratory arrival of birds and many other phenologic responses, changes in species' ranges and physiology, and indirectly such as added vulnerability to other stressors including increasing invasive species and pathogens. Predicting biological response at the population level, however, requires complex research and information and sophisticated models that can be validated with field studies

over time. This highlights the importance of monitoring habitat and species to establish potential correlations and adaptation options.

The Refuge will participate in and contribute to climate change and sea level rise assessment efforts, including those underway at a landscape scale. Participation in the North Pacific Landscape Conservation Cooperative (LCC) will provide Refuge staff with a means to tie in with a larger scale assessment of the impacts of climate change. LCCs are formal science-management partnerships between the Service, Federal agencies, states, tribes, nongovernment organizations (NGOs), universities, and other entities to address climate change and other biological stressors in an integrated fashion. LCCs provide science support, biological planning, conservation design, research, and design of inventory and monitoring programs.

Knowledge and monitoring of regional and local climate trends on Refuge resources will be used to assess potential changes or enhancements to the Refuge's management actions and techniques and/or their timing, using the adaptive management approach described above. As needed, objectives and strategies will be adjusted to assist in enhancing Refuge resources' resiliency to climate change. Specific management goals, objectives and strategies, based on climate change impact projections, will be identified for Refuge habitats most vulnerable to climate change and sea level rise.

The Service has developed a Strategic Plan for Responding to Accelerating Climate Change in the 21st Century (USFWS 2010a), and an Action Plan outlining specific actions needed to implement the Strategic Plan. The Action Plan calls for the Service to make its operations carbon-neutral by 2020. The Refuge will work toward this goal by continuing to pursue and engage in mechanisms to conserve energy in Refuge operations including the use of fuel-efficient vehicles; exploring the feasibility of photo-voltaic panels; and building appropriately sized, energy-efficient facilities, as funding becomes available. The Refuge will seek to reduce the carbon footprint of land management activities by using energy-efficient techniques, where feasible and in line with management goals. The Refuge will also explore ways of offsetting any remaining carbon balance, such as carbon sequestration.

Implementation Subject to Funding Availability
Actions described in this CCP will be implemented over the life of the plan as funding becomes available. Project priorities and projected staffing and funding needs are included in Appendix C.

Maintenance and Upgrading of Existing Facilities
Periodic maintenance and upgrading of Refuge buildings and facilities will be necessary for safety and accessibility (e.g., compliance with the Architectural Barriers Act of 1968 and the Americans with Disabilities Act of 1990), reducing the Refuge's carbon footprint, and to support management and visitor needs, and is incorporated in the Service Asset Management System.

Management of Dawley Unit Structures and Property North of Highway 101
The Service plans to keep the Dawley Unit structures and property north of U.S. Highway 101 in caretaker status and work with other agencies or conservation organizations to pursue cooperative management.

Paleontological and Cultural Resources Protection
The possibility of finding paleontological resources on the Refuge is considered high. The collection and curation of paleontological resources will be managed under the Department of the Interior's Museum Property program and the Paleontological Resources Preservation Act (PRPA) of 2009. The

Service will continue to uphold Federal laws protecting cultural resources, including the National Historic Preservation Act (NHPA), Archaeological Resources Protection Act (ARPA), and Native American Graves Protection and Repatriation Act (NAGPRA). These laws also mandate consultation with Native American tribes, the State Historic Preservation Office (SHPO), and other preservation partners. The NHPA mandates that all projects that use federal funding, permitting, or licensing be reviewed by a cultural resource professional to determine if there is the potential to affect cultural resources. An inventory will be conducted as necessary, and appropriate actions to mitigate effects will be identified prior to implementation of the project. A project specific determination will be conducted for all undertakings as defined by NHPA, including habitat maintenance and restoration projects as well as new or expanded trails, roads, facilities, and public use areas.

Tribal Coordination
The Service will coordinate and consult with Native American Tribes on a regular basis regarding issues of shared interest. Currently, the Service seeks assistance from Tribes in Native American Graves Protection and Repatriation Act and National Historic Preservation Act and related issues. The Service is also interested in partnering with Tribes to provide cultural resources education and interpretation opportunities (see Objective 8.2). Neither the existence of this CCP nor any portion of its contents is intended to enlarge or diminish treaty rights or to have any influence over the resolution of unadjudicated treaty rights. The Service will coordinate with the appropriate Tribes as they exercise their treaty rights in an effort to minimize potential adverse impacts to Refuge resources.

County Coordination
The Service will continue to coordinate with Clallam County regarding the Dungeness trailhead parking lot and public restroom lease, invasive species management, conservation planning and marine issues (e.g., Marine Resource Committee).

State Coordination
The Service will continue to coordinate with Washington State agencies regarding areas of mutual interest. This includes communications with the Washington Department of Fish and Wildlife (WDFW) regarding management of state wildlife resources; Washington Department of Natural Resources (WDNR) regarding forest and aquatic lands management and biological surveys; Washington Department of Ecology (WDOE) on oil spill response (WDOE 2008); and Washington Department of Agriculture (WSDA) on *Spartina* detection and treatment.

Invasive Species Control
Because invasive plants and animals threaten the ecological integrity of the Refuge's wildlife and habitat, control of invasive species will be a high priority management activity. Invasive species such as *Spartina* and State and County-listed noxious weeds will continue to be a primary management concern. Additionally, nonnoxious weeds such as blackberry, English holly, and English ivy, and introduced animals such as feral cats, also limit the Refuge's ability to provide high quality habitat for establishment purposes and trust species, and will be controlled to the degree that funding permits. Invasive species control will be initiated prior to or concurrently with habitat restoration efforts.

Integrated Pest Management (IPM)
In accordance with 517 Departmental Manual (DM) 1 and 569 Fish and Wildlife Service Manual (FW) 1, an integrated pest management (IPM) approach will be utilized, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on

Refuge lands. IPM will involve using methods based upon effectiveness, cost, and minimal ecological disruption, which considers minimum potential effects to nontarget species and the Refuge environment. Pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. If a pesticide is needed on Refuge lands, the most specific (selective) chemical available for the target species will be used unless considerations of persistence or other environmental and/or biotic hazards would preclude it. In accordance with 517 DM 1, pesticide usage will be further restricted because only pesticides registered with the U.S. Environmental Protection Agency (USEPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and as provided in regulations, orders, or permits issued by USEPA may be applied on lands and waters under Refuge jurisdiction.

Environmental harm by pest species refers to a biologically substantial decrease in environmental quality as indicated by a variety of potential factors including declines in native species populations or communities, degraded habitat quality or long-term habitat loss, and/or altered ecological processes. Environmental harm may be a result of direct effects of pests on native species including preying and feeding on them; causing or vectoring diseases; preventing them from reproducing or killing their young; outcompeting them for food, nutrients, light, nest sites or other vital resources; or hybridizing with them so frequently that within a few generations, few if any truly native individuals remain. Environmental harm also can be the result of an indirect effect of pest species. For example, decreased migratory bird use may result from invasive plant infestations reducing the availability and/or abundance of native wetland plants that provide forage during the winter.

Environmental harm may involve detrimental changes in ecological processes. For example, invasive plants in wetlands and uplands reduce migratory bird species food availability during all periods of the year. Environmental harm may also cause or be associated with economic losses and damage to human, plant, and animal health. For example, invasions by fire-promoting grasses that alter entire plant and animal communities eliminating or sharply reducing populations of many native plant and animal species can also greatly increase firefighting costs.

See Appendix G for the Refuge's IPM program documentation to manage pests for this CCP. Along with a more detailed discussion of IPM techniques, this documentation describes the selective use of pesticides for pest management on Refuge lands, where necessary. Throughout the life of the CCP, proposed pesticide uses on Refuge lands will be evaluated for potential effects to Refuge biological resources and environmental quality. These potential effects will be documented in "Chemical Profiles" (see Appendix G). Pesticide uses with appropriate and practical best management practices (BMPs) for habitat management as well as facilities maintenance will be approved for use on Refuge lands where there likely would be only minor, temporary, and localized effects to species and environmental quality based on non-exceedance of threshold values in Chemical Profiles. However, pesticides may be used on Refuge lands where substantial effects to species and the environment are possible (exceed threshold values) in order to protect human health and safety (e.g., mosquito-borne disease).

The magnitude of pest problems on the Refuge is beyond the available capital resources to expect control or eradication during any single field season; therefore, it is essential to prioritize treatment of infestations. Some nonnative species which are pervasive on Refuge lands are the subject of long-term control efforts and will continue to be a high priority. Also, the Service will find and verify the identity of new invasive species as early after entry as possible, when eradication and control are still feasible and less costly. Regardless of whether the invasive species is well established or newly

introduced, the Refuge will prioritize pre- and post-treatment monitoring, assessment of the successes and failures of treatments and development of new approaches when proposed methods do not achieve desired outcomes.

Fire Management
The overall objective for fire management on the Complex is to promote a program that provides for firefighter and public safety, reduces the occurrence of human-caused fires, and ensures appropriate suppression response capability to meet expected wildland fire complexity. A Fire Management Plan (FMP) was completed for the entire Complex, including Protection Island and San Juan Islands Refuges, in 2004 (USFWS 2004a). A new FMP is in draft concurrently with this CCP.

Regulatory Compliance
Prior to implementation, all planned activities will undergo appropriate reviews and consultations, and permits and clearances will be secured, as necessary, to comply with legal and policy requirements. This includes water quality permits required under Section 401, and dredge and fill permits required under Section 404 of the Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. 1251-1382); appropriate evaluations and documentation under the National Environmental Policy Act; evaluation and consultation required by Section 7 of the Endangered Species Act, and review and consultation required by Section 106 of the National Historic Preservation Act.

Participation in Planning and Review of Regional Development Activities
The Refuge staff will actively participate in and contribute to planning and conservation efforts for ongoing and future land and energy development projects, monitoring and research associated with climate change, oil spill response, removal of derelict fishing gear, and other activities that may affect Refuge wildlife resources and habitats. Pre-spill planning and preparedness is required by the Federal Oil and Pollution Act of 1990. Refuge staff has been involved with WDOE and others in preparing Area Geographic Response Plans, as part of the oil and hazardous substance spill prevention and response (Participation in Regional Planning and Conservation Efforts RCW Title 90 Chapter 90.56). Participation in the North Pacific LCC will provide Refuge staff with a means to tie in with a larger scale assessment of the impacts of climate change (USFWS 2010a). Protecting focal resources by supporting partners' efforts to reduce or eliminate fisheries bycatch and the removal of derelict fishing gear continues to be a priority for the Refuge. Refuge staff will cultivate working relationships with pertinent local, county, State, and Federal agencies to stay abreast of current and potential developments; and will utilize outreach, education, and information as needed to raise awareness of Refuge resources and their dependence on a healthy local environment.

Refuge Revenue Sharing
Annual payments to Clallam County under the Refuge Revenue Sharing Act (16 U.S.C. 715s) will continue according to the established formula and subject to congressional appropriations.

Volunteer Opportunities and Partnerships
Volunteer opportunities are key components of the successful management of public lands, and are vital to Refuge programs, plans, and projects, especially in times of static or declining budgets. Currently the Refuge makes extensive use of volunteers in public use programs. In addition, interested volunteers participate in invasive species control, habitat restoration, and survey and monitoring activities. In the future, successful implementation of native habitat restoration and environmental education and interpretation programs will require the use of partnerships and volunteers.

Partnerships
Partnerships on the Refuge are critical components in maintaining and continuing efforts to enhance recreation opportunities or implement research directed towards adaptive management in response to climate change and other threats. These partnerships typically involve joining forces with federal, state, tribal, and local agencies and organizations.

Wilderness Review
The Service's CCP policy requires that a wilderness review be completed for all CCPs. If it is determined that the potential for wilderness designation is found, the process moves on to the wilderness study phase. As part of the process for this CCP, the planning team completed a wilderness review, which can be found in Appendix D. This review concluded that the Refuge is not suitable for wilderness designation.

Land Protection
The Service has authority to acquire land or negotiate agreements on behalf of the National Wildlife Refuge System only within an approved refuge boundary. Lands within an approved refuge boundary may become part of the Refuge System through fee acquisition, conservation easement, or cooperative agreement. Service policy for land acquisition is to work on a willing seller/interested landowner basis. The Service will work with partners to assess conservation priorities within the surrounding areas in order to identify possible additions to the approved Refuge boundary.

The New Dungeness Light Station, within the approved Refuge boundary, is located on land withdrawn from the public domain for light station purposes and is under the administrative jurisdiction of the U.S. Coast Guard (USCG). In the event that the USCG declares the light station property excess to its needs, the Service will work with the USCG to bring the light station property into the Refuge System either through interagency cooperative management agreement or property jurisdiction transfer (i.e., Public Land Order by the Bureau of Land Management). Subsequently, the Service plans to enter into an agreement with the New Dungeness Light Station Association (NDLSA) to continue their management and maintenance of the light station facilities.

Bringing the USCG property into the Refuge System would contribute to achieving the Service's mission, the Refuge's purposes, and would help meet several of our goals by allowing us to protect wildlife resources through control of activities associated with maintenance and operation of the light station facilities.

Table 2-1 Summary of Management Direction

Key Theme/Issue	Future Management
HABITAT MANAGEMENT	
Mixed-coniferous Forest	
Forest management within Dungeness Unit	- Invasive species removal. - Use fire suppression techniques to prevent catastrophic wildfire. - Clear downed or overhanging branches across the public use trails that are hazards. - Enhance the effectiveness of the main trail firebreak by removing dead and downed materials within 10 feet of either side of the trail; keep live and large woody debris >21 inches DBH and snags.
Forest management within Dawley Unit	- Continue invasive species removal and fire suppression. - Conduct forest assessment. - Develop step-down forest management plan by 2018. - Use various techniques such as, but not limited to snag creation, thinning, and prescribed fire to enhance forest structure within core 40-acre area. - Remove small dump site.

Key Theme/Issue	Future Management
Roads within Dawley Unit	- Conduct road inventory and condition assessment by 2016. - Maintain main road for regular vehicles up to turnaround (0.95 mile), beyond that maintain for ATV only. - Slide stabilization, where needed. - Rehabilitate unneeded logging spur roads (0.58 mile) outside of 40-acre core area.
Nearshore Habitats	
Multiple habitats Oil spill and contaminants	- Rapid response in accordance with the Strait of Juan de Fuca Geographic Response Plan. - Collect and maintain information needed by the response team for resource protection. - Periodically review/ update Geographic Response Plan. - Increase staff participation in deployment drills. - Work with partners (WA Dept. of Ecology, oil spill response groups) on validating deployment locations and techniques within Refuge lands.
Sandy bluff habitat	- Maintain public use closure. - Use IPM to control invasive species. - Coordinate with partners (e.g., State, County, and Tribes) to prevent or reduce shoreline armoring, especially to the west of Dungeness NWR. - Restrict further development within 150 feet of the bluff on Refuge lands.
Barrier beach habitat	- Seasonal public use closures. - Regular removal of marine debris. - Prohibition of driftwood collection. - Fire suppression. - Rapid response in accordance with Strait of Juan de Fuca Geographic Response Plan. - IPM for invasive species control. - Work with partners to remove marine debris and creosote-covered logs in adjacent marine areas, off-Refuge, and increase removal in closed areas. - Monitor environmental factors that are climate change related stressors (e.g., accelerated erosion due to sea level rise and/or increased frequency and severity of storm events, driftwood recruitment and retention).
Mudflat and barrier lagoon	- Monitor and if found, remove invasive species (e.g., *Spartina*) using IPM techniques. - Monitor for European green crab. - Seasonal public use closures. - Coordinate with partners (e.g., Clean Water Working Group) to monitor and address water quality issues within Dungeness Bay and Harbor. - Rapid response in accordance with the Strait of Juan de Fuca Geographic Response Plan. - Removal of marine debris. - Monitor environmental factors that are climate change related stressors (e.g., sedimentation, ocean acidification, salinity). - Remove abandoned USCG road access dike located at base of spit if determined to be on Refuge lands.
Eelgrass Beds	- Coordinate with partners (e.g., Clean Water Working Group) to monitor and address water quality issues within Dungeness Bay and Harbor. - Coordinate with oil spill response team. - Monitor for European green crab. - Monitor environmental factors that are known stressors. - Work with partners to determine adaptive management techniques to address stressors (e.g., climate change, sedimentation, excessive nutrients).
Salt marsh	- Monitor and if found, remove invasive species (e.g., *Spartina*) using IPM techniques. - Public use closure. - Fire suppression. - Rapid response in accordance with the Strait of Juan de Fuca Geographic Response Plan. - Removal of marine debris and creosote-covered logs. - Monitor environmental factors that are known stressors (e.g., sedimentation, ocean acidification, salinity, vegetation community, driftwood recruitment and removal).

Key Theme/Issue	Future Management
Freshwater Wetlands	
Seasonal freshwater wetlands on the Dawley and Dungeness units	- Conduct wetland inventory and hydrological assessment by 2015. - Conduct amphibian and bat surveys. - Use IPM to control invasive species.
Instream and riparian habitat	- Slope stabilization of main road. - Partner with upstream land owners to improve and protect water quality. - Conduct hydrological assessment by 2015. - Conduct survey and assess habitat suitability for anadromous and resident fish. - Use IPM to control invasive species.
Freshwater impoundment on Dawley Unit	- Maintain water delivery system to impoundment. - Maintain water level for use in fire suppression. - Clear woody vegetation from dike. - Conduct hydrological assessment of relationship between impoundment and domestic water source. - Map bathymetry of impoundment. - Conduct amphibian and bat surveys. - Install new water control structure and water gage. - Maintain minimum water levels and manage for optimum water levels/benthic layer characteristics for amphibians. - Manage vegetation and downed woody debris along waterline. - Use IPM to control invasive species (e.g., bullfrogs and nonnative fish).
Monitoring and Research	
Status monitoring (Surveys)	- Continue or expand bird counts (Christmas Bird Count, Mid-winter Waterfowl Survey) and monitoring for invasive plants, European green crab, marine debris. - Conduct breeding bird surveys. - Determine frequency of effort and monitor the distribution and densities of common eelgrass on the Refuge.
Research	- Caspian tern colony productivity. - Sediment dynamics at the base of Dungeness Spit. - Large woody debris monitoring in the Elwha nearshore. - Assess the value of salt marsh habitat on Graveyard Spit as a nursery area for crab, salmon, etc. - Assess driftwood recruitment and removal rates within the barrier beach and salt marsh habitats. - Plot and monitor microhabitat characteristics (e.g., species, percent cover) to track changes in distribution and diversity of plant species in the Graveyard Spit RNA. - Assess climate change impacts on natural spit habitats such as Dungeness Spit.
Effectiveness Monitoring	- Monitor CCP and other step-down plan objectives.
Scientific Assessments	- Conduct amphibian and bat surveys. - Follow-up assessment of the distribution and abundance of Lepidopterans on Graveyard and Dungeness spits. - Assess the number of breeding pairs of gulls in the colony at the tip of Graveyard Spit. - Conduct survey and assess habitat suitability for anadromous and resident fish. - Conduct wetlands inventory (Dawley Unit) and hydrological assessment (Dawley and Dungeness units) by 2015. - Conduct road inventory and condition assessment (Dawley Unit) by 2016.
PUBLIC USE	
Human-caused Wildlife Disturbance	
Aircraft disturbance	- Federal Aviation Administration 2,000 foot Above Ground Level flight recommendation over national wildlife refuges.
Refuge Foot Access – Open and Closed Areas	
Open areas: upland trails, strait-side of Dungeness Spit from west Refuge boundary to lighthouse (Zones 1, 2, and 3).	- Foot access only, sunrise to sunset.

Key Theme/Issue	Future Management
Seasonal open areas: uplands and tidelands in the first ½ mile of the Spit's harbor side (Zone 2).	- Foot access only May 15-September 30, sunrise to sunset.
Temporary Closures	- Close portions of high use areas when seal pups present.
Closed areas: upland forest (except on established trails), bluffs, Graveyard Spit (Zone 4), end of Dungeness Spit (Zone 4), bay- and harbor- side of Dungeness Spit (Zone 4), Dawley Unit	- Closed to public use.
Refuge Motorized and Nonmotorized Boat Access – Open and Closed Areas	
Boat access – landings	- Allowed by advance reservation at designated lighthouse boat landing zone only. - Limited to 20 boat landings per day. - Boat landing limited to 9am-5pm.
Boat access – Refuge waters (tideland areas east and west of Graveyard Spit in Zone 5)	- Open to boating May 15-September 30, sunrise to sunset. - No wake zone in all Refuge waters. - Boats must stay 100 yards from the mean high tide line. - Refuge waters closed to personal watercraft, windsurfing, and para-surfing/sailing.
Boat buffers, non-Refuge waters	- Boaters are encouraged to stay at least 100 yards from the mean high tide line.
Visitor Orientation	
Staff and volunteer time devoted to making visitor contacts on the Refuge	- Increase staff time to 520 hours per year and volunteer time to 1,200 hours per year.
Orientation materials	- Tear sheet maps available at main trail entrance. Panel maps located at entrance station, base of main trail, and lighthouse boat landing area. - Add information and map panels at Cline Spit boat launch and Dungeness Landing boat launch. - Develop trail etiquette materials including brochure and signage.
Regulation Signs	- Signs at closed areas (permanent): bluffs; bay and harbor-side of spit at ½ mile to lighthouse; across end of spit at lighthouse; north side of trail adjacent to parking lot. - Signs at closed areas (seasonal): harbor-side of spit to ½ mile; boundary pilings in bay. - International symbol signage at: main and primitive trail entrance stations; bluffs. - Additional signs at lighthouse, lighthouse boat landing, and end of Dungeness Spit.
Wildlife-dependent Uses	
Wildlife Observation and Photography	- Unstructured opportunities to observe and photograph wildlife along approximately 1 mile of trails (including main, primitive, and bluff trails) and on approximately 5.5 miles of beach (Zones 1, 2, and 3). - Offer at least 5 guided wildlife walks and/or programs.
Fishing	- Permitted on Strait-side of spit and seasonally in boat access areas (Zones 1, 2, 3, and 5). - Install map and regulations panel at Cline Spit and Dungeness Landing. - Partner with WDFW to include Refuge-specific information in State sport fishing rules pamphlet.
Shell-fishing	- Permitted seasonally on Refuge tidelands in Dungeness Harbor and Bay up to 100 yards from the mean high tide line in Zone 5 and in all foot access tideland areas (first ½ mile of Spit, Zone 2). - Install map and regulations panel at Cline Spit and Dungeness Landing. - Partner with WDFW to include Refuge-specific information in State sport fishing rules pamphlet.
Interpretation – biological	- Maintain kiosk panel, trail panel, and overlook panels (6 panels) and Refuge brochures. - Use volunteers and subject-matter experts for interpretation programs. - Present 1 interpretive program per year. - Provide at least 2 guided plant walks and/or programs annually.

Key Theme/Issue	Future Management
	- Improve wildlife interpretive displays at lighthouse. - Incorporate Refuge-specific climate change information into at least 1 interpretive product.
Interpretation – geological	- Kiosk panel, trail panel, overlook panel (1 panel). - Use trained and expert volunteers to provide interpretive information. - Present 1 interpretive program per year. - Provide 1 guided geology walk and/or program annually.
Environmental Education	- Continue to allow the Refuge to be used by others as an outdoor classroom. - Hire education specialist and offer education programs to primary and secondary level school groups on and off the Refuge. - Increase partnerships.
Other General Public Uses	
Beach use	- Recreational beach use allowed from west Refuge boundary to the first ½ mile of the spit (Zone 1 and Strait-side of Zone 2).
Horseback riding	- Allowed on west beach (Zone 1) with stipulations if an alternate access route is developed. - Daily, October 1-March 31, and weekdays, April 1-September 30. - No horseback riding on Memorial Day, the Fourth of July, and Labor Day. - Horses must walk (no trotting, cantering, or galloping). - Party size is limited to no more than 4 horses. - Pedestrians have right-of-way.
Jogging	- Allowed on west beach (Zone 1) and trail adjacent to the parking lot only. Not allowed on Dungeness Spit (Zones 2 and 3) and upland trails. - Monitor for repeated patterns of violations. If found, then will reevaluate compatibility.
Cultural Resources Interpretation and Education	
Interpretation – New Dungeness Light Station and maritime history	- Continue to partner with USCG and NDLSA to provide interpretation. - Continue to allow motorized access for keeper exchanges and facility maintenance. - Maintain human history interpretive panel in Refuge entrance kiosk. - In the event that the USCG declares the light station property excess to its needs, the Service will work with the USCG to bring the light station property into the Refuge System and enter into formal agreement with NDLSA on management.
Interpretation – Native American history and culture	- Maintain human history interpretive panel in Refuge entrance kiosk and displays in lighthouse. - Provide at least 1 interpretive product or program per year. - Partner with Tribe(s) to provide at least 1 Native American cultural program per year.
Cultural Resources Protection, Preservation and Evaluation	
Preservation - cultural resources	- Identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects. - Conduct systematic documentation and evaluation of historic buildings. - Evaluate threatened and impacted sites and structures for eligibility to the National Register of Historic Places. - Develop a GIS layer for cultural resources that can be used with other GIS layers for the Refuge, yet contains appropriate locks to protect sensitive information. - Develop partnerships with the Tribes for cultural resources inventory, evaluation, and project monitoring, consistent with National Historic Preservation Act regulations. - Continue to coordinate with USCG to allow Aids to Navigation maintenance personnel motorized access for lighthouse servicing and repair.
Native American Graves Protection and Repatriation Act (NAGPRA)	- Identify Native American Tribes, Groups, and direct lineal descendants that may be affiliated with the Refuge lands. - Open consultation process with affiliated Tribes, Groups, and direct lineal descendants. - Develop procedures to follow for intentional and inadvertent discoveries. - Identify persons to contact for the purposes of NAGPRA compliance.
Community outreach	
Festivals and other public events	- Attend at least 3 events per year.
Community presentations	- Deliver at least 5 presentations per year about the Service and Washington Maritime NWRC.

Key Theme/Issue	Future Management
Refuge website	- Routinely upgrade and improved content. Add links to partners' and other resources.
Media outreach	- Increased coordination with media sources to improve the accuracy and content of Refuge-related articles. - Publish at least 2 local articles per year. - Target select media articles toward boating and aviation communities.
Volunteer Program	- Continue to work with Friends group. - Conduct 7 beach clean-ups per year. - Provide up to 4 full-time volunteer hosts. - Provide additional volunteer trainings.
Illegal Uses	
Pets, bicycles, resource collecting, fires, fireworks, discharging firearms, after hours trespass including camping, kite flying, ball playing, and Frisbees.	- Maintain and increase law enforcement patrols. - Maintain regulation information panels and signage. - Continue to use staff, volunteers, and trail rovers to inform visitors. - Replace regulatory and guidance signage at lighthouse boat landing zone and end of Dungeness Spit.

2.4 Goals, Objectives, and Strategies

Goals and objectives are the unifying elements of successful refuge management. They focus and describe management priorities and actions that resolve issues and help bring a refuge closer to its vision. A vision broadly reflects the refuge purposes, the Refuge System mission and goals, other statutory requirements, and larger-scale plans as appropriate. Public use and wildlife/habitat management goals then define general targets in support of the vision, followed by objectives that direct effort into incremental and measurable steps toward achieving those goals. Finally, strategies identify specific tools and actions to accomplish objectives (USFWS 2004b).

The goals for Dungeness NWR over the next 15 years under the CCP are presented on the following pages. The goal order does not imply any priority. Priority actions are identified in the staffing and funding analysis (Appendix C, Implementation). Each goal is followed by its associated objectives. Some objectives pertain to multiple goals and have simply been placed in the most appropriate location. Similarly, some strategies pertain to multiple objectives. The timeframe for accomplishing CCP objectives is the 15-year life of the CCP, unless otherwise specified in the objective.

Readers, please note the following:
Habitats for all Refuge-managed lands depicted within the Service's National Cadastral Geodatabase, current to August 1, 2012, were mapped based on the interpretation and analysis of 2011 true-color and color infrared orthorectified aerial photography. All Refuge habitat acreages calculated based on this mapping are approximate.

Below each objective statement are the strategies that could be employed in order to accomplish the objectives. The "Rationale" section provides additional information and the reasoning behind the objectives and strategies. Symbols used in the following tables include:

% percent sign
> Greater than
< Less than
≥ Greater than or equal to
≤ Less than or equal to

2.4.1 Goal 1. Protect, maintain, and enhance the structure of forested habitats characteristic of mature to late-successional forest structures on the Olympic Peninsula for the benefit of forest-dependent species.

Objective 1.1. Protect and maintain mixed-coniferous forest in the Dungeness Unit
Annually, protect and maintain 57 acres of existing second growth conifer and hardwood forest within the Dungeness Unit for the benefit of primary cavity excavators (e.g., pileated woodpecker) and forest-dependent wildlife (e.g., amphibians). This habitat is characterized by the following: • Multi-aged, multi-layered, multi-species canopy consisting of Douglas-fir, western redcedar, western hemlock, bigleaf maple, and red alder. • Natural gaps in the canopy that promote regeneration of the dominant tree species. • Remnant (mature or old-growth) trees 100-200+ years old with average tree diameters >21 inches. • Absence of English holly and English ivy.
Strategies Applied to Achieve Objective
Management Strategies:
a. Use Integrated Pest Management (IPM) strategies including mechanical, physical, biological and chemical means to eradicate, control or contain invasive or undesirable species (see Appendix G).
b. Monitor for new infestations and, if found, remove all English holly and English ivy immediately.
c. Clear dead and downed branches that fall across the public use trails and within a buffer of 10 feet from both sides of main trail to maintain a fire break for ground fires; keep live and large woody debris >21 inches DBH and snags.
d. Use fire suppression techniques (including use of fire-lines, hand tools, backpack and slip-on water pumps) to prevent catastrophic wildfire on this unit.
Monitoring Strategies (see also Goal 4):
e. Conduct baseline forest inventory.
f. Continue monitoring of invasive species not currently found in early detection and rapid response (e.g., spurge laurel, herb Robert). See Appendix G.
g. Continue to conduct breeding bird survey and Christmas Bird Count.
h. Collect baseline data on the distribution and abundance of amphibians and bats.
Rationale: Numerous definitions of old-growth forest exist and vary by location and dominant tree species. However most definitions indicate four important structural components: number and minimum size of large live trees; diverse canopy conditions; number and minimum size of snags; and number and size of downed woody debris (DWD). This habitat type is in precipitous decline due to extensive logging and human settlement, resulting in approximately 3% of old-growth conifer stands in western Washington remaining. These stands are important for at least 1,000 species (WDFW 2005). Although the Dungeness Unit supports a small fragment of forested habitat, it serves as an example of a system that is decreasing elsewhere as young and mature stands continue to be intensively logged or converted to urban and residential uses. The emphasis on this objective is to allow natural processes (e.g., windfall and natural regeneration in openings) to drive vegetative changes. Currently, the stand is considered a fragment of second growth forest that is isolated from other forested habitat on the Olympic Peninsula by residential and agricultural lands. However several patches within this stand contain late successional forest characteristics (e.g., clumps of older, remnant trees >21 inches DBH and a multi-layered, multi-

aged forest canopy) and provide important habitat for forest-dependent wildlife such as amphibians with limited range. Maintenance measures, primarily invasive plant control, will be regularly implemented. Pileated woodpecker has been selected as a focal species because it plays a key role in the creation of habitat for other forest wildlife (e.g., cavities for owls or forest carnivores), is indicative of mature to old growth habitat characteristics and can be found in urban environments supporting these habitat types. This species requires larger snags (5-18 snags >21 inches DBH and >25 feet tall/acre) or decadent trees (live trees with dead or broken tops) in early to moderate stages of decay for foraging, roosting and nesting (Mellen-McLean 2011). This is one functional component of the forested habitat on the Dungeness Unit that is present in minimal amounts. Downed woody debris is also in short supply on the forested landscape and an important life history component for amphibians. Limited information is available on specific habitat characteristics for amphibians; however Plethodontid salamanders (e.g., ensatina) prefer habitats with DWD in diameters of 3-11 inches (Aubry et al. 1988). Several bald eagle nests are located off-Refuge in adjacent forested habitat and they use larger trees on the Refuge as perches, particularly on the edge of the bay.

Several isolated patches of English holly and English ivy have been removed from this Unit. The invasive nature of these plants is the reason for the zero tolerance. Clallam County includes English ivy on their noxious weed list. Continued early detection and rapid response for these, and potential new invaders, is important in protecting the native flora from this unwanted competition.

The main trail acts as a minor fire break for ground fires. By expanding the clearing of vegetative material (e.g., small dead and downed debris), which is more likely to carry a fire, the forest will be better protected from a stand replacement fire.

Objective 1.2. Protect and enhance mixed-coniferous forest in the Dawley Unit

Initiate enhancement activities on up to 40 acres of the forested tract on the Dawley Unit to create mature to old-growth characteristics for the benefit of primary cavity excavators (e.g., pileated woodpecker), amphibians, bats, and other forest-dependent species by 2019. This forested habitat would be characterized by the following:

- Multi-aged, multi-layered, multi-species canopy consisting of Douglas-fir, western redcedar, western hemlock, and bigleaf maple.
- Natural gaps in the canopy that promote regeneration of the dominant tree species.
- 8 dominant (old-growth and mature) trees 100-200+ years old with tree diameters >32 inches DBH/acre.
- 12 sub dominant trees with >16 inches DBH/acre.
- >4 snags of >20 inches DBH and >15 feet tall/acre.
- 4 pieces of downed woody debris >24 inches diameter and >50 feet long/acre.
- Density range of 50-100 trees/acre.
- <10% of invasive species (e.g., spurge laurel, English ivy, English holly) in the forest structure.

Strategies Applied to Achieve Objective

Management Strategies:

a. Complete a step-down forest management plan by 2018.

b. The Forest Management Plan will include the use of silviculture practices (e.g., thinning, prescribed fire, and inoculating) to advance mature to old-growth characteristics.

c. Maintain main road for regular vehicles up to turnaround (mile point 0.95), beyond that maintain for ATV only.

d. Stabilize the slide at mile point 1.2 on the main road.
e. Rehabilitate 0.58 mile unneeded logging spur roads.
f. Use appropriate IPM techniques including mechanical, physical, biological, and chemical methods (see Appendix G) to control invasive or undesirable species.
g. Remove small dump sites.
h. Use fire suppression techniques (including but not limited to the use of fire-lines, hand tools, backpack and slip-on water pumps) to prevent catastrophic wildfire on this unit.
Monitoring Strategies (see also Goal 4):
i. Conduct forest assessment (e.g., % canopy closure, tree species, understory species, DBH of live trees, DBH and height of snags, snag density).
j. Conduct road inventory (e.g., skidder roads, culverts, etc.) and condition assessment by 2016.
k. Invasive species monitoring (e.g., spurge laurel, English ivy, English holly). See Appendix G.
l. Conduct periodic surveys to assess the success of forest management for use in adaptive management (e.g., breeding bird surveys, vegetative surveys, etc.).
m. Collect baseline data on the distribution and abundance of amphibians and bats.
Rationale: The 123 acres of second growth within the Dawley Unit differs from that on the Dungeness Unit in that it is part of a continuous stretch of forested habitat that includes portions of the Olympic National Park, Olympic National Forest, and adjacent state and private forests. It also provides a wildlife corridor between nearshore and forested habitats. It currently supports trees up to 140 years old interspersed with dense pockets of smaller trees. Loss and fragmentation of mature to old-growth forests are the primary limiting factors to the distribution and/or breeding success of many forest-dependent species such as pileated woodpecker. With approximately 3% of original old-growth remaining in western Washington (WDFW 2005), active management toward mature to old-growth habitat is a high priority for the Refuge. This adaptation strategy is designed to increase forest resilience to climate change by reducing other stressors and increasing connectivity. This objective has been developed to accelerate the development of mature to old-growth characteristics within the stand using active management techniques. Specific management prescriptions will be identified under a separate step-down management plan. However, the majority of the characteristics listed above is the desired outcome over the next 75 years and have been adopted from the Old Growth Definition Task Group (1986) and WDFW (2008). In a preliminary assessment of the forested habitat of this unit, larger trees and snags (>24 inches DBH) and downed woody debris were identified as key components of mature to old-growth forest that were missing from the stand. Silviculture practices such as inoculation will accelerate creation of snags and downed woody debris in areas lacking these components. In addition, the core, northeastern segment of the unit currently supports a high density of small DBH trees (approximately 180 trees per acre) which is two to three times than that of historical densities (50-100 trees/acre). Thinning and prescribed fire will help return the stand to historical densities and provide gaps in the canopy for the accelerated growth of remaining trees. The use of prescribed fire will be outlined in greater detail in the FMP, but one typical use is the burning of brush piles created during thinning operations. Throughout the managed areas, climate change adaptation strategies such as planting native, drought tolerant or fire influenced species will be considered. The northwestern section of the stand appears to support suitable tree density as well as larger trees and snags however it is lacking in berry-producing plants which support a diversity of wildlife. This will be a key strategy toward enhancing this section. Along the southern section, the steep, unstable slopes within the forested, riparian corridor poses a problem for active forest

management. For more information on management strategies in this section of the unit, see Objective 3.2.

A comprehensive forest assessment is needed to help formulate a suitable forest management plan as well as provide baseline data for use in effectiveness monitoring. The plan will be developed to primarily address the issues listed with various management techniques such as prescribed fire. A key component of forest management will be to minimize negative effects to forest-dependent wildlife during active management periods. This may include the use of a buffer zone around wetlands and seasonal restrictions on management activities. Breeding bird surveys and collection of baseline data for amphibians and bats will further inform development of the forest management plan. For more information on focal species selected for this habitat, see the rationale for Objective 1.1. Periodic surveys to assess management activities will be conducted and results will direct adaptive management.

Although the forest was logged, the presence of nonnative species is minimal. Some of the noxious and/or undesirable species that have been found are Scotch broom, English holly, English ivy, spurge laurel, and herb Robert. The Service uses a variety of control methods as different species require different techniques for control to be effective. The Service IPM policies outlines that the least environmentally harmful, yet effective method be use when controlling undesirable species.

Under the previous land owner a few small dumps sites had been established and used for personal property disposal. This included appliances, construction debris, and other miscellaneous items. In 2006, the Service conducted a Phase I and Phase II Environmental Site Assessment of the property. Hazardous asbestos containing material was found in two locations. These were removed by a contractor in 2009. Nonhazardous materials remain to be removed.

This unit does not have any natural fire breaks, and the few old logging roads would provide little opportunity to control a wildland fire. The main road had been maintained to allow access of small wildland fire engines. Many factors are considered to determine what control methods would be used during any given fire situation. The Service and its interagency wildland fire partners will determine what methods would be used on a case by case basis.

Current management of the roads involves minimal maintenance of 1.2 miles along the main road and several logging spur roads within the property. These roads were developed by the previous owner over a number of years. A slide has developed both above and below the main road at mile point 1.2. This slide has reached Dean Creek; however the degree of sedimentation due to the slide or the potential for further degradation is unknown. A road inventory and condition assessment is needed to determine the best practices for management of the road infrastructure. A geospatial database will be developed for all skidder roads, main roads, culverts, drainage crossing, and other access features. Following development of the forest management plan, all unnecessary logging spur roads will be rehabilitated.

2.4.2 Goal 2. Protect and maintain the diversity of nearshore habitats historically characteristic of the Salish Sea ecosystem for the benefit of native plants and marine associated wildlife.

Objective 2.1. Protect and maintain the sandy bluff west of Dungeness Spit
Annually, protect and maintain ½ mile of sandy bluff habitat west of Dungeness Spit to safeguard for the continuation of natural erosion processes that supply sediment to the spit. Natural bluff erosion will be protected by the following attributes: • Limit impervious surfaces within 150 feet of the top of the bluff. • No public use of the bluff toe or face at any time. • No hard armoring (e.g., rip rap) on shoreline adjacent to the bluff.
Strategies Applied to Achieve Objective
Management Strategies:
a. Enforce public use closure (see Objective 5.2).
b. Use IPM strategies including mechanical, physical, biological, and chemical means to eradicate, control, or contain invasive plants (see Appendix G).
c. Coordinate with partners (e.g., County, State, Tribes) to promote activities that reduce shoreline armoring, according to their conservation plans (EDPU 2005, WDEQ 1992), especially to the west of Dungeness NWR.
d. Replacement of existing or development of new facilities within 150 feet of bluffs will be guided by the Clallam County Shoreline Master Plan to the fullest extent possible.
Monitoring Strategies (see also Goal 4):
e. Invasive species monitoring. See Appendix G.
f. Work with partners to study environmental factors that are climate change related stressors (e.g., accelerated erosion due to sea level rise, increased frequency and severity of storm events, and/or erosion induced by excessive surface water runoff).
g. Continue existing research projects (e.g., sediment dynamics at the base of Dungeness Spit and large woody debris monitoring in conjunction with Elwha nearshore habitat studies) through to agreed-upon end dates.
Rationale: Sandy bluffs constitute approximately 60% of Puget Sound shores and are often referred to as "feeder bluffs" because natural erosion of these bluffs is the primary source of sediment for beaches in the area. However, one third of Puget Sound's shoreline has been effectively eliminated from this natural cycle through armoring. Armoring is typically used to reduce erosion of bluffs adjacent to homes or important areas by placing sea walls or bulkheads parallel to bluff habitats (Johannessen and MacLennan 2007). Armoring has far-reaching negative effects on all nearshore habitats, primarily through the reduction of sediment deposition to sandy beaches. In addition, armoring can increase the wave energy reflected to down drift beaches and bluffs, thereby increasing the potential erosion rates (Johannessen and MacLennan 2007). Due to the dynamic nature of tidal habitats and the restricted scope of this management plan (Refuge lands only), there are relatively few viable actions available for management of this and subsequent nearshore habitats in this goal. The following actions have been identified to safeguard the natural erosion of sandy bluff habitat along the northwest corner of the Refuge: enforcing a year-round public use closure of the sandy bluffs and restricting development adjacent to the upper edge of the bluff on Refuge lands. The restriction on development adjacent to bluffs will decrease the amount of impervious surfaces upslope which in turn can reduce the amount of surface water runoff that would accelerate natural erosion. No further development of Refuge lands is planned at

this time, however should the need arise within the time frame of this plan (e.g., Dungeness caretaker's cabin), we will strive to follow guidelines set in place by the existing Clallam County Shoreline Master Plan as established for residential uses on Shorelines in the Natural Environment (WDEQ 1992). Currently, the County is developing the draft of a new Shoreline Master Plan. Once that plan has been approved by the County and the Washington Department of Ecology, the Service will adopt the guidelines in the final SMP. In addition, no hard armoring (e.g., rip rap) will be placed adjacent to bluffs on Refuge lands. Human intrusion and trespass within sandy bluff habitat have the potential to exacerbate erosion and cause disturbance to wildlife (e.g., burrow nesting pigeon guillemots). Threats from climate change include sea level rise as well as the increase in the incidence and severity of storm events further weakening the toe of the bluff and accelerating natural erosion. Bluff areas west of Dungeness Spit appear to be eroding at a rate of 0.5 to 3 feet per year on average but a single storm event or bluff failure can take as much as 28 feet of bluff at a time (ESA 2011). Given the importance of bluff habitat to the maintenance of barrier beaches and other nearshore habitats on Dungeness NWR, every effort will be made to safeguard the natural erosion processes. Strategies addressed in this goal are designed to reduce other stressors for wildlife and habitats of the nearshore environment thereby increasing resilience to climate change.

Objective 2.2. Protect and maintain the barrier beaches on Dungeness and Graveyard spits

Annually, for the benefit of native strand plants, marine mammals, and other migratory and resident wildlife, protect and maintain 239 acres of barrier beach along Dungeness and Graveyard spits with the following attributes:

- Natural deposition and/or erosion of sand and gravel.
- Continuous ridge of sand and gravel rising a short distance above high tide.
- Materials derived from erosion of nearby sandy bluffs.
- Presence of native strand plants including large-headed sedge and American dunegrass.
- Absence of marine debris.
- Presence of driftwood along the "backbone" of Dungeness Spit and the eastern side of Graveyard Spit.
- <1% total cover of Dalmatian toadflax and <20% total cover of cheat grass.
- No human disturbance during seasonal and year-round closures of the barrier beach habitats (see Objective 5.2).
- Absence of man-made or natural fires on the spits.
- Minimal to no impact from oil spills or other contaminants.
- Minimal creosote-covered logs or marine debris.

Strategies Applied to Achieve Objective

Management Strategies:

a. Maintain the seasonal public use closure to the interior portion of the first half-mile of the spit and year-round closure of the remainder of the interior portion; Graveyard and tip of Dungeness spits (see Objective 5.2).

b. Continue to prohibit driftwood collection.

c. Continue full fire suppression.

d. Continue routine removal of marine debris in open areas of the barrier beaches at least 5 times per year (see Objective 7.2).

e. Annually remove marine debris in closed areas of the Refuge.

f. Rapid response to oil spills or other contaminant events in Dungeness Bay and Dungeness Harbor in accordance with the Strait of Juan de Fuca Geographic Response Plan.

g. Remove 90% of known creosote-covered logs by 2020.
h. Work with partners to remove marine debris and creosote-covered logs in adjacent marine areas, off-Refuge.
i. Use IPM strategies including mechanical, physical, biological, and chemical means to eradicate, control, or contain invasive plants (see Appendix G).
Monitoring Strategies (see also Goal 4):
j. Invasive species monitoring (e.g., Dalmatian toadflax, cheatgrass). See Appendix G.
k. Monitor creosote-covered log deposition.
l. Work with partners to study environmental factors that are climate change related stressors (e.g., accelerated erosion due to sea level rise and/or increased frequency and severity of storm events, driftwood recruitment and retention).
m. Plot and monitor microhabitat characteristics (e.g., species, percent cover) to track changes in distribution and diversity of plant species in the Graveyard Spit RNA.
n. Conduct surveys to assess breeding bird distribution (e.g., gulls).
o. Assess the distribution and abundance of Lepidopterans (i.e., sand-verbena moth and Taylor's checkerspot) on Graveyard and Dungeness spits.
p. Conduct breeding bird surveys and Christmas Bird Count.
q. Continue existing research projects (e.g., Caspian tern colony productivity) through to agreed-upon end dates.
Rationale: Barrier beach habitat is defined as a relatively continuous ridge of sand and gravel rising a short distance above the high tide line and is often formed across embayments (Shipman 2008). On this Refuge, barrier beach habitat consists of Dungeness and Graveyard spits. Pacific harbor seals and native strand plants have been selected as focal species. Pacific harbor seals represent the lower shoreline component (traditionally referred to as the spit) while native strand plants represent key components of the upper portion of the barrier beach (traditionally referred to as strand). Dungeness Spit is considered one of the world's longest natural sand spits. It totals approximately 5.5 miles and accretes (expands through deposition of sediment) toward the east at an average rate of 15 feet per year (USFWS 1997a). The strategies identified to manage and protect barrier beaches on Refuge lands include safeguarding the natural erosion of sandy bluff habitat, retention of driftwood through fire suppression and a prohibition of driftwood removal. The natural erosion of sandy bluffs is critical to the integrity of barrier beach habitat. Natural erosion supplies down drift beaches with fine sediments on a more gradual, protracted pace. Increased armoring and increases in the incidences and severity of storm events all lead to higher wave energy which accelerates erosion of down drift nearshore habitats. The driftwood found along the "backbone" of Dungeness Spit serves an important role in stabilizing the upper portion of the beach by holding sediments in place, particularly during high tide events that coincide with storms. Given the importance of driftwood to the barrier beach, full fire suppression and prohibition of the removal of driftwood is vital to the ecological integrity of this habitat type. Many of our partners have identified human disturbance as a pervasive and serious threat to wildlife and their habitats (WDFW 2005, Mills et al. 2005, Rojek et al. 2007, Tessler et al. 2007, USFWS 2005b). Refuge visitation ranged from 76,000-80,000 visitors per year for the last five years. The majority of use occurs primarily from May to September. This level of visitation in open areas or illegal trespass into closed areas cause stress and reduced productivity. Seals that are pupping in open areas are vulnerable to human-caused disturbance particularly because peak pupping periods coincide with periods of high visitation (Boren et al. 2003, Sanguinetti 2003).

Disturbance can reduce fitness or increase mortality, especially during molt or nursing. Several studies have noted that pinnipeds have a disproportional, negative response to approaches by kayaks in contrast to other recreational vessels (Szaniszlo 2001, Grella et al. 2001) potentially due to the stealthy, low profile approach of a kayak. Human disturbance also affects nearshore habitats. Public use closures have been set in place to protect the integrity of habitat and reduce introduction of invasive species. For example, Graveyard Spit is closed to protect fragile strand plant communities from trampling, inadvertent introduction of invasive plant species, and illegal fires. The majority of invasive plant species in nearshore habitats of the Refuge can be found within the area surrounding the New Dungeness Light Station and an abandoned Navy facility on Graveyard Spit, areas of historically high public use.

Nearshore habitats of the Refuge are particularly at risk of contamination from oil spills and rogue creosote-covered logs, and wildlife is threatened by derelict gear and marine debris. The U.S. Coast Guard determined that Dungeness Spit is one of the top five high-risk areas in the U.S. for oil related spill events due, in part, to its prominent location within the Strait of Juan de Fuca and proximity to the high level of shipping traffic within the Salish Sea (Melvin et al. 2001). Predominantly westerly currents have transported oil and/or oiled birds from recent oil spills in Port Angeles Harbor (e.g., T/V Arco Anchorage in 1985). Creosote-covered logs, derelict gear, and marine debris are similarly transported. Creosote is of conservation concern because it contains chemicals (notably polycyclic aromatic hydrocarbons or PAHs) that are considered "highly" or "very highly" toxic to fish and aquatic invertebrates by the U.S. Environmental Protection Agency (USEPA 2008). Effects range from decreased productivity to low survival rates. WDNR removed 150 tons of creosote-covered logs from Dungeness Spit in 2006. During the same time frame, a study of creosote contamination on Dungeness Spit revealed that 2 of 9 creosote-covered logs contained PAH levels that exceeded Washington State Department of Ecology conservative standards (Holman and Lyons 2009). Studies have shown that PAHs tend to leach and remain in sediments with less oxygen such as those found in salt marshes, mudflats and the protected shore of barrier beaches (USEPA 2008, Holman and Lyons 2009). Therefore, removal is a priority for Refuge management. Derelict fishing gear (e.g., lost or abandoned nets) and marine debris (e.g., Styrofoam and plastic) pose a direct threat to marine birds and pinnipeds as it can entangle seals or be fed to seabird chicks causing mortality.

Climate change also poses a serious threat to this environment. According to modeling using the Sea-Level Affecting Marshes Model, within the time span of this plan, roughly half of the barrier beach habitat (not including the strand component of barrier beach) is predicted to be lost based on the 1 meter (3.3-foot) global average sea level rise scenario (through 2025; Clough and Larson 2010). In 100 years, 98% of this component of the barrier beach on Dungeness Spit is predicted to be lost to sea-level rise based on the 1 meter (3.3-foot) global average sea level rise scenario (Clough and Larson 2010). However, there is some uncertainty in these results due to a lack of precise geospatial data used in the models. For this reason, we propose studies to assess variables that affect sea level rise rate scenarios (e.g., sedimentation, geospatial extent of the spit and salt marshes, etc.). Given the dynamic nature of marine systems, reducing other stressors may be the only practical, large-scale adaptation approach available until the state of the science improves. For additional information on the threats posed by climate change to nearshore habitats, see Objective 2.1.

Graveyard Spit was designated a Research Natural Area (RNA) in 1990 because it supports high quality examples of low intertidal, high salinity, sandy marsh; high salinity coastal lagoon; and coastal spit with native vegetation. The RNA contains approximately 58 acres of native strand

habitat. This RNA provides an excellent opportunity to study the effects of climate change on a relatively undisturbed, stable strand plant community. In addition, one sand-verbena moth was collected here in 2008 via light trapping. This species is under consideration for listing under the Endangered Species Act. Targeted (Lepidopteron and Native Strand Plants) as well as general (breeding bird surveys and Christmas Bird Count) surveys will further inform management on changes to this environment as a result of climate change, disturbance, or invasive species stressors and inform adaptive management in the future.

Objective 2.3. Protect and maintain barrier lagoons and mudflats of Dungeness Harbor and Dungeness Bay

Annually, protect and maintain approximately 403 acres of barrier lagoon and mudflat habitats for the benefit of dunlin and associated species such as brant, forage fish, and marine invertebrates located in Dungeness Harbor and Dungeness Bay. This habitat is characterized by the following attributes:

- Absence of *Spartina* sp.
- Substrate primarily composed of fine silt.
- Shallow gradient benthic layer (i.e., <10 centimeters or <4 inches).
- Absence of human disturbance from Oct. 1-May 14 on Refuge portions of Dungeness Harbor and Bay; no human disturbance year-round to the lagoons within the spits (see Objective 5.2).
- No creosote-covered logs on or near mudflats and the barrier lagoon habitats.
- Absence of marine debris.

Strategies Applied to Achieve Objective

Management Strategies:

a. Maintain the seasonal public use closure within Dungeness Harbor and Bay portions of the Refuge and year-round closure in the lagoons within Dungeness and Graveyard spits (see Objective 5.2).

b. Use appropriate IPM techniques including mechanical, physical, biological, and chemical methods (see Appendix G) to control invasive or undesirable species.

c. Rapid response to oil spills or other contaminant events in Dungeness Bay and Dungeness Harbor in accordance with the Strait of Juan de Fuca Geographic Response Plan.

d. Monitor and if found, remove invasive species (e.g., *Spartina*) immediately.

e. Increase annual removal of marine debris efforts.

f. Coordinate with partners (e.g., Clean Water Working Group) to address water quality issues within Dungeness Bay and Harbor.

g. Determine if the abandoned USCG's former access road dike at the base of the spit is located on Refuge land, and if so remove it.

Monitoring Strategies (see also Goal 4):

h. Invasive species monitoring (e.g., *Spartina* and European green crab). See Appendix G.

i. Work with partners to study aspects of habitat quality of mudflats (e.g., macro- and micro-invertebrate abundance and distribution; water quality; and forage fish abundance and distribution).

j. Continue to conduct Mid-winter Waterfowl Surveys and formalize overwintering and migratory shorebird surveys to assess the Refuge's contribution to overwintering and migratory refugia in the Salish Sea.

k. Work with partners to monitor environmental factors that are climate change related stressors (e.g., changes to rate of sedimentation, temperatures, and salinity; ocean acidification).

Rationale: Barrier lagoons are tidal embayments that lack a significant freshwater source and are often associated with barrier beaches which protect them from wave action (Shipman 2008). Common elements include intertidal mudflats and high tidal flats. The intertidal mudflats of these lagoons are found between Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW). High tidal flats consist primarily of sandy shores with a thin ring of salt marsh vegetation bordering the uplands. Barrier lagoons support a high abundance of wildlife including marine birds; marine invertebrates and their larvae (e.g., littleneck clam, Dungeness crab, and polychaete worms); forage fish; and marine mammals. Dunlin has been selected as the focal species for this habitat type.

Approximately 403 acres of barrier lagoon and mudflat habitats are found within the Refuge in Dungeness Harbor, the interior of both spits, and east of Graveyard Spit in Dungeness Bay. Approximately 47 of those acres are barrier lagoon while 356 acres are intertidal mudflat. Both habitats are managed by the Service in the same way under a perpetual easement with WDNR as tidelands of the second class. Current management includes invasive species monitoring and removal as well as coordination with partners on oil spill preparedness and solving clean water issues. By their very nature, barrier lagoons are partially protected from oil spill contamination; however due to the limited tidal action within this habitat type, they are also more vulnerable to persistence of contaminants. For more information on threats from climate change, marine debris, or creosote contamination, see Objectives 2.1 and 2.2. For more information on the threat posed by human disturbance, see Objective 2.2.

Spartina anglica was initially found within the barrier lagoon on Dungeness Spit in 2007 and approximately 27 square feet was removed. It has been found and removed each year since that time. In 2011, approximately 6 square feet was removed. Mechanical means of control have been sufficient to keep up with this infestation.

The proposed removal of the abandoned USCG road would require a survey to determine if the dike road is on a portion of the Refuge. The Service will coordinate with the USCG and BLM in order to determine ownership. If it is found to be under Refuge ownership that portion will be removed. The Service has been participating in an early detection monitoring program for European green crab with WDFW. Recently, European green crab was detected on the Canadian side of the Salish Sea. They are considered very invasive and have a negative impact by competing with wildlife such as native crabs and are major predators on clams, mussels, juvenile fishes and other species (PSP 2009).

There are 41 acres of barrier lagoon habitat in the Graveyard Spit RNA. This RNA provides an excellent opportunity to study the effects of sea level rise.

Objective 2.4 Protect and maintain common eelgrass beds in Dungeness Harbor and Dungeness Bay

Annually, protect and maintain common eelgrass beds within Dungeness NWR tidelands for the benefit of brant and other overwintering waterfowl; forage fish; and marine invertebrates. The Refuge supports approximately 314 acres of eelgrass beds (Figure 2-1), estimated based on Wilson (1993) and Norris and Fraser (2009). Since this includes areas of sparse, patchy, and dense coverage, the actual footprint of eelgrass beds is smaller.

Target habitat conditions exhibit the following characteristics:

- Intertidal areas with muddy to sandy substrates.
- Depth range from +0.4 to -8.8 meters (+1.3 feet to -28.9 feet), average is -3.5 meters (11.5 feet) (relative to MLLW).
- Low- to moderately high-energy environments (waves and currents).
- Absence of marine debris.
- Absence of human disturbance from Oct. 1-May 14 on the Refuge portion of Dungeness Harbor and Bay.

Strategies Applied to Achieve Objective

Management Strategies:

a. Maintain the seasonal public use closure on the Refuge portion of Dungeness Harbor and Bay (see Objective 5.2).

b. Rapid response to oil spills or other contaminant events in Dungeness Bay and Dungeness Harbor in accordance with the Strait of Juan de Fuca Geographic Response Plan.

c. Work with partners on monitoring and removal of derelict gear (e.g., crab pots) in eelgrass habitats on and off-Refuge.

d. Coordinate with partners (e.g., Clean Water Working Group) to monitor and address water quality issues within Dungeness Bay and Harbor.

Monitoring Strategies (see also Goal 4):

e. Determine frequency of survey effort and monitor the distribution and density of common eelgrass on the Refuge.

f. Invasive species monitoring (e.g., European green crab). See Appendix G.

g. Work with partners to study environmental factors that are climate change related stressors (e.g., accelerated erosion due to sea level rise, increased frequency and severity of storm events, and/or erosion induced by excessive surface water runoff).

Rationale: Common eelgrass is a vital component of the nearshore environment providing shelter for forage fish spawning (e.g., Pacific herring, surf smelt, Pacific sand lance), and young anadromous fish. It also provides forage for brant, other waterfowl, and marine invertebrates (e.g., Dungeness crab, snails, and urchin). Finally it serves an important function as a carbon sink in the nearshore environment. Despite its importance to the ecoregion, minimal long-term data exist to determine the status of common eelgrass throughout the Salish Sea. However, studies conducted in 1987 and 1991 in Dungeness Harbor reveal a decline of approximately 40% (120 acres) between years (Wilson 1993). The reasons for this decline vary, however a portion of the loss was attributed to the dynamic nature of intertidal areas and former common eelgrass beds covered by *Ulva spp.* (Wilson 1993). In addition, the Dungeness Bay/Sequim Bay Pacific herring stock is listed as declining while the regional (Strait of Juan de Fuca) stocks are considered critical (Stick and Lindquist 2009). The exact cause of decline in these stocks is unknown, but loss or degradation of habitat, pollution, and changes in prey and predator distribution have been proposed (WDFW 2005). This species prefers to spawn on common eelgrass almost exclusively in this area. The plant itself has been selected as a focal species for the habitat.

Approximately 314 acres of common eelgrass beds are managed by the Service under a perpetual easement for the second class tidelands. This acreage figure is estimated based on Wilson (1993) and Norris and Fraser (2009) and represents the total extent of eelgrass beds within the Refuge. Since this includes areas of sparse, patchy, and dense coverage, the actual footprint of eelgrass beds is smaller. The majority of these beds are located within Dungeness Harbor due west of Graveyard Spit with the remainder located due east of Graveyard Spit in Dungeness Bay. Common eelgrass restoration within the Salish Sea has a highly variable success rate (13-80%) and is very

costly ($100,000-$1,000,000; Mumford 2007). As a result, current and future management actions on the Refuge consist of protecting existing beds from invasive species, contamination, and poor water quality. In addition, the Refuge will maintain a public use closure of the tidelands and open water encompassed within Refuge boundaries from October 1 through May 14.

Primary limiting factors for common eelgrass growth include light availability and water temperature which drive photosynthesis. These growth factors are highly affected by water quality (e.g., excessive nutrients foster algal blooms; heavy sedimentation blocks light; oil contamination blocks light and kills plants). Increased sedimentation from boat wakes and damage from propellers or persistent marine debris also threaten common eelgrass growth and eelgrass bed continuity. Climate change has the potential to raise water levels, increase temperature stress, and/or increase periods of turbidity as a result of increases in wave heights and storm events which would limit growth of common eelgrass. Research has shown that sea surface temperatures within the Strait of Juan de Fuca have increased with the 1990s noted as the warmest decade on record since the 1840s; researchers expect the warming trend to continue (Snover et al. 2005). For more information on the effects of human disturbance, marine debris and contamination see Objective 2.2.

Objective 2.5 Protect and maintain salt marsh on Graveyard Spit
Annually, protect and maintain approximately 52 acres of salt marsh habitat within Graveyard Spit to benefit marine invertebrates, forage fish, and waterfowl. This habitat is characterized by the following attributes: • Vegetation dominated primarily by American glasswort. • Infrequent inundation except at highest high tides. • Maximum of 40% coverage by driftwood. • Absence of man-made or natural fires. • Absence of creosote-covered logs. • <1% invasive plant species (e.g., *Spartina*) cover. • No human disturbance year-round (see Objective 5.2).
Strategies Applied to Achieve Objective
Management Strategies:
a. Maintain year-round public use closure (see Objective 5.2).
b. Monitor, and if found, remove invasive species (e.g., *Spartina*) immediately.
c. Continue full fire suppression.
d. Remove 90% of known creosote-covered logs by 2020.
e. Annual marine debris removal in salt marsh habitats.
f. Use IPM strategies including mechanical, physical, biological, and chemical means to eradicate, control, or contain invasive species (see Appendix G).
g. Rapid response to oil spills or other contaminant events in Dungeness Bay and Dungeness Harbor in accordance with the Strait of Juan de Fuca Geographic Response Plan.
Monitoring Strategies (see also Goal 4):
h. Study key ecological attributes (hydrological flows and tidal elevation/cycles) and their effects on sedimentation rates (accretion/erosion) as well as driftwood recruitment.
i. Identify use and assess the value of these wetlands as nursery areas for marine invertebrates.
j. Invasive species monitoring (e.g., *Spartina*). See Appendix G.
k. Monitor creosote-covered log deposition.
l. Assess the number of breeding pairs in the gull colony at the tip of Graveyard Spit.

m. Work with partners to study environmental factors that are climate change related stressors (e.g., ocean acidification, changes to the vegetative community due to increased inundation, etc.).

Rationale: Salt marshes are among the most productive ecosystems on earth because they contribute greatly to the base of the food chain. In the nearshore environment, this food chain starts with one-celled microscopic floating plants called phytoplanktonic algae. These algae are consumed by minute floating animals (zooplankton); anadromous and forage fishes; and marine invertebrate larvae to name a few. Phytoplankton production is especially high in the nearshore because of high nutrient concentrations resulting from decaying marsh vegetation. The resulting dissolved organic materials are flushed from the marsh by tides and wind into adjacent nearshore habitats (Gosselink 1980). Salt marshes are important components of the nearshore ecosystem for a host of other reasons. They serve as an import nursery for commercially important species such as marine invertebrates (e.g., Dungeness crab) which seek these areas for refugia. They filter pollutants (e.g., nitrogen) from the water and break them down into less harmful forms. In addition, they buffer inland areas from the damaging effects of severe storms and act as water reservoirs that may reduce flooding in surrounding uplands. Finally, salt marsh plants remove carbon from the atmosphere and store it as undecomposed materials in the soil. Yet despite their significance, approximately 70% of tidally influenced wetlands have been lost since the Puget Sound was first settled (PSP 2013).

Approximately 52 acres of salt marsh can be found on both the northern and southern ends of Graveyard Spit. In each salt marsh, one or two channels serve as the conduit for saltwater intrusion but the entire marsh is not typically flooded each day; inundation occurs on the highest of high tides. As with the barrier beach, these salt marshes contain a bulwark of driftwood along their northern borders which adds to the organic material available for decomposition and provides cover for marine invertebrates. The predominant plant covering these marshes is American glasswort.

The purpose of this objective is to protect the existing habitat within the scope of this plan. Management actions will remain the same and include maintaining a public use closure; assuring that the driftwood accumulation is preserved through full fire suppression; contaminants are reduced or eliminated through removal of creosote-covered logs; and rapid response to oil spills. Due to the limited extent of salt marsh habitats on the Refuge, minimal change is predicted as a result of sea level rise within the life time of this management plan (i.e., 2025 under the 1-meter 34.3-foot) rise scenario; Clough and Larson 2010). However, this model is in need of improvement, particularly increasing the accuracy of the habitat data layer used (e.g., the south marsh is not delineated) and incorporating effects from other stressors due to climate change. As a result, we plan studies to assess variables associated with climate change stressors (e.g., accretion, salinity, driftwood recruitment, etc.) and steps to improve geospatial data layers used in the model. For more information on the threat of sea level rise, creosote-covered logs and fire suppression see Objective 2.2. For more information on the threat of oil spills see Objective 2.4. The threat of human disturbance in salt marsh habitats on the Refuge is particularly relevant to the southern marsh which supports a small colony of breeding glaucous-winged gulls. For more information on human disturbance of marine birds and habitats, see Objective 2.2.

2.4.3 Goal 3. Enhance and/or protect freshwater wetlands for the benefit of wetland-dependent species.

Objective 3.1 Protect and maintain seasonal, freshwater wetlands on the Dawley and Dungeness units
Annually, protect and maintain small (<0.1 acre), seasonal freshwater wetlands located on the Dawley and Dungeness units for the benefit of amphibians, bats, and other wildlife species. These wetlands are characterized by the following attributes: • Conditions vary from dry in late summer to as high as 3 feet in spring. • Up to 80% short emergent vegetation (e.g., *Scirpus*, *Carex*, and *Juncus* spp.). • Up to 10% cover of downed woody debris from the shoreline into the wetland. • Absence of aquatic invasive plants and animals (e.g., American bullfrog, purple loosestrife, or Bohemian knotweed).
Strategies Applied to Achieve Objective
Management Strategies:
a. Use appropriate IPM techniques including mechanical, physical, biological, and chemical methods (see Appendix G) to control invasive or undesirable species.
b. Remove nonnative fish and American bullfrogs if present.
Monitoring Strategies (see also Goal 4):
c. Invasive species monitoring (e.g., American bullfrog, purple loosestrife, Bohemian knotweed). See Appendix G.
d. Conduct wetland inventory and hydrological assessment by 2015.
e. Collect baseline data on the distribution and abundance of amphibians and bats.
Rationale: These wetlands are classified by the USFWS as palustrine forested wetlands (wetlands <20 acres and <6.6 feet deep) which are considered a decreasing wetland type, particularly those of less than 5 acres (Cowardin et al. 1979, Dahl 2006, Johnson and O'Neil 2001). Approximately 31% of all wetlands have been lost in Washington State through the late 1970s (Dahl 1990). Within the Sequim Bay watershed, freshwater wetlands account for <1.5% of the land base (EDPU 2005). Small, ephemeral wetlands are important components of the landscape for amphibians as they provide refugia during dispersal or migration. As a result, amphibians have been identified as focal species for this habitat type. In addition, wetlands provide openings within the canopy for bats which feed on insects found in profusion around wetlands. A small (<0.05 acre) seasonal freshwater wetland is located in the uplands of the Dungeness Unit. This linear wetland is dominated by slough sedge and water hemlock and is surrounded by a red alder forest. In the winter months, it is capable of supporting two pools with 8-10 inches of standing water. A similar 0.05 acre seasonal freshwater wetland is located on the Dawley Unit. This wetland is deeper and holds water longer into the summer. These two wetlands appear to be healthy as indicated by the presence of amphibians, native vegetation, and aquatic invertebrates. The amount of water and consequently, persistence into the summer season varies with the level of precipitation throughout the year. As a result, these wetlands are threatened by climate change induced alteration of temperature and precipitation cycles. These strategies are designed primarily to acquire more information about the seasonal condition and use of these wetlands, which will further guide management actions. Because most amphibians require two or more different habitat types in close proximity during their life cycle, forest management will incorporate spatial and seasonal restrictions suggested by Pilliod and Wind

(2008). More active management for amphibians and their habitats is intended to aid them in adapting to climate change by providing refugia in the form of habitat free of other stressors. For more information, see Objective 1.2.

Objective 3.2 Protect and maintain riparian corridor and instream habitat on the Dawley Unit

For the benefit of anadromous and resident fish and instream amphibians, protect and maintain ¼ mile of instream habitat in Dean Creek on the Dawley Unit. Ideal instream habitat is characterized by the following attributes:

- Intact riparian corridor providing stream surface shade of 60-80%.
- Overstory riparian vegetation characterized by red alder, bigleaf maple, Douglas-fir, and western redcedar.
- Understory riparian vegetation characterized by Pacific rhododendron, salal, salmonberry, and sword fern.
- <10% cover of invasive plants.
- Low amounts of fine sediments.
- Cool temperatures (<73°F) with a preferred temperature range (40-58°F).
- Well-oxygenated water, with dissolved oxygen levels >5 parts per million.
- Instream presence of large woody debris.

Strategies Applied to Achieve Objective

Management Strategies:

a. Initiate measures to stabilize the slope along the upper reaches of the main road within the riparian corridor.

b. Partner with upstream land managers to improve and protect water quality within the riparian corridor.

c. Use appropriate IPM techniques including mechanical, physical, biological, and chemical methods (see Appendix G) partnering with others to control invasive or undesirable species.

Monitoring Strategies (see also Goal 4):

d. Invasive species monitoring. See Appendix G.

e. Assess instream habitat for anadromous and resident fish suitability by 2013.

f. Conduct hydrological assessment of the Dawley Unit by 2015.

g. Collect baseline data on the distribution and abundance of amphibians and instream fish.

Rationale: Dean Creek is an intermittent stream that drains 3 square miles of land within the Sequim Bay Watershed (EDPU 2005). Approximately 0.25 mile of Dean Creek runs through the Dawley Unit beginning at river mile 0.6 on the eastern boundary. The western half of the creek within Refuge boundaries is dominated by cascades (ranging from 1-6 feet tall) with a few small pools (<3 foot diameter) and averages 3 feet wide during a high flow period in late March 2011. Most of the small pools are ~1-1.5 feet deep; however there are a few larger pools that are deeper. The eastern half of the creek is primarily made up of riffles and widens to approximately 8 feet wide and is 1 foot deep on average during high flow periods. The banks of this creek are very steep and the substrate is primarily loose gravel covered by a thick layer of forest humus. According to the Elwha-Dungeness Watershed Plan (EDPU 2005), impassable fish barriers are located at river mile 0.5 and 1.2. The plan also notes that fish passage can be severely limited at the confluence with the bay during the spawning period due to extreme low flows which often go underground near the bay.

There are three families of amphibians endemic to the Northwest that breed and deposit eggs in small streams (less than 6 feet wide). Dean Creek has the potential to support four of these secretive species: Cope's giant and Olympic torrent salamanders, and Cascades and coastal tailed frogs. These species require rocky, fast flowing streams that provide cool, oxygenated water and forested canopy cover that provides shade and leaf litter which nourishes aquatic insects. The creek supports coho and cutthroat trout. Unknown species of resident fish have been noted in the stretch of Dean Creek that runs through the Refuge (EDPU 2005). In addition, many other species of wildlife use riparian corridors for dispersal.

The objectives listed above are designed to improve instream water quality for resident fish and instream amphibians that can be found on Refuge lands as well as conditions encountered by anadromous fish that may use the creek as spawning habitat. Priority strategies include closing the main road at approximately mile point 0.95 and stabilizing a slide area that is located along the western boundary of this unit. Minimal to no forest management strategies will be recommended in the riparian area due to steep, unstable slopes. For more information on road closure and forest management, see Objective 1.2. Other important strategies include collecting data on the presence/absence of species in the instream habitat and delineating the immediate riparian habitat, which will then drive riparian habitat management.

Objective 3.3 Enhance and maintain the managed wetland on the Dawley Unit

Annually, enhance and maintain up to 0.39 acre within the freshwater impoundment on the Dawley Unit for the benefit of amphibians, bats, and other wildlife species. This impoundment will be managed for the following attributes:

- Up to 80% short emergent vegetation (e.g., *Scirpus*, *Carex*, and *Juncus*).
- <20% of tall emergent vegetation (e.g., cattail).
- 10% cover of partially submerged, downed woody debris along the shoreline .
- <30% cover of shrubs and trees on the shoreline (e.g., salmonberry, western redcedar, and western hemlock saplings).
- Absence of invasive and nonnative species (e.g., American bullfrogs and nonnative fish).

Strategies Applied to Achieve Objective

Management Strategies:

a. Maintain water delivery system to impoundment.

b. Map the bathymetry (i.e., delineate the benthic layer) of the impoundment.

c. Install new water control structure and water gage.

d. Maintain a minimum pool level but manage for optimum pool level and benthic layer characteristics for amphibian egg development from December through early May. This may involve shoreline contouring and water level control.

e. Remove nonnative fish and American bullfrogs if detected.

f. Manage emergent vegetation and partially submerged downed woody debris for egg attachment and concealment from predators (once key species are identified).

g. Clear all woody vegetation on the dike along the southern edge of the impoundment to maintain structural integrity.

h. Manage woody vegetation along the north, east, and western edges of the impoundment for optimal temperature and shading (once key species are identified through baseline surveys).

i. Use appropriate IPM techniques including mechanical, physical, biological, and chemical methods (see Appendix G) to control invasive or undesirable species.

Monitoring Strategies (see also Goal 4):

j. Invasive species monitoring. See Appendix G.

k. Conduct hydrological assessment of relationship between impoundment and domestic water source (spring box).

l. Collect baseline data on the distribution and abundance of amphibians and bats.

Rationale: The previous land owner developed the impoundment for fire suppression, irrigation, and waterfowl use. Along with the donation of the land came the owners' existing water rights to Dean Creek. Since this property was donated to the Refuge, staff has exercised these rights by utilizing the existing water delivery system to the impoundment for similar purposes. This involves maintaining water levels to a maximum depth of 7 feet year-round. This objective will alter the primary purpose to providing amphibian habitat, which will entail varying and lowering water levels depending on the species encountered.

In Washington, 46% of native amphibians are considered of special concern and many species of concern are forest-dependent species that have become locally extinct (Blaustein et al. 1995). Numerous amphibians are long-lived and reach sexual maturity after years of growth. Their dispersal or migration distance is limited to the immediate area around their breeding ponds, streams, or forests. Loss of habitat, habitat degradation, and fragmentation all pose serious threats to amphibians. Because their skins are permeable, amphibians are more susceptible to habitat degradation through pollution and changes in air, water, and soil moisture as well as temperature than most forest species. Many amphibians are particularly sensitive to UV-B exposure with potential effects including mortality, slowed growth, or deformities (NatureServe 2011). As a result, they are highly susceptible to climate change and the effects may be exacerbated due to their limited dispersal distance. In addition, they typically require more than one habitat type for their life history needs. For instance, many amphibians lay their eggs in ponds, the larva develop and then metamorphose in those same ponds. They then spend their adult life in the forests within a ½ mile of those ponds, returning in later years to lay eggs and the cycle continues. Thus, providing suitable habitats in close proximity is important, particularly to maintaining adult survival.

This objective is intended to provide freshwater wetland in forested habitats in an area that is lacking in this important resource (<1.5% of the land area in Sequim Bay Watershed is listed as freshwater wetland). The primary benefiting species include 7 species of amphibians that may use the impoundment during all or a portion of their life cycle. Forest bats may also benefit as this type of habitat provides suitable foraging habitat. Improved management of the impoundment for the benefit of amphibians will allow us to provide habitat free of nonnative predators (i.e., American bullfrogs and fish) in an area where pollution and human use can be limited. This may become increasingly important as the myriad of effects of climate change become apparent. The strategies are designed to first collect baseline data on amphibian presence/absence and diversity as well as hydrologic information for use in determining optimum (most suitable level to sustain populations) and conservation (minimal level to sustain populations) pool levels. Management actions will be dependent on species found and may include installation of a water control structure and contouring of the benthic layer, if necessary, to assure that a conservation pool level can be provided. A 30- to 50-foot woody and herbaceous vegetative buffer with a down woody component will be maintained around the shoreline to provide cover from predators and maintain moisture levels. An additional buffer will be established for use during active forest management to minimize disturbance and siltation due to management actions (see Objective 1.2).

2.4.4 Goal 4. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions under objectives for Goals 1-3.

Objective 4.1 Conduct and facilitate surveys
Throughout the life of the CCP, conduct high priority inventory and monitoring (survey) activities that evaluate resource management and public-use activities to facilitate adaptive management. These surveys contribute to the enhancement, protection, use, preservation, and management of wildlife populations and their habitats on- and off-Refuge lands. Specifically, they can be used to evaluate achievement of resource management objectives identified in Goals 1-3 in this CCP. These surveys have the following attributes: • Data collection techniques will likely have minimal animal mortality or disturbance and minimal habitat destruction. • Minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) to meet statistical analysis requirements will be collected for identification and/or experimentation in order to minimize long-term or cumulative impacts. • Proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary, will minimize the potential spread or introduction of invasive species. • Projects will adhere to scientifically defensible protocols for data collection, where available and applicable.
Strategies Applied to Achieve Objective
a. Conduct regular invasive species surveys to guide IPM (see all Objectives for Goals 1-3).
b. Annually monitor for derelict gear and/or creosote-covered log deposition in nearshore habitats (see Objectives 2.2-2.5).
c. Continue to collect data from bird counts (Christmas Bird Count, breeding bird surveys, and Mid-winter Waterfowl, overwintering and migrant shorebird surveys) on the Dungeness Unit (see Objectives 1.1, 2.2, 2.3).
d. Conduct periodic surveys in the forested habitat on the Dawley Unit to assess the success of forest management (e.g., bat, amphibian and vegetative surveys, etc.; see Objective 1.2).
e. Determine frequency of survey effort and monitor the distribution and density of common eelgrass on the Refuge (see Objective 2.4).
Rationale: National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C. 668dd-ee) requires that refuges "monitor the status and trends of fish, wildlife, and plants in each refuge." Surveys will be used primarily to evaluate resource response to and assess progress toward achieving Refuge management objectives (under Goals 1-3 in this CCP) derived from the NWRS Mission, Refuge purpose(s), and maintenance of biological integrity, diversity, and environmental health (601 FW 3). Determining resource status and evaluating progress toward achieving objectives is essential to implementing adaptive management on Department of Interior lands as required by policy (522 DM 1). Specifically, results of surveys will be used to refine management strategies, where necessary, over time in order to achieve resource objectives. Surveys would provide the best available scientific information to promote transparent decision-making processes for resource management over time on Refuge lands.

Objective 4.2 Conduct and facilitate research

Throughout the life of the CCP, conduct high-priority research projects that provide the best science for habitat and wildlife management on- and off-Refuge. Scientific findings gained through these projects will expand knowledge regarding life-history needs of species and species groups as well as identify or refine habitat and wildlife management actions. Research also will reduce uncertainty regarding wildlife and habitat responses to Refuge management actions in order to achieve desired outcomes reflected in resource management objectives and to facilitate adaptive management. These research projects have the following attributes:

- Adhere to scientifically defensible protocols for data collection, where available and applicable, in order to develop the best science for resource management.
- Data collection techniques will likely have minimal animal mortality or disturbance and minimal habitat destruction.
- Collect the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) to meet statistical analysis requirements for identification and/or experimentation in order to minimize long-term or cumulative impacts.
- Utilize proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary, to minimize the potential spread or introduction of invasive species.
- Often result in peer reviewed articles in scientific journals and publications and/or symposiums.

Strategies Applied to Achieve Objective

a. Work with partners to study environmental factors that are climate change related stressors (e.g., accelerated erosion due to sea level rise, increased frequency and severity of storm events, and/or erosion induced by excessive surface water runoff) on nearshore habitats of Dungeness and Graveyard spits (see Objectives 2.1-2.5).

b. Work with partners to study aspects of mudflat habitat quality (e.g., macro- and micro-invertebrate abundance and distribution; water quality; and forage fish abundance and distribution; see Objective 2.3).

c. Continue existing research projects (e.g., Caspian tern colony productivity; sediment dynamics at the base of Dungeness Spit and large woody debris monitoring in conjunction with Elwha nearshore habitat studies) through to agreed-upon end dates.

d. Study the value of salt marsh habitat on Graveyard Spit RNA as a nursery area for crab and other wildlife (see Objective 2.5).

e. Study key ecological attributes of salt marsh habitat (hydrological flows and tidal elevation/cycles) and their effects on sedimentation rates (accretion/erosion) as well as driftwood recruitment (see Objective 2.5).

f. Study microhabitat characteristics (e.g., species, percent cover) to track changes in distribution and diversity of plant species in the Graveyard Spit RNA (see Objective 2.2).

g. Track common eelgrass distribution and density (see Objective 2.4).

Rationale: Research projects on Refuge lands will address a wide range of natural and cultural resource as well as public-use management issues. Examples of research projects include habitat use and life-history requirements for specific species/species groups, practical methods for habitat management and restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, identification and analyses of paleontological specimens, modeling of wildlife populations, and assessing response of habitat/wildlife to disturbance from public uses. Projects may be species or Refuge specific, or evaluate the relative contribution of the Refuge to larger landscape (e.g., ecoregion, region, flyway, national, international) issues and

trends. Like monitoring, results of research projects will expand the best available scientific information and potentially reduce uncertainties to promote transparent decision-making processes for resource management over time on Refuge lands. In combination with results of surveys, research will promote adaptive management on Refuge lands. Scientific publications resulting from research on Refuge lands will help increase the visibility of the NWRS as leader in the development of the best science for resource conservation and management.

Objective 4.3 Conduct and facilitate scientific assessments

Throughout the life of the CCP, conduct scientific assessments to provide baseline information to expand knowledge regarding the status of Refuge resources to better inform resource management decisions. These scientific assessments will contribute to the development of Refuge resource objectives and they will also be used to facilitate habitat restoration through selection of appropriate habitat management strategies based upon site-specific conditions.

- Utilize accepted standards, where available, for completion of assessments.
- Scale and accuracy of assessments will be appropriate for development and implementation of Refuge habitat and wildlife management actions.

Strategies Applied to Achieve Objective

a. Conduct forest assessment on the Dawley Unit (e.g., percent canopy closure, tree species, understory species, DBH of live trees, DBH and height of snags, snag density; see Objective 1.2).

b. Conduct baseline forest inventory on the Dungeness Unit (see Objective 1.1).

c. By 2018, collect baseline data on the distribution and abundance of amphibians and bats that are using forested and wetland habitats on the Dungeness and Dawley units (see Objectives 1.1, 1.2, 3.1, 3.2, 3.3).

d. Assess the distribution and abundance of Lepidopterans (i.e., sand-verbena moth and Taylor's checkerspot) on Graveyard and Dungeness spits (see Objective 2.2).

e. Assess the number of breeding pairs in the gull colony at the tip of Graveyard Spit (see Objective 2.5).

f. By 2013, assess instream habitat for anadromous fish suitability and collect baseline data on presence/absence of fish and instream amphibians (see Objective 3.2).

g. Conduct a wetlands inventory (Dawley Unit) and hydrological assessment (Dawley and Dungeness units) by 2015 (see Objectives 3.1-3.3).

h. Conduct road inventory and condition assessment (Dawley Unit) by 2016 (see Objective 1.2).

Rationale: In accordance policy for implementing adaptive management on Refuge lands (522 DM 1), appropriate and applicable environmental assessments are necessary to determine resource status, promote learning, and evaluate progress toward achieving objectives whenever using adaptive management. These assessments will provide fundamental information about biotic (e.g., vegetation data layer) as well as abiotic processes and conditions (e.g., soils, topography) that are necessary to ensure that implementation of on-the-ground resource management achieve resource management objectives identified under Goals 1-3.

2.4.5 Goal 5. Visitors feel welcomed and know they are on a national wildlife refuge as well as where they can safely explore and learn more about the diversity of wildlife, while being good wildlife stewards. As a result, visitors will have a memorable experience and leave the Refuge with a greater connection between themselves and nature.

Objective 5.1 Enhance visitor orientation
Throughout the life of the CCP, provide visitors of all ages and abilities an integrated setting of welcome and orientation facilities and programs. Successful visitor orientation at the Refuge is characterized by: • >75% of visitors greeted at entrance. • 100% of Refuge visitors know they are on a national wildlife refuge and that Dungeness Spit is part of the Refuge. • >95% of Refuge visitors understand that "wildlife comes first" on wildlife refuges, recognize that humans and pets disturb wildlife and their habitat, and can identify at least one negative impact from human/pet disturbance. • >95% of Refuge visitors know how to minimize wildlife disturbance by practicing proper trail etiquette. • >50% of visitors know there are other refuges in the Washington Maritime National Wildlife Refuge Complex and where to find information about those refuges including the complex headquarters location and additional information about Dungeness NWR.
Strategies Applied to Achieve Objective
Management Strategies:
a. Volunteers welcome and orient visitors at the entrance station during the peak visitation season (April 1-September 30). Increase volunteer time to 1,200 hours per year.
b. Staff members welcome and orient visitors. Increase staff time to 520 hours per year.
c. Maintain signs to greet and inform visitors.
d. Continue to use and maintain interpretive materials including display panels and brochures.
e. Develop trail etiquette materials.
f. Replace existing signage with a new Refuge map and regulations panel at Cline Spit boat launch.
g. Replace existing signage with a new Refuge map and regulations panel at Dungeness Landing boat launch.
Monitoring Strategies:
h. Track volunteer and staff hours spent welcoming and orienting visitors.
i. Informal visitor contact and tracking to determine percentage of visitors.
Rationale: The Dungeness NWR is one of the busiest refuges in the region. Trained volunteer greeters can disseminate information about Refuge purposes and resources and are an effective means to actively engage with the public. Using volunteer greeters during the busiest visitation times–April 1 to September 30–can augment the passive orientation signs, interpretive materials, and staff presence. Greeters may also be effectively used during busy winter holiday weekends, as well. In less busy times, interpretive signage and displays continue to provide visitors with a passive opportunity for orientation and learning. Using trained greeters creates a valuable opportunity to teach visitors about the Refuge and the Refuge System, including how to be good resource stewards and how to minimize human impacts on wildlife. Trail etiquette materials would provide Refuge visitors guidelines on how to minimize wildlife disturbance.

Objective 5.2 Manage Refuge access
Throughout the life of the CCP, allow managed foot and motorized and nonmotorized boat access to Dungeness NWR so that people of all ages and abilities may learn about and experience Refuge wildlife and habitats while minimizing adverse impacts to Refuge resources. Ideal Refuge visitor access understanding is characterized by: • 100% of the Refuge's pedestrian visitors knowing and using only open access points. • >95% of the Refuge's boating visitors knowing and using only open access points to the Refuge and 100% compliance with shoreline buffers.
Strategies Applied to Achieve Objective
Management Strategies:
a. Provide areas where visitors of all ages and different abilities can experience Refuge wildlife (Forested uplands and Zones 1-3 and 5).
b. Provide a year-round 100-yard boat landing area at the New Dungeness Light Station by reservation only. Limited to 20 boat landings per day. Boat landing hours limited to 9am to 5pm.
c. Maintain seasonal opening for public access along the first ½ mile of Dungeness Spit from May 15 to September 30 (Zone 2, Harbor side).
d. Provide seasonal openings for boat access to Refuge waters and tidelands from May 15 to September 30 (Zone 5).
e. Maintain public access closures including west bluffs, upland forest (except established trails), and all of Zone 4.
f. Continue temporary closures in portions of high-use areas when seal pups are present.
g. Replace existing signage with a new Refuge map and regulations panel at Cline Spit boat launch.
h. Replace existing signage with a new Refuge map and regulations panel at Dungeness Landing boat launch.
i. Maintain signs on pilings at Refuge water boundaries.
j. Maintain signs at Refuge boundaries and at closed areas.
k. Add regulation signage at lighthouse, lighthouse boat landing zone, and end of Dungeness Spit.
Monitoring Strategies:
l. Informal contact and tracking to determine compliance with access.
m. Number of access violations.
n. Number of boat landings at lighthouse compared with number of reservations.
Rationale: Dungeness Bay and Dungeness Harbor are very busy with commercial fishing and recreational boating activity. Both user groups tend to access the Refuge at areas that are not open to boat access. Increasing signage and information about appropriate and allowable means of accessing the Refuge would support the "Wildlife First" mandate while allowing access to the Refuge without causing unnecessary damage or disturbance. Many of our partners have identified human disturbance as a pervasive and serious threat to wildlife and their habitats (WDFW 2005, Mills et al. 2005, Rojek et al. 2007, Tessler et al. 2007, USFWS 2005b). Refuge visitation ranged from 76,000 to 80,000 visitors per year for the last five years. The majority of use occurs primarily May-September. This level of visitation in open areas or illegal trespass into closed areas cause stress and reduced productivity of wildlife on the Refuge. Pacific harbor seals that are pupping in open areas are vulnerable to human-caused disturbance particularly because peak pupping periods coincide with periods of high visitation (Boren et al. 2003, Sanguinetti 2003). Disturbance can reduce fitness or increase mortality, especially during molt or nursing. Several studies have noted that pinnipeds have a disproportional, negative response to approaches by kayaks in contrast to other recreational vessels (Szaniszlo 2001, Grella et al. 2001) potentially due to the stealthy, low profile approach of a kayak. In addition, human disturbance can displace overwintering dunlin and

brant. Human disturbance also affects nearshore habitats. Public use closures protect the integrity of habitat and reduce introduction of invasive species. For example, Graveyard Spit is closed to protect fragile strand plant communities from trampling, inadvertent introduction of invasive plant species, and illegal fires. In addition, the majority of invasive plant species on this Refuge can be found within the area surrounding the New Dungeness Light Station and an abandoned Navy facility on Graveyard Spit, areas of historically high public use.

While it is important to have undisturbed areas for wildlife to rest and feed, it is also important for visitors to experience and learn about Refuge wildlife. There are opportunities to allow access to less-sensitive habitats and/or habitats at less-sensitive times of the year.

The designated boat landing area on the beach directly south of the New Dungeness Light Station is the only place boats are allowed to land in the Refuge and is intended to provide visitors who wish to visit the historic lighthouse with an alternative to hiking the spit. It also provides lighthouse access at high tide when hiking the Dungeness Spit may not be practical and an alternative for those who are unable to make the 11-mile round trip hike. It is not intended to be an alternate access point for the Dungeness Spit and areas adjacent to the landing are closed to reduce wildlife disturbance. The lighthouse is open to visitation from 9am to 5pm daily; consequently, boat landings on the Refuge are limited to the same times. This restriction is not intended to apply to the USCG or others during emergencies or other coordinated activities.

This objective supports continued access for Tribes to exercise their adjudicated treaty rights.

Objective 5.3 Improve compliance with Refuge regulations

The purpose of Refuge regulations is to protect human health and safety, wildlife, and habitat. Throughout the life of the CCP, enhance Refuge visitors' understanding and compliance of Refuge regulations. Visitor understanding would be exhibited by:

- Decreasing the occurrence of violations observed or reported by 50% over the next 5 years.
- Pet owners being 100% compliant with the no-pets-allowed regulations.
- Zero occurrences of trespassing on bluffs.
- Zero occurrences of inappropriate and incompatible recreational uses (e.g., kite-flying, jet skiing, wind surfing, ball/Frisbee tossing, camping, campfires, after hours trespass, etc.).

Strategies Applied to Achieve Objective

Management Strategies:

a. Maintain existing regulatory and guidance signs.

b. Replace regulatory and guidance signs at lighthouse boat landing and end of Dungeness Spit.

c. Provide information about Refuge regulations at trailhead kiosks (e.g., tear sheets, map panels, and Refuge brochures).

d. Increase law enforcement patrols (deterrents, warnings, citations).

e. Staff, volunteer greeters, and trail rovers provide information to visitors.

f. Formalize Refuge-specific public use regulations.

Monitoring Strategies:

g. Informal contact and tracking to determine compliance with Refuge regulations.

h. Number of violations.

i. Number of staff-hours dedicated to ensuring visitor compliance with Refuge regulations (e.g., law enforcement patrols, visitor contacts).

Rationale: The Dungeness NWR is situated adjacent to a County recreation area and visitors do not always understand when they are using the County park/recreation area versus the Dungeness

NWR. Therefore, visitors do not always recognize when they have entered an area in which wildlife is the highest management priority, as opposed to recreation. Clearly communicating Refuge regulations contributes to the objective of protecting both human health and safety as well as protecting wildlife and habitat from disturbance. In addition, a greater understanding and appreciation of Refuge resources can ensure that visitors have the least amount of impact on wildlife. Providing safe Refuge access and minimizing wildlife and habitat disturbance is expected to contribute to a high-quality visitor experience.

2.4.6 Goal 6. Visitors have the opportunity to participate in safe, quality wildlife-dependent recreation programs and compatible nonwildlife-dependent recreation activities while minimizing wildlife disturbance in the face of increasing Refuge visitation. Programs and activities, including interpretation, environmental education, wildlife observation and photography, and fishing, will focus on enhancing public understanding and appreciation of wildlife and cultural resources while building support for the Refuge.

Objective 6.1 Provide high quality interpretation of Refuge habitats and processes
Actively and passively interpret Refuge habitats and processes for the public throughout the life of the CCP so that the following objectives are met: • >60% of Refuge visitors can name the main habitat types associated with the Refuge's shoreline, coastal forest, and bay (eelgrass beds) areas. • >50% of Refuge visitors can name at least one species associated with each Refuge habitat type. • >40% of visitors are aware of the Refuge's unique geomorphology • >40% of visitors can identify at least one potential impact to the Refuge as a result of climate change
Strategies Applied to Achieve Objective
Management Strategies:
a. In coordination with partners, develop new interpretive panels at lighthouse.
b. Maintain and update Refuge interpretive brochures, as necessary.
c. Create at least one permanent interpretive product that includes Refuge-specific climate change information.
d. Use trained and/or subject matter expert volunteers to present programs and/or information about the resources and processes of the Refuge.
e. Develop and present 2-5 interpretive programs per year focusing on Dungeness NWR wildlife and habitats, Dungeness Spit geomorphology, and Refuge-related cultural resources.
f. Create an environmental education/outreach specialist position and offer guided interpretive programs.
Monitoring Strategies:
g. Informal visitor contacts and tracking.
h. OMB-approved survey.
Rationale: There are tremendous opportunities to teach visitors about the Refuge and its wildlife resources in an informal setting, outside of formal education programs. Doing so can instill a greater appreciation for the Refuge, its wildlife, and their habitats. An additional staff member would develop, facilitate, and coordinate interpretive programs. In addition, the greater Sequim

community includes many habitat- and resource-specific specialists that regularly engage their expertise with the Refuge. It is a region that attracts a disproportionally high number of retirees from the environmental and resource management or education fields. The Refuge can capitalize on these relationships to enhance interpretive programs.

Objective 6.2 Provide high quality interpretation of human history

Human history is an important part of the Salish Sea including both Native American presence and early European exploration and settlement of the Dungeness area. Visitors to the Refuge can enhance their awareness and understanding of local history through self-guided and Refuge-led interpretation provided throughout the life of the CCP. To meet this objective:

- >70% of visitors would know that Native Americans have inhabited the area and used its resources since prehistoric times and that they continue to use Refuge waters and tidelands to harvest aquatic resources.
- Visitors know that early European exploration and settlement of the Salish Sea and its shores brought dramatic change to the area.

Strategies Applied to Achieve Objective

Management Strategies:

a. Partner with interested Tribe(s) to deliver education, interpretation materials, and 1 interpretation program per year that focus on Refuge and area Native American culture.

b. Annually provide at least 1 Refuge interpretive product(s) or program(s) that focus primarily on the general human history of the area.

c. All appropriate Refuge educational products include interpretation of cultural resources.

Monitoring Strategies:

d. Number of interpretive products or programs provided per year.

e. Informal visitor contacts and tracking.

Rationale: Although the Refuge is managed for wildlife first, it is also important for visitors to understand the human history and its influence upon the lands and waters of the Salish Sea. Native Americans continue to have and exercise treaty rights to harvest resources in the Salish Sea, including in/on Refuge-managed waters and tidelands.

Objective 6.3 Provide high quality interpretation of the New Dungeness Light Station and maritime history

Throughout the life of the CCP, promote high quality interpretive opportunities for visitors to enjoy and appreciate the New Dungeness Light Station and its important role in maritime history. To meet this objective:

- >50% of visitors would know that the New Dungeness Light Station is more than 150 years old.

Strategies Applied to Achieve Objective

Management Strategies:

a. Partner with the New Dungeness Light Station Association (NDLSA), USCG, and others to provide opportunities to learn about the lighthouse.

b. Continue to provide a designated boat landing area near the lighthouse.

c. Volunteers provide basic information about the light station and inform visitors how to access the light station.

d. Continue to allow NDLSA motorized vehicle access to the New Dungeness Light Station facilities for the purpose of volunteer lighthouse keeper exchanges and facilities maintenance as specified in an MOU between the NDLSA and the Refuge.

e. Continue to coordinate with USCG to allow Aids to Navigation maintenance personnel motorized access for lighthouse servicing and repair.
f. In the event that the USCG declares the light station property excess to its needs, the Service will work with the USCG to bring the light station property into the Refuge System and enter into formal agreement with NDLSA to continue to manage and maintain the light station facilities.
Monitoring Strategies:
g. Informal visitor contact and tracking.
Rationale: The New Dungeness Light Station was first lit in 1857 and was the second lighthouse established in the Washington territory. Consequently, the Service and its partners aim to inform visitors about the historic and present significance of the light station. There are two ways to access the light station: by foot and boat. Strategies under this objective support the continued maintenance of the designated boat landing at the light station to accommodate access by boaters. The light station facilities are currently owned by the USCG and managed and maintained by the NDLSA. The Refuge is interested in acquiring the light station facilities when the USCG is prepared to excess them. The Refuge recognizes the NDLSA as an important and valued partner and would be interested in NDLSA continuing to manage and maintain the light station. The Refuge's interest is in the wildlife value of the overall property within the Refuge setting and recognizes there is also an important cultural value to be maintained, including its role as an iconic symbol of the area.

Objective 6.4 Enhance environmental education programs
Throughout the life of the CCP, provide quality environmental education programs to community groups and schools. Through the Refuge environmental education program, instill a stewardship value in program participants exhibited by the following characteristics: • >90% of environmental education program participants learn that the main habitat types associated with the Refuge are shoreline habitat, coastal forest habitat, and eelgrass beds (bay) habitat. • >80% of environmental education program participants can name at least one species associated with each habitat type. • >80% of environmental education program participants know how the spit is formed (Refuge geomorphology). • >80% of environmental education program participants know at least one potential impact of climate change to the Refuge.
Strategies Applied to Achieve Objective
Management Strategies:
a. Facilitate other organizations' abilities to teach students about Refuge resources (e.g., permits and fee waivers, environmental education material packets, teacher training programs, etc.).
b. Develop partnerships with universities, the Friends of Dungeness NWR, and other interested organizations to provide educational materials and programs about the geomorphology of the Refuge and regional issues associated with climate change.
c. Create an environmental education/outreach specialist position and offer education programs to primary and secondary level school groups on and off the Refuge.
Monitoring Strategies:
d. Post-program student assessment/evaluation.
Rationale: The Refuge is an ideal outdoor classroom where students have the opportunity to experience focused study of a variety of interdependent habitats and their associated wildlife, the unique geomorphology of the area, and the potential impacts of climate change on a coastal

environment. Cultural history can also be incorporated into environmental education programming. Cultural history as explored in the setting of a wildlife refuge is about how people have interacted with, shaped, and been influenced by the environment (e.g., native uses of plants for food, shelter, and tools; the cultural significance of certain animal species for food, identity, etc.; and traditional management and/or harvesting activities such as fish weirs or controlled burning) (also see Objective 8.2).

Learning about the Refuge can instill a sense of stewardship among students and foster a greater appreciation for the National Wildlife Refuge System. Because Refuge staff and funding resources are limited, the Refuge can benefit from increased staff and partnering with other organizations to deliver the environmental education programs. The Refuge environmental education program can augment other institutions' programs by providing a real-world situation in which to observe textbook learning.

Objective 6.5 Promote opportunities for wildlife observation and photography

Throughout the life of the CCP, promote opportunities in which visitors can observe and photograph Refuge wildlife and habitats, especially species for which the Refuge is important (e.g., brant, bald eagles, and shorebirds, etc.). A quality experience would be exhibited by:

- >80% of the visitors seeking to observe and photograph Refuge wildlife knowing what species might be observed on the Refuge.
- >50% of visitors to the Refuge knowing when (seasonally and temporally) and where the best wildlife viewing opportunities are and how to maximize those opportunities.
- >90% of visitors to the Refuge knowing how to observe wildlife without causing disturbance to the wildlife or its habitat features.

Strategies Applied to Achieve Objective

Management Strategies:

a. Maintain observation decks with viewing scopes.

b. Use volunteer greeters as a resource to inform visitors of recent wildlife sightings and potential observation locations.

c. Maintain wildlife checklist for the Refuge.

d. Update and enhance wildlife checklist to include habitat associations for various species groups.

e. Maintain Refuge brochure to include wildlife observation areas including species and habitat type associations.

f. Partner with interest groups to develop ≥ 5 wildlife observation walking tours with naturalists per year.

g. Seasonal wildlife identification guide exhibit.

h. Recreational beach use incidental to wildlife observation and photography allowed from west Refuge boundary to ½ mile (Zone 1 and Strait side of Zone 2). Permitted activities are defined as: wading, picnicking and sunbathing.

i. Horseback riding incidental to wildlife observation and photography allowed on west beach (Zone 1) with stipulations if a safe and legal alternate access route can be obtained from the west or from the east of the Refuge. If an alternate route is obtained from the east then horseback use of the administrative road from the gate separating the Refuge from the private landowner to the east will also be allowed. Horseback riding will be by advance reservation only. Party size will be limited to no more than 4 horses to prevent resource damage, overcrowding and ensure public safety. Allowed daily, October 1-March 31, and weekdays, April 1-September 30. No horseback riding on Memorial Day, the Fourth of July, and Labor Day. Horses must walk (no trotting, cantering, or galloping). Pedestrians have right-of-way.

j. Jogging allowed only on west beach (Zone 1) and on the trail adjacent to the Refuge parking lot. Use is limited to daylight hours only. Organized running groups and running events will be prohibited. Groups will be limited to 3 people or less along the parking lot trail.
Monitoring Strategies:
k. Informal visitor contacts and tracking.
l. Number of violations (nonpermitted recreational activities and permitted activities outside of allowed beach use area).
Rationale: As two of our six priority wildlife-dependent public uses, wildlife observation and photography are important Refuge activities. Visitors' can be enhanced if they know where and when to observe particular species. Providing visitors up-to-date information and wildlife viewing tips can enhance their success in enjoying this activity on the Refuge. Enjoying these activities with a naturalist can also increase visitor knowledge and appreciation of Refuge wildlife resources. Naturalist guides can also broaden visitor understanding about how to reduce human disturbance to wildlife and how that enhances the viewing experience. Within this CCP process, existing public use activities were re-evaluated based on the refined criteria outlined under the appropriateness and compatibility policies. Our analysis has found that both horseback riding and jogging are appropriate and compatible activities when performed under certain stipulations (see Appendix B, Compatibility Determinations). While not one of the six wildlife-dependent public uses listed or identified in the National Wildlife Refuge System Administration Act, as amended (1997), horseback riding on the Dungeness NWR can facilitate wildlife observation. Allowing use on only the west beach (Zone 1) should reduce conflicts between user groups as this area historically sees limited public use. Although horseback riding can result in disturbance to wildlife, disturbance is expected to be intermittent and short-term and limited in time and space. There is more than an adequate amount of undisturbed habitat available to the majority of wildlife for escape and cover. Although jogging is not a wildlife-dependent public use of the Refuge, it is likely that some joggers observe and enjoy wildlife while on the Refuge. Occasional use of the west beach and trail adjacent to the parking lot is expected to have negligible impacts on wildlife or wildlife-dependent public uses. Potential for wildlife disturbance is minimal given the low level of use by wildlife and Refuge visitors in these areas. In addition, conflicts between joggers and wildlife-dependent public uses are expected to be low due to the low use of the west beach and trail adjacent to the parking lot by wildlife and subsequent low expectations of visitors to encounter wildlife in these areas.

Objective 6.6 Provide opportunities for quality fishing and shell-fishing
Throughout the life of the CCP, provide opportunities for visitors interested in fishing and shell-fishing to enjoy those activities with minimal disturbance to Refuge wildlife. Success would be exhibited by: • Boaters remaining 100 yards away from the mean high tide line and observing the no-wake regulation. • Anglers and shell fishers knowing and complying with fishing and shell-fishing access and harvest areas identified in Refuge-specific regulations.
Strategies Applied to Achieve Objective
Management Strategies:
a. Continue to provide seasonal access to Refuge waters and tide flats.
b. Install a Refuge map and regulations panel at Cline Spit and Dungeness Landing.

c. Maintain signs on pilings at Refuge water boundaries.
d. Partner with WDFW to include Refuge-specific fishing/shell-fishing information in the State fishing regulations pamphlet.
Monitoring Strategies:
e. Number of observed violations.
Rationale: The Refuge currently has few visitors that engage in fishing and shell-fishing activities because other higher-quality experiences are available nearby. The State manages harvest limits and seasons; the Refuge can provide access to fishing/shell-fishing for those visitors that are interested in this activity on the Refuge. Depending upon wildlife disturbance concerns during the State harvest seasons, the Refuge maintains the management option to limit access to fishing/shell-fishing areas located within the Refuge boundary.

2.4.7 Goal 7. Through Refuge outreach efforts local residents will have the opportunity to gain an understanding of and appreciation for the Refuge and Refuge System mission.

Objective 7.1 Conduct community outreach
Throughout the life of the CCP, conduct outreach to the public in an effort to promote understanding and awareness of the Dungeness NWR within the North Olympic Peninsula community. Desired outcomes are characterized by: • >90% of government and tribal officials, local citizens, and visitors to the area knowing of the Dungeness NWR and that it provides key habitat for a variety of wildlife, including migrating birds and marine mammals. • >80% of government and tribal officials and local citizens understanding the conservation mission of the National Wildlife Refuge System. • >90% of area boaters recognizing Dungeness Spit is a NWR and staying 100 yards from the mean high tide line to avoid disturbances to wildlife and their habitats. • >90% of airplane pilots knowing where the Dungeness NWR is located and maintain a 2,000-foot minimum ceiling above the Refuge. • Increased accuracy of local news articles about the Refuge and increased contact with local news sources by a Refuge media liaison.
Strategies Applied to Achieve Objective
a. Develop and distribute media packets to local news sources.
b. Increase media contact by the Refuge media liaison to improve communication conduits and information accuracy.
c. Publish >2 articles in local publications per year.
d. Deliver >5 presentations to local organizations per year.
e. Attend 3 community events per year and display Refuge exhibits and information.
f. Specifically target 2 media articles toward the boating and aviation communities per year.
g. Continue to work with the Friends Group to provide public outreach.
h. Work with the Friends Group to recruit volunteer speakers to give presentations to groups on behalf of the Refuge.
i. Routinely upgrade and improve Refuge website content, and add links to partners and other resources.
Rationale: Community outreach efforts can promote greater understanding and appreciation of the Refuge and the NWRS and can result in lower impacts to wildlife resources through increased visitor compliance.

Objective 7.2 Continue recruiting, training, retaining, and utilizing volunteers for support of Refuge programs and activities.
Build volunteer participation so that within 7 years, more than 150 active and engaged volunteers regularly participate in Refuge programs and projects on a recurring basis annually.
Strategies Applied to Achieve Objective
a. Continue to work with the Friends Group to provide volunteer opportunities. Increase number of regularly participating volunteers to 150 per year.
b. Conduct 7 beach clean-ups per year.
c. Effectively utilize volunteers to orient visitors, maintain facilities, monitor invasive species, control invasive plants, assist with biological program, and conduct community outreach.
d. Host 2-4 full-time volunteer caretaker(s).
e. Replace volunteer cabin on Dungeness Unit.
f. Provide annual new volunteer training.
g. Provide 2 returning volunteer orientations.
h. Provide >5 additional training opportunities to volunteers (e.g., project-specific, Refuge resources, area history, cultural resources, geology, etc.).
Rationale: The Refuge relies heavily on volunteers to serve as visitor contacts, assist with habitat projects, maintenance, and invasive species monitoring and control activities. Annually, volunteers contribute as many hours as full-time staff. Currently, the number of volunteers that participate on a recurring basis is estimated at 100. These repeat volunteers have an excellent knowledge of the Refuge and its resources, and often add value to the programs by working on more than one project and have a better understanding of the resource. For example, in recent years volunteers working on Feeder Watch and Christmas Bird Count also worked at the entrance station greeting visitors. Increasing this core of dedicated repeat volunteers would provide major benefits to both habitat management and public use programs.

2.4.8 Goal 8. Protect, preserve, evaluate and interpret the cultural heritage and resources of the Refuge while consulting with appropriate Native American groups and preservation organizations, and complying with historic preservation legislation.

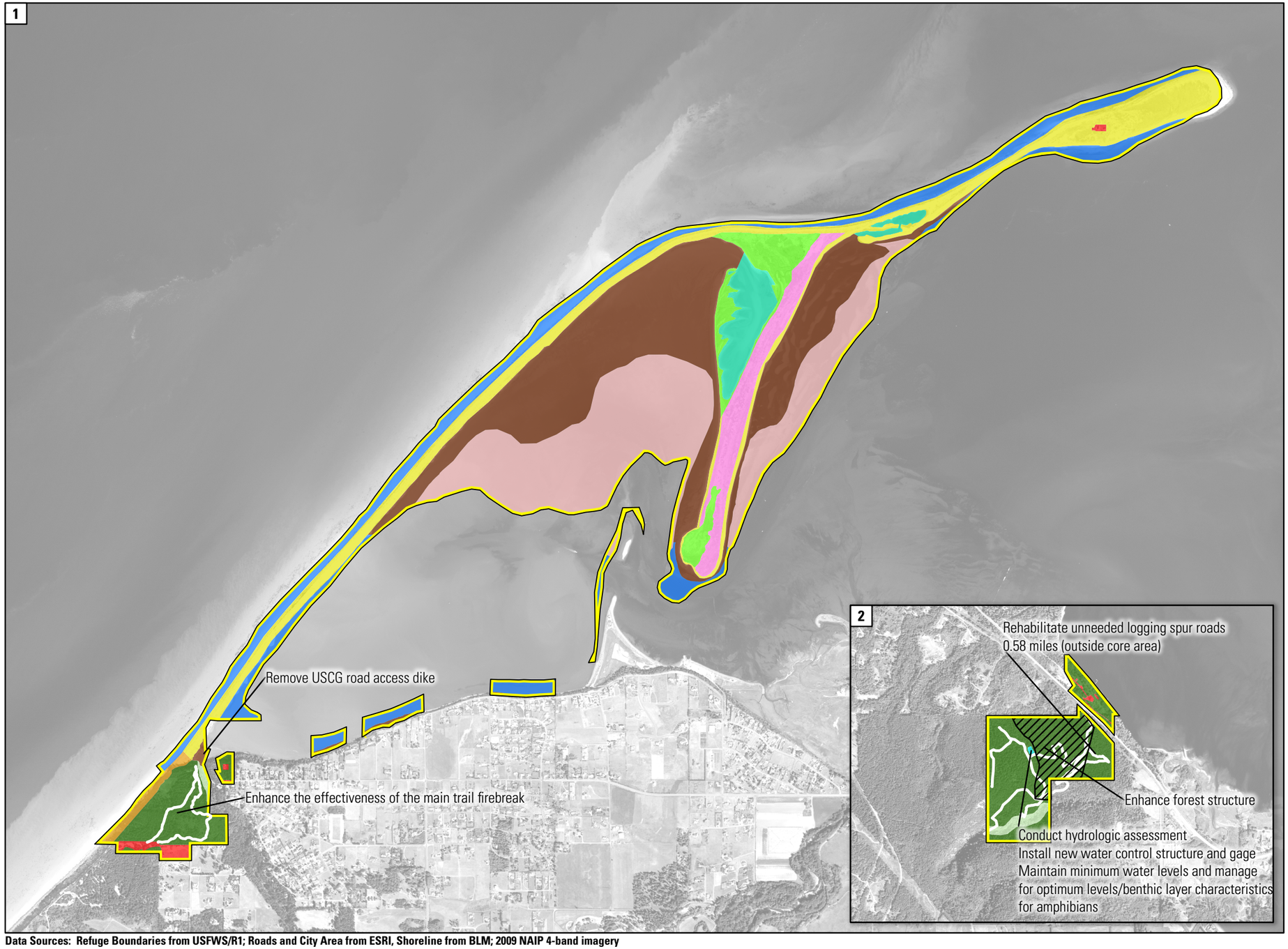
Objective 8.1. Implement a proactive cultural resource program.
Throughout the life of the CCP, implement a proactive cultural resources management program that focuses on meeting the requirements of the National Historic Preservation Act, including consultation, identification, inventory, evaluation, and protection of cultural resources.
Strategies Applied to Achieve Objective
a. Identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects. Evaluate threatened and impacted sites and structures for eligibility to the National Register of Historic Places. Prepare and implement activities to avoid and mitigate impacts to sites and structures as necessary.
b. Conduct systematic documentation and evaluation of historic buildings.
c. Implement a proactive historic preservation program to evaluate eligibility to the National Register of Historic Places of those archaeological sites and historic-era structures that may be impacted by Service undertakings, management activities, erosion, or neglect.
d. Develop a GIS layer for cultural resources that can be used with other GIS layers for the Refuge, yet contains appropriate locks to protect sensitive information.
e. Develop partnerships with the Tribes for cultural resources inventory, evaluation, and project

monitoring, consistent with the regulations of the National Historic Preservation Act.
Rationale: Various federal historic preservation laws and regulations require the Service to implement the kind of program described under this objective.

Objective 8.2 Develop a cultural resources education and interpretation program.
Develop, in partnership with the Tribes and other preservation partners, a program for the education and interpretation of cultural resources of the Refuge throughout the life of the CCP.
Strategies Applied to Achieve Objective
a. Prepare interpretive media (e.g., pamphlets, signs, exhibits) that relate the cultural resources.
b. Work with partners to prepare cultural/historical educational materials for use in Refuge environmental education program.
c. Consult with the Tribes, historical societies, and other preservation partners to identify the type of cultural resources information appropriate for public interpretation.
d. Develop an outreach program and materials so that the cultural resource messages become part of cultural events in the area, including National Wildlife Refuge Week and appropriate local festivals.
e. Develop Museum Property Inventory. Create storage and use plans for museum property as part of the outreach program.
Rationale: Cultural history as explored in the setting of a wildlife refuge is about how people have interacted with, shaped, and been influenced by the environment and include uses of plants for food, shelter, and tools; the cultural significance of certain animal species for food, identity, etc.; and traditional management and/or harvesting activities. Cultural resources are not renewable. Thus, interpretation of cultural resources can instill a conservation ethic among the public and others who encounter or manage them. The goals of the cultural resource education and interpretive program are fourfold: (1) translate the results of cultural research into media that can be understood and appreciated by a variety of people, (2) relate the connection between cultural resources and natural resources and the role of humans in the environment, (3) foster an awareness and appreciation of native cultures, and (4) instill an ethic for the conservation of our cultural heritage.

Objective 8.3 Develop and implement a Memorandum of Understanding to formalize NAGPRA activities.
Create and, throughout the life of the CCP, utilize a Memorandum of Understanding (MOU) with Native American groups to implement the inadvertent discovery clause of the Native American Graves Protection and Repatriation Act (NAGPRA).
Strategies Applied to Achieve Objective
a. Identify Native American Tribes, Groups, and direct lineal descendants that may be affiliated with the Refuge lands. For example, continue to coordinate with Jamestown S'Klallam and Makah Tribes.
b. Open consultation process with affiliated Tribes, Groups, and direct lineal descendants.
c. Define funerary objects, sacred objects and objects of cultural patrimony.
d. Develop procedures to follow for intentional and inadvertent discoveries.
e. Identify persons to contact for the purposes of NAGPRA.
Rationale: Development of an MOU prior to an inadvertent discovery is strongly suggested by the NAGPRA implementing regulations. Such an agreement can greatly facilitate and speed up consultations as required by law after an inadvertent discovery.

Figure 2-1. Dungeness National Wildlife Refuge Wildlife and Habitat Management Direction



Legend

Planned Management

- Mixed-coniferous forest Enhancement core area

Habitat Type

- Mixed-coniferous forest
- Bluff-backed beach
- Barrier beach
- Coastal strand
- Barrier lagoon
- Intertidal mudflat
- Eelgrass bed
- Salt marsh
- Seasonal freshwater wetland
- Freshwater impoundment
- Riparian corridor and instream
- Open water
- Low intensity developed

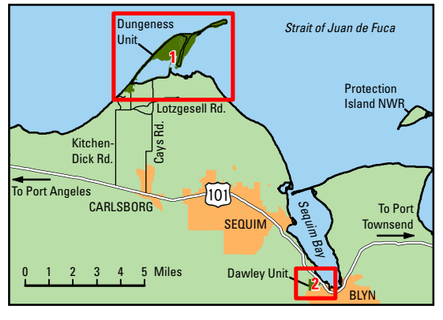
Refuge Land Status

- Refuge Managed Lands (Fee Title or Easement)

0 Miles 0.5

0 Kilometers 0.5

UTM ZONE 10N
NAD 83



Data Sources: Refuge Boundaries from USFWS/R1; Roads and City Area from ESRI, Shoreline from BLM; 2009 NAIP 4-band imagery

The back sides of maps are blank to improve readability.

1

Zone 1: Beach in front of bluffs
Zone 2: Base of Dungeness Spit out to ½ mile
Zone 3: Strait of Juan de Fuca side of Dungeness Spit from ½ mile to Lighthouse
Zone 4: Dungeness Spit from Lighthouse to end of spit and the Harbor and Bay sides of Dungeness Spit and all of Graveyard Spit, including the 100 yard buffer zone below Mean High tide line
Zone 5: Refuge waters and tidelands on the Harbor and Bay sides of Dungeness Spit outside of the 100 yard buffer zone

Zone 3
Open Year-Round

New Dungeness Light Station
National Historic Site
(5.5 miles from parking lot)

Zone 2
Open Year-Round

Boat Landing Zone
Open year-round by reservation only , limited to 20 boat landings per day.
9am - 5pm only.

Zone 1
Beach Open Year-Round

Jogging allowed.

Horseback riding allowed if a safe and legal alternate access can be obtained.

Strait of Juan de Fuca

Dungeness Spit

Dungeness Harbor

Graveyard Spit

Zone 4
Closed to All Public Access

Zone 5
Boat Access Only
(no-wake zone)
Open May 15 to Sept. 30

Dungeness Bay

Zone 2
Foot Access Only
Open May 15 to Sept. 30

Cline Spit

Marine Drive

Upland Forest Off-trail and Bluff Closed to All Public Access

Dungeness Recreation Area (Clallam Co.)

2

101

Sequim Bay

Dawley Unit Closed to All Public Access

Legend

Public Use

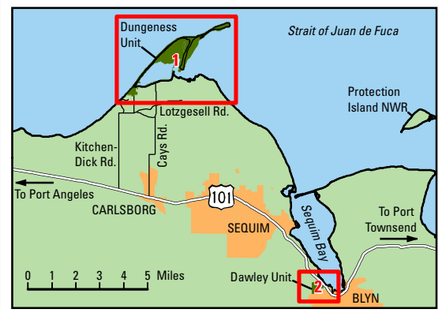
- Hiking
- Wildlife Observation/Photography
- Boating (no-wake zone)
- Beach Use
- Jogging
- Clamming, Crabbing
- Saltwater Fishing
- Horseback Riding
- Boat Landing Zone
- Public Boat Launch
- Refuge Headquarters
- Parking
- Restrooms
- Hiking Trail
  Horseback riding and jogging not allowed.
- Primitive Trail
  Horseback riding and jogging not allowed.

Refuge Land Status

- Refuge Managed Lands
  (Fee Title or Easement)

0 Miles 0.5
0 Kilometers 0.5

UTM ZONE 10N
NAD 83



Data Sources: Refuge Boundaries from USFWS/R1; Roads and City Area from ESRI, Shoreline from BLM

The back sides of maps are blank to improve readability.

Chapter 3
Physical Environment

Chapter 3. Physical Environment

3.1 Climate and Climate Change

3.1.1 General Climate Conditions

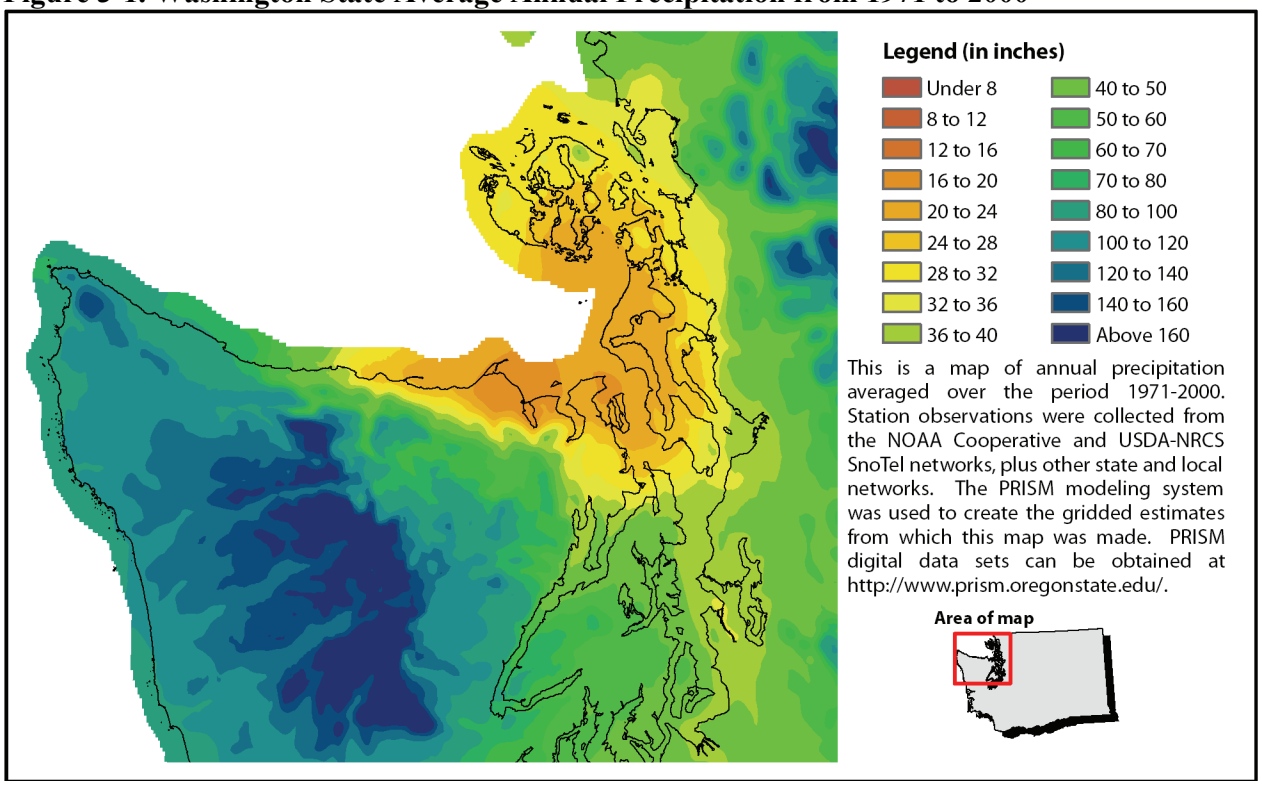
The climate at Dungeness National Wildlife Refuge (NWR) is a mild, midlatitude west coast marine type. Because of the moderating influence of the Pacific Ocean, extremely high or low temperatures are rare. Summers are generally cool and dry while winters are mild but moist and cloudy with most of the precipitation falling between November and January (USDA 1987, WRCC 2011a). Annual precipitation in the region is low due to the rain shadow cast by the Olympic Mountains and the extension of the Coastal Range on Vancouver Island (Figure 3-1). Snowfall is rare or light. During the latter half of the summer and in the early fall, fog banks from over the ocean and the Strait of Juan de Fuca cause considerable fog and morning cloudiness (WRCC 2011a).

Climate Change Trends
The greenhouse effect is a natural phenomenon that assists in regulating and warming the temperature of our planet. Just as a glass ceiling traps heat inside a greenhouse, certain gases in the atmosphere, called greenhouse gases (GHG), absorb and emit infrared radiation from sunlight. The primary greenhouse gases occurring in the atmosphere include carbon dioxide (CO_2), water vapor, methane, and nitrous oxide. CO_2 is produced in the largest quantities, accounting for more than half of the current impact on the Earth's climate.

A growing body of scientific evidence has emerged to support the fact that the Earth's climate has been rapidly changing and the magnitude of these alterations is largely due to human activities (IPCC 2007a, NAS 2008, USGCRP 2009). Although climate variations are well documented in the Earth's history, even in relatively recent geologic time (e.g., the Ice Age of approximately 10,000 years ago), the current warming trend differs from shifts earlier in geologic time in two ways. First, this climate change appears to be driven primarily by human activities such as deforestation and the burning of fossil fuels which results in a higher concentration of atmospheric GHG. Second, atmospheric CO_2 and other greenhouse gases, levels of which are strongly correlated with the Earth's temperature, are now higher than at any time during the last 800,000 years (USGCRP 2009). Prior to the start of the Industrial Revolution in 1750, the amount of CO_2 in the atmosphere was about 280 parts per million (ppm). Current levels are about 390 ppm and are increasing at a rate of about 2 ppm/year (DOE 2012). The current concentration of CO_2 and other greenhouse gases as well as the rapid rate of increase in recent decades are unprecedented in the prehistoric record (Ibid).

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). The term "climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007b). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (Ibid).

Figure 3-1. Washington State Average Annual Precipitation from 1971 to 2000



Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s (Figure 3-2). Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions (e.g., IPCC 2007b, Solomon et al. 2007). In the Pacific Northwest, increased greenhouse gases and warmer temperatures have resulted in a number of physical and chemical impacts. These include changes in snowpack, stream flow timing and volume, flooding and landslides, sea levels, ocean temperatures and acidity, and disturbance regimes such as wildfires, insect, and disease outbreaks (USGCRP 2009). All of these changes will cause major perturbations to ecosystem conditions, possibly imperiling species that evolved in response to local conditions.

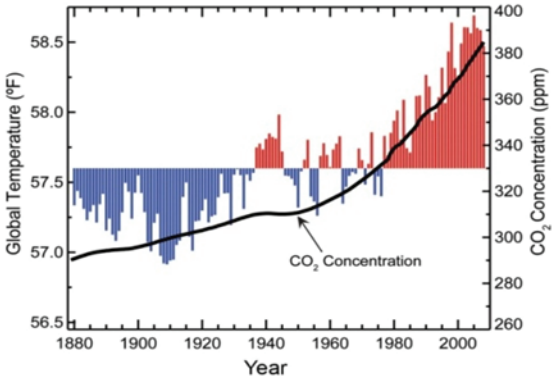
Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is "very likely" (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007b, Solomon et al. 2007). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011), who concluded that it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

In the Northern Hemisphere, recent decades appear to be the warmest since at least about A.D. 1000, and the warming since the late 19th century is unprecedented over the last 1,000 years. Globally, including 2011, the first 11 years in the 21st century (2001 to 2011) rank among the 13 warmest years in the 130-year instrumental record (1880 to present) according to independent analyses by NOAA and NASA. 2010 and 2005 are tied as the warmest years in the instrumental record and the new 2010 record is particularly noteworthy because it occurred in the presence of a La Niña and a period of low

solar activity, two factors that have a cooling influence on the planet. However, in general, decadal trends are far more important than any particular year's ranking.

Trends in global precipitation are more difficult to detect than changes in temperature because precipitation is generally more variable and subject to local topography. However, while there is not an overall trend in precipitation for the globe, significant changes at regional scales can be found. Over the last century, there have been increases in annual precipitation in the higher latitudes of both hemispheres and decreases in the tropical regions of Africa and southern Asia (USGCRP 2009). Most of the increases have occurred in the first half of the 20th century and it is not clear that this trend is due to increasing greenhouse gas concentrations.

Figure 3-2. Global Annual Average Temperature and CO_2 from 1880-2008 (NOAA 2012a)



Global annual average temperature (as measured over both land and oceans). Red bars indicate temperatures above and blue bars indicate temperatures below the average temperature for the period 1901-2000. The black line shows atmospheric carbon dioxide (CO_2) concentration in parts per million (ppm). While there is a clear long-term global warming trend, each individual year does not show a temperature increase relative to the previous year, and some years show greater changes than others.[33] These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niños, La Niñas, and the eruption of large volcanoes.

Just as important as precipitation totals are changes in the intensity, frequency, and type of precipitation. Warmer climates, owing to increased water vapor, lead to more intense precipitation events, including more snowstorms and possibly more flooding, even with no change in total precipitation (Dominguez et al. 2012). The frequency of extreme single-day precipitation events has increased, especially in the last two decades. Paradoxically more droughts and heat waves have occurred because of hotter, longer-lasting high pressure systems.

3.1.2 Air Temperatures

There is no climate/weather station established on Dungeness NWR; however, temperature data have been consistently collected since October 1980 at the Sequim 2 E station (number 457544) located approximately 7 miles east of the Refuge. The proximity of this station to the Refuge provides valuable regional data. Table 3-1 provides a summary of the period of record.

As a result of the ocean's proximity, winter minimum and summer maximum temperatures are moderated. On average, 91.7 days per year experience minimum temperatures at or below freezing while 0.1 days per year experience temperatures at or below 0°F (WRCC 2011b). The coldest weather is usually associated with an outbreak of cold air from the interior of Canada. The first occurrence of freezing temperatures is usually in October (WRCC 2011c). The date of the last freezing temperatures in the spring ranges from the latter half of April to the first half of May (WRCC 2011d). Also, it is only in the extreme occurrences that temperatures have been recorded to exceed 90°F (WRCC 2011b).

Table 3-1. Air Temperature Summary near Dungeness NWR (WRCC 2011b)

Temperatures (°F)	Sequim 2 E Oct. 1980 – Dec. 2010
Average Monthly Temperature – High	57.6
Average Monthly Temperature – Low	39.3
Monthly Mean Winter Temperature – High	47.0
Monthly Mean Winter Temperature – Low	31.2
Monthly Mean Summer Temperature – High	68.6
Monthly Mean Summer Temperature – Low	49.0
Daily Maximum Extreme – High	94
Daily Maximum Extreme – Low	63
Daily Minimum Extreme – High	39
Daily Minimum Extreme – Low	-3

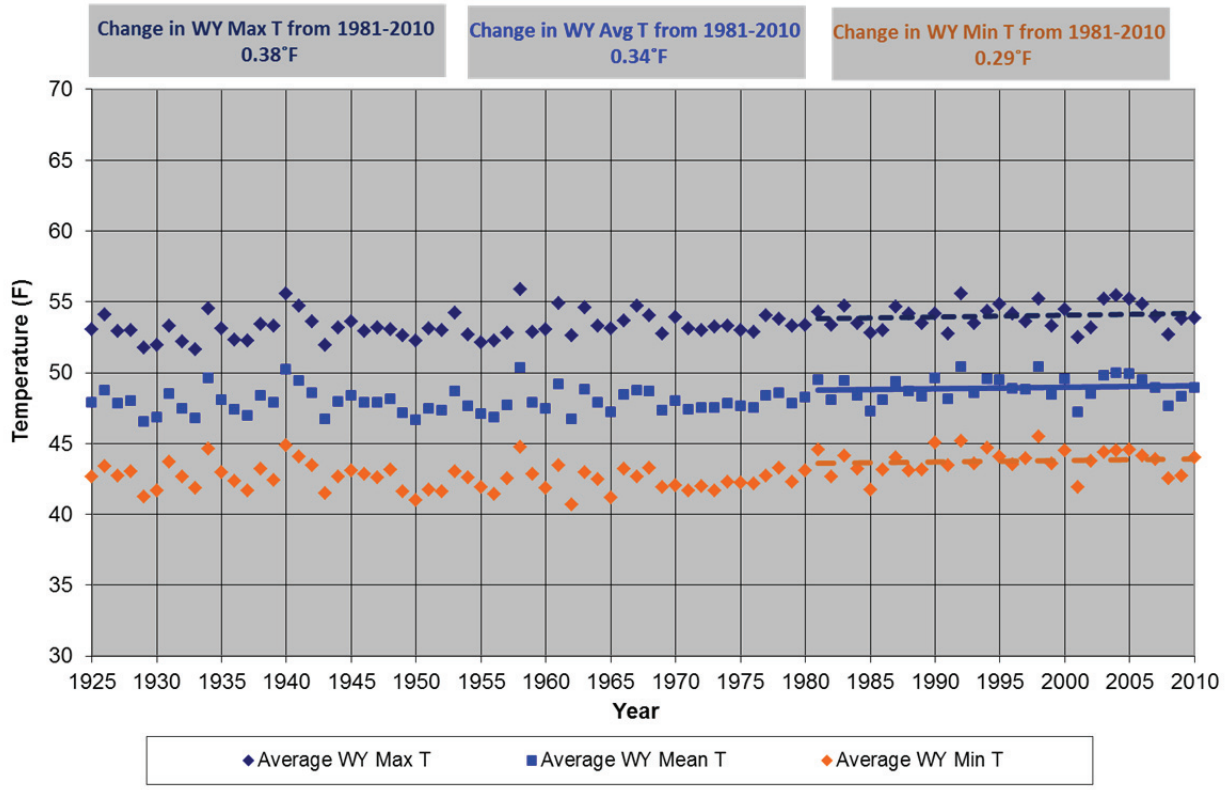
Mote (2003) observed that the Pacific Northwest region experienced warming of approximately 1.5°F during the 20th century. Fu et al. (2010) found that in Washington State from 1952 to 2002, annual mean air temperature increased 1.1°F (daily mean), 0.43°F (daily maximum), and 1.67°F (daily minimum), on average. For trends local to the Refuge we turn to the United States Historical Climatology Network (USHCN) which provides a high quality data set of daily and monthly records of basic meteorological variables from 1,218 observing stations throughout the continental U.S. The data have been corrected to remove biases or heterogeneities from nonclimatic effects such as urbanization or other landscape changes, station moves, and instrument and time of observation changes. The closest station is Port Angeles and trends are provided in Table 3-2 and Figure 3-3. The average yearly temperature change has increased 0.34°F over the past 30 years, and more striking are the seasonal trends which show warmer winters, summers, and falls than the yearly trends, and cooler springs (Table 3-2).

Table 3-2. Seasonal Temperature Trends, 1981-2010 (USHCN 2012)

Port Angeles, WA United States Historical Climatology Network Observation Station			
Monthly Absolute Change	Maximum Temp.	Average Temp.	Min. Temp.
Winter (Dec-Feb)	+1.36°F	+0.63°F	-0.11°F
Spring (March-May)	-0.60°F	-0.48°F	-0.36°F
Summer (Jun-Aug)	+0.46°F	+0.69°F	+0.93°F
Fall (Sept-Nov)	+0.36°F	+0.56°F	+0.77°F

The graph below illustrates a sample of these temperature trends using monthly data. The most recent 30-year period is calculated using the slope of the linear trend line, and temperature change is shown as an absolute change over the 30-year period. A water year is defined as the 12-month period from October 1, for any given year, through September 30 of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months.

Figure 3-3. Water Year Temperature 1925-2010 at Port Angeles, WA (USHCN 2012)



Future Trends

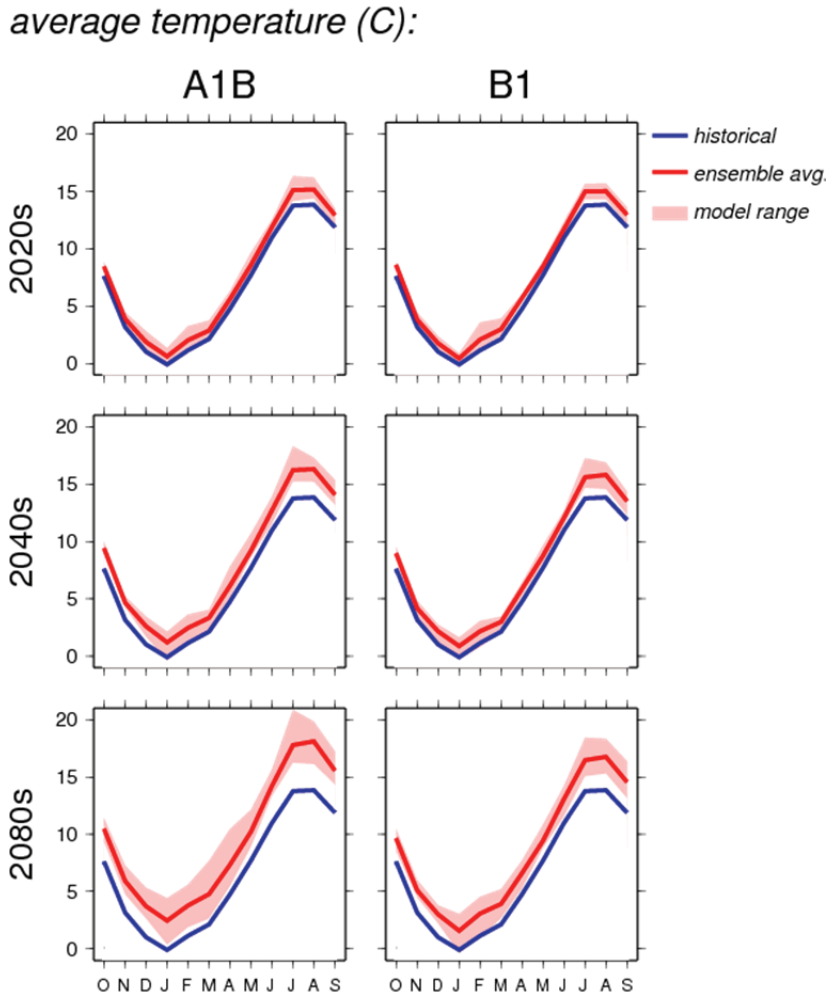
Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of GHG emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (Meehl et al. 2007, Ganguly et al. 2009, Prinn et al. 2011). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007c, Meehl et al. 2007, Ganguly et al. 2009, Prinn et al. 2011).

The statistical downscaling of an ensemble of 20 global climate models and two carbon emissions scenarios for each model run projects average annual temperature for the Pacific Northwest to increase 2.0°F (1.1°C) by the 2020s, 3.2°F (1.8°C) by the 2040s, and 5.3°F (3.0°C) by the 2080s, relative to the 1970-1999 average temperature (Mote and Salathé 2009, 2010). The projected changes in average annual temperature are substantially greater than the 1.5°F (0.8°C) increase in average annual temperature observed in the Pacific Northwest during the 20th century. Seasonally, summer temperatures are projected to increase the most. The emissions scenarios modeled included the A1B scenario, which assumes moderate greenhouse gas emissions in the future, and the B2 scenario, which assumes low greenhouse gas emissions in the future. Actual global emissions of greenhouse

gases in the past decade have so far exceeded even the highest IPCC emissions scenario (A2), which was not included in Mote and Salathé (2009, 2010) or Salathé et al. (2010). Consequently, if these emissions trends continue the climate projections referenced herein likely represent a conservative estimate of future climatic changes.

The two regional climate simulations (Salathé et al. 2010) using a dynamical downscaling method with two global climate models (the CCSM3 and ECHAM5 – to specify boundary climate conditions within the region) support the warming increases described above, with small variations – one model slightly higher and one slightly lower. Both regional climate models project increases in heat wave frequency and the frequency of warm nights throughout the State of Washington. Figure 3-4 shows these modeled, downscaled temperature projections for the Dungeness-Elwha watershed (HUC 17110020) (Hamlet et al. 2010).

Figure 3-4. Projected Temperature Changes for the Dungeness-Elwha Watershed under Two Emission Scenarios (Hamlet et al. 2010)



Note: A1B is a higher emission scenario than B1. Current rates are higher than both A1B and B1.

3.1.3 Precipitation

The prevailing wind direction across the Olympic Peninsula from the southwest, means that storms frequently drop their moisture on the west side of the Olympic Mountains. Consequently, the relatively low precipitation at Dungeness NWR is the result of its location in the "rain shadow." The rain shadow is an area that extends east from Port Angeles towards Everett and north into the San Juan Islands (Bach 2004).

The discussion below includes data from the climate station closest to Dungeness NWR, located in Sequim. An average of 8.12 inches, or roughly 50 percent of the annual precipitation, at this station occurs during late fall and winter in the months of November, December, January, and February. By comparison, the summer months of June, July, and August receive an average of 2.11 inches, a scant 13 percent of the annual precipitation. Additionally, the rate of rainfall within the rain shadow differs from other areas on the Olympic Peninsula. This area frequently receives drizzle or light rain while other localities are experiencing light to moderate rainfall (WRCC 2011a). On average, 5 days per year experience more than 0.50 inch of precipitation and 1 day greater than 1.00 inch (WRCC 2011e). Snow events are infrequent. However, snowfall increases with distance from water and rise in terrain. Consequently, the snow is a major source of water for the Dean Creek system, which passes through the Dawley Unit. Precipitation data for Sequim are summarized in Table 3-3.

Table 3-3. Precipitation Summary near Dungeness NWR (WRCC 2011e)

Precipitation (inches)	Sequim 2 E Oct. 1980 – Dec. 2010
Average Annual Precipitation	16.02
Average Annual Snowfall	1.5
Average Monthly Snowfall Range (winter)	0.2 to 0.9
Highest Annual Snowfall	13.7 (1989)
Highest Monthly Snowfall	25.0 (Dec. 1996)
Wettest Year on Record	20.51 (1997)
Driest Year on Record	11.35 (1994)
Wettest Season on Record	9.18 (winter 1997)
Driest Season on Record	0.41 (summer 2003)

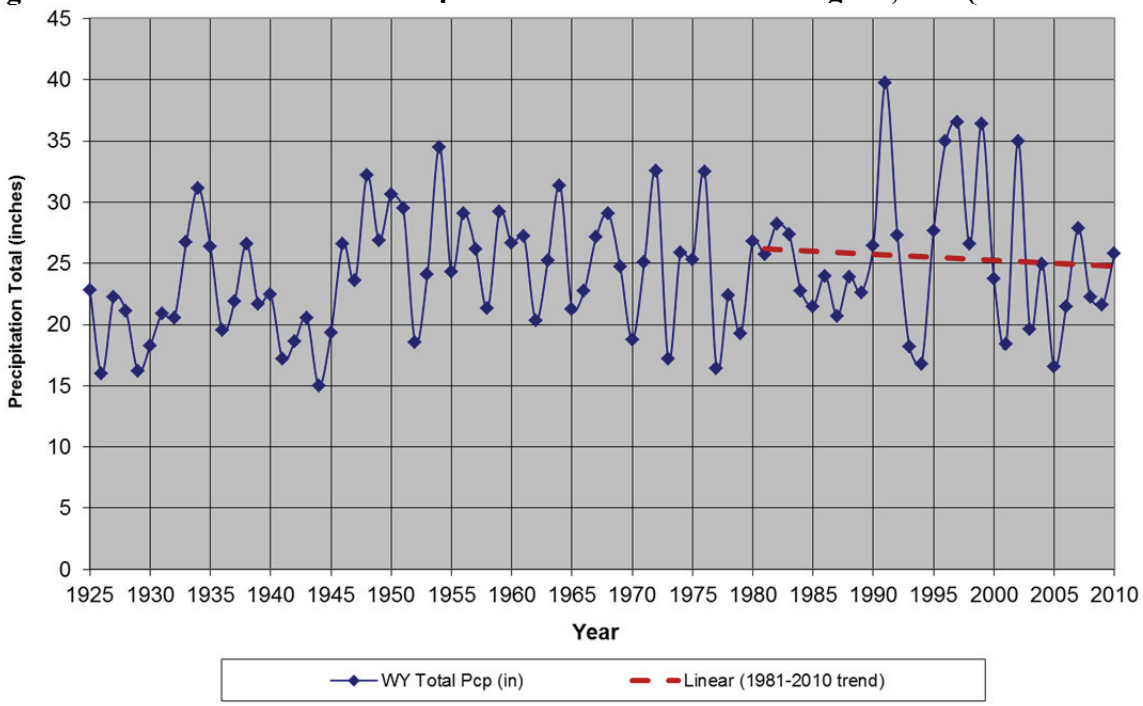
Longer-term precipitation trends in the Pacific Northwest are more variable than temperature and vary with the period of record analyzed (Mote et al. 2005). The Pacific Northwest experiences wide precipitation variability based on geography and seasonal and year-to-year variability (Salathé et al. 2010). Looking at the period 1920 to 2000, total annual precipitation has increased almost everywhere in the region, though not in a uniform fashion. Most of that increase occurred during the first part of the record with decreases more recently (Mote et al. 2005).

Precipitation trends from the Port Angeles USHCN observation station shows the average yearly precipitation change has decreased more than 5% over the past 30 years, with more striking decreases in the winter and increases in the summer (Table 3-4 and Figure 3-5).

Table 3-4. Seasonal Precipitation Trends, 1981-2010 (USHCN 2012)

Port Angeles, WA, United States Historical Climatology Network Observation Station	
Monthly Precipitation	30-year Change % from 1981 Value
Winter (Dec-Feb)	-17.1%
Spring (March-May)	14.3%
Summer (Jun-Aug)	-4.1%
Fall (Sept-Nov)	-1.6%

Figure 3-5. Water Year Total Precipitation 1925-2010 at Port Angeles, WA (USHCN 2012)



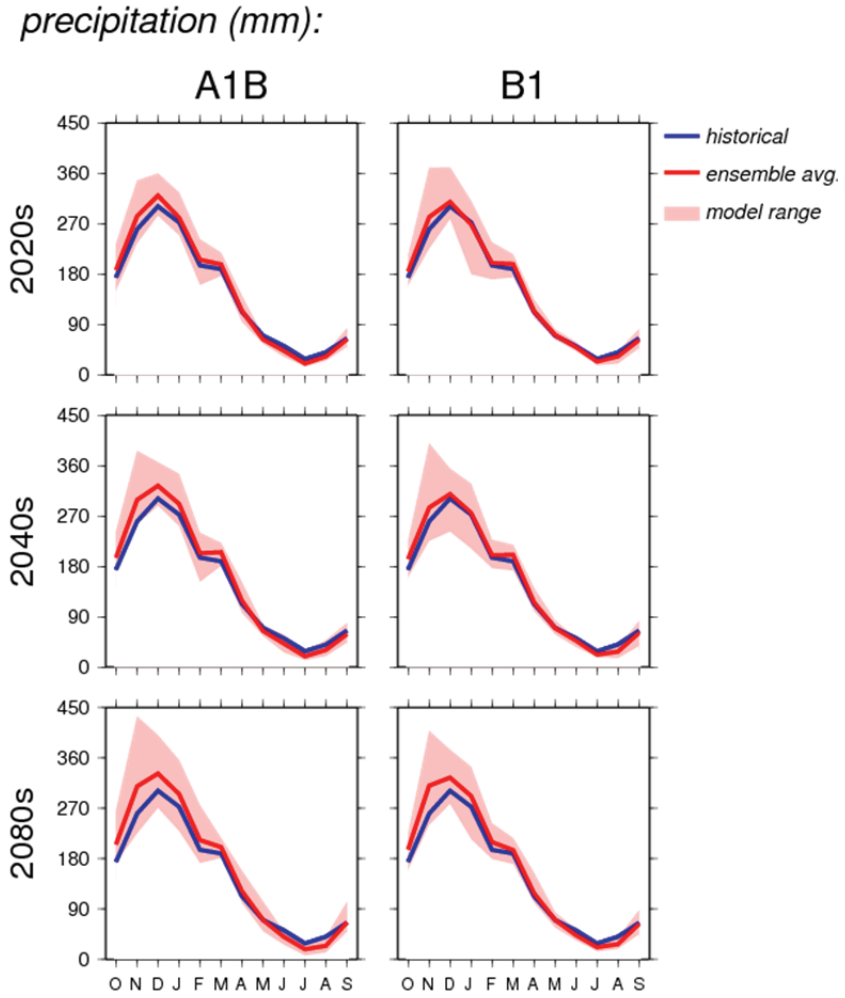
Future Trends

On a global scale, warmer temperatures are predicted to lead to a more vigorous hydrologic cycle, translating to more severe droughts and/or floods (IPCC 1996). Observations of Pacific Northwest precipitation trends through the 20th century indicate a region-wide increase of 14% for the period 1930-1995. Sub-regional trends ranged from 13% to 38% (Mote 2003). However, these trends are not statistically significant and depend on the time frame analyzed. Thus, decadal variability has dominated annual precipitation trends. Cool season precipitation variability, though, has increased (Hamlet and Lettenmaier 2007).

Using data derived from the statistical downscaling of 20 global climate models, projected changes in annual precipitation within the Pacific Northwest throughout the 21st century, averaged over all models, are small (+1% to +2%) though individual models produce changes of as much as -10% or +20% by the 2080s. Some models project an enhanced seasonal cycle with changes toward wetter autumns and winters and drier summers (Mote and Salathé 2010). However, even small changes in seasonal precipitation could have impacts on streamflow flooding, summer water demand, drought stress, and forest fire frequency. Additionally, researchers have consistently found that regional climate model simulations yield an increase in the measures of extreme precipitation. This finding suggests that extreme precipitation changes are more related to increased moisture availability in a

warmer climate than to increases in climate-mean precipitation (Leung et al. 2004, Salathé et al. 2010). Salathé et al. (2010) project increased extreme precipitation events in the State of Washington, with stronger increases in the northwestern portion of the state. The fraction of precipitation falling on days with precipitation exceeding the 20th century 95th percentile is projected to increase throughout the state. It is important to note that the one conclusion shared by researchers is that there is greater uncertainty in precipitation projections than that of temperature predictions and models (Leung and Qian 2003, CIG 2004, Salathé et al. 2010). Figure 3-6 shows these modeled, downscaled precipitation projections for the Dungeness-Elwha watershed (HUC 17110020) (Hamlet et al. 2010).

Figure 3-6. Projected Precipitation Changes for the Dungeness-Elwha Watershed under Two Emission Scenarios (Hamlet et al. 2010)



Note: A1B is a higher emission scenario than B1. Current rates are higher than both A1B and B1.

3.1.4 Wind

During the spring and summer, the semipermanent low-pressure cell over the North Pacific Ocean becomes weak and moves north beyond the Aleutian Islands. Meanwhile, a high-pressure area spreads over the North Pacific Ocean. Air circulates in a clockwise direction around the high-pressure cell bringing prevailing westerly and northwesterly winds. This seasonal flow is comparatively dry, cool, and stable (WRCC 2011a).

In the fall and winter, the high-pressure cell weakens and moves southward while the Aleutian low-pressure cell intensifies and migrates southward as well. It reaches its maximum intensity in midwinter. Wind direction switches to primarily southwesterly or westerly prevailing winds. The air mass over the ocean is moist and near the temperature of the water. As it moves inland, it cools and condenses, bringing the beginning of the wet season (WRCC 2011a).

Wind data collected hourly from an automated station located 14.5 miles west of the Dungeness NWR at the William R. Fairchild International Airport in Port Angeles, have been used to draw generalizations about wind activity in/on the Refuge (Table 3-5). Average wind speeds have been calculated on hourly data collected from 1996 to 2006. The highest average wind speeds occurred during the summer months of June and July. The calmest months were during the fall months of October and November.

Prevailing wind direction, defined as the direction with the highest percent of frequency, was calculated from hourly data during 1996 to 2006. Westerly winds occur from March through October, switching to southwesterly winds in November, and then to west-southwest during January, and southwest winds in February.

Table 3-5. Wind Data Summary for Port Angeles (WRCC 2011f)

	Port Angeles
Prevailing Wind Direction	W
Average Annual Wind Speed	5.2 mph
Average Monthly Wind Speed Range	4.2 (Jan., Oct., Nov.) – 6.6 (Jun., Jul.) mph

The open waters of the Strait of Juan de Fuca periodically allow very strong winds to develop, particularly during midlatitude cyclone events (Reed 1980). Wantz and Sinclair (1981) published estimates of extreme winds in the Northwest. They estimate that speeds within the vicinity of Dungeness NWR sustained for an average of one minute and recurring on average every two years are as high as 50 mph, while fifty-year events would produce winds of approximately 68 mph. Peak gusts would be about 32% higher.

As a rule, tornadoes are infrequent in Washington and generally small in the northwestern part of the United States. The National Climatic Data Center maintains a database that provides information on the incidence of tornadoes reported in each county in the United States. This database reports that 107 tornadoes were reported in Washington from 1950 to 2011. No tornadoes have ever been reported in Clallam County (NCDC 2011).

3.1.5 Climate Cycles in the Pacific Northwest

Two climate cycles have major influences on the climate and hydrologic cycles in the Pacific Northwest: the El Niño/Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). In El Niño years, average sea surface temperatures in the central and eastern equatorial Pacific Ocean are warmer than average and easterly trade winds in the tropical Pacific are weakened. A La Niña is characterized by the opposite – cooler than average sea surface temperatures and stronger than normal easterly trade winds. These changes in the wind and ocean circulation can have global impacts to weather events. The ENSO influence on Pacific Northwest climate is strongest from October to March. During an El Niño event, the winters tend to be warmer and drier than average. La Niña winters tend to be cooler and wetter than average. Each ENSO phase typically lasts 6 to 18

months and the shift between the two conditions takes about four years (CIG 2011, Conlan and Service 2000).

Like ENSO, the PDO is characterized by changes in sea surface temperature, sea level pressure, and wind patterns. The PDO is described as being in one of two phases: warm and cool. During a warm phase, sea surface temperatures near the equator and along the coast of North America are warmer while in the central north Pacific they are cooler. During a cool phase, the patterns are opposite. Within the Pacific Northwest, warm phase PDO winters tend to be warmer and drier than average while cool phase PDO winters tend to be cooler and wetter than average. A single warm or cool PDO phase lasts 20-30 years. The triggering cause of the PDO phase shift is not understood.

The potential for temperature and precipitation extremes increases when ENSO and PDO are in the same phases and thereby reinforce each other. When ENSO and PDO are in opposite phases, their opposite effects on temperature and precipitation can cancel each other out, but not in all cases and not always in the same direction (CIG 2011).

Future Trends
Based on the evidence of the history of ENSO and PDO events, it is likely that these cycles will continue to occur far into the future. However, the potential influence of anthropogenic climate change on ENSO and PDO is unknown because more information is needed by the experts.

3.2 Hydrology

3.2.1 Refuge Hydrology

The circulation of Salish Sea region, which includes the Straits of Georgia, Juan de Fuca, and Puget Sound, is driven by tidal currents, the surface outflow of freshwater from river systems, and the deep inflow of saltwater from the ocean. The two major fresh water sources affecting the Refuge, the Dungeness River and Dean Creek, originate from the Olympic Mountains.

The headwaters of the Dungeness River begin in the steep alpine watershed of Olympic National Park. The Dungeness River and its tributaries drain about 200 square miles (322 square kilometers) and contain over 546 miles (879 kilometers) of river (Thomas et al. 1999). The Dungeness River flows generally north for about 32 miles, crossing the broad alluvial fan of the Sequim-Dungeness peninsula and into Dungeness Bay. The Dungeness and Graveyard spits separate Dungeness Bay and Harbor from the Strait of Juan de Fuca.

Dungeness Spit is a narrow, high-energy spit which extends approximately 5 miles northeasterly into the Strait of Juan de Fuca. Graveyard Spit is a broader, sheltered spit which extends south 1.4 miles from and in the lee of Dungeness Spit at a point about 3 miles out, creating a narrow channel between its southern terminus and the mainland. Graveyard Spit separates Dungeness Bay into two parts: the outer Bay and the inner Bay. The inner portion of Dungeness Bay, also known as Dungeness Harbor, has a surface area of 1.8 square miles or 1,151.5 acres (Rensel 2003).

Larger amounts of snow fall in the upper part of the Dungeness River drainage basin. This snow, along with glacier ice, is a major source of water to the Dungeness River system (BOR 2002). The river is a bimodal flow river, showing two peaks over the course of the year: a smaller peak associated with winter storm flows and a larger peak associated with snowmelt and runoff in the late

spring and early summer (EDPU 2005). According to the Dungeness-Quilcene Water Resources Management Plan (Jamestown S'Klallam Tribe 1994), "there is relatively little storage in the upper watershed, so that current-year precipitation directly controls runoff… and the rain shadow location exacerbates the late-summer low flow." Where the river empties into Dungeness Bay, the river flow situation is even more complex due to irrigation diversion and hydraulic continuity between the river and the shallow aquifer (Simonds and Sinclair 2002).

Groundwater is recharged primarily by precipitation, the Dungeness River and irrigation water. Recharge from irrigation ditch leakage may be predominating over precipitation recharge in some areas of the lower Dungeness watershed. Flow is generally south to north, following the slope of the land with the exception of some confined aquifers where vertical movement up or down is attributed to an artesian effect.

Dean Creek is an intermittent stream draining about one square mile. The creek drains the east side of Burnt Hill and the northwest side of Lookout Hill, flowing behind the 7 Cedars Casino into the southwest corner of Sequim Bay. A short (0.25 mile) reach of the creek runs through the Dawley Unit beginning at river mile 0.6 from Sequim Bay. The headwaters of Dean Creek begin at an elevation of 690 feet, approximately four miles from its mouth. The creek is in a degraded condition, with culverts in various locations, and incidents of severe flooding (EDPU 2005).

Tidal salt marshes are found on both the northern and southern ends of Graveyard Spit. Barrier lagoons and mudflats are located within the Refuge in the interior of both spits. Refuge mudflats are also east of Graveyard Spit in Dungeness Bay. Small (< 0.10 acre) seasonal freshwater wetlands are located within the Dungeness and Dawley units. For more information on Refuge wetlands, see Chapter 4.

A historic tidal lagoon and marsh was located at the base of Dungeness Spit. Today, dikes or old roadbeds, possible remnants of the old railroad grade or wharf, alter the hydrology of this tidal lagoon.

3.2.2 Tides and Salinity

The nearest National Ocean Survey tidal benchmarks to Dungeness NWR are located in Port Angeles, approximately 13 miles west, and Port Townsend, approximately 18 miles east. Additionally, soundings collected in Dungeness Bay bathymetry in 2000 were analyzed and modeled to provide local tidal datums (Rensel 2003). Tidal benchmark information for Port Angeles and Port Townsend for the 1983-2001 period and tidal datums calculated for inner Dungeness Bay are summarized in Table 3-6. Historic records of tides and water levels from the Port Angeles and Port Townsend tide stations are summarized in Table 3-7. Data for each station include mean ranges, diurnal ranges, and the minimum and maximum water levels on record where available. The mean range is the difference in height between the mean high water and the mean low water. The diurnal range is the difference between the mean higher high water and the mean lower low water of each tidal day.

Table 3-6. Tidal Benchmark Summary for Port Angeles and Port Townsend, Washington and Tidal Datum Summary for Inner Dungeness Bay (NOAA 2011a, NOAA 2011b, Rensel 2003)

Station Information	Port Angeles Sta. ID 9444090	Port Townsend Sta. ID 9444900	Inner Dungeness Bay (05/2000)
Mean Higher High Water (MHHW) (ft)	7.07	8.52	7.55
Mean High Water (MHW) (ft)	6.52	7.84	6.89
Mean Tide Level (MTL) (ft)	4.23	5.17	N/A
Mean Sea Level (MSL) (ft)	4.25	4.99	4.59
Mean Low Water (MLW) (ft)	1.93	2.50	2.30
North American Vertical Datum 1988 (NAVD88)	0.43	N/A	N/A
Mean Lower Low Water (MLLW)	0.00	0.00	0.00

Table 3-7. Historic Tidal Data Summary for Port Angeles and Port Townsend, Washington (NOAA 2011c, NOAA 2011d)

Station Information	Port Angeles Sta. ID 9444090	Port Townsend Sta. ID 9444900
Mean Range (ft)	4.60	5.34
Diurnal Range (ft)	7.06	8.52
Mean Tide Level (MTL) (ft)	4.23	5.17
Minimum Water Level (ft below MLLW)	-4.83 (06/13/1982)	-4.22 (12/12/1985)
Maximum Water Level (ft above MHHW)	10.52 (01/02/2003)	11.73 (12/10/1993)

Tides are semidiurnal in Dungeness Bay, with higher high low, lower high and lower low tides generally occurring within a 24 hour 50 minute period. The mean tidal range, which relates to flushing ability, within the inner bay is approximately 4.4 feet. The water residence time in the inner bay averages about 40 hours. Details on tidal circulation can be found in Appendix A of *Dungeness Bay Bathymetry, Circulation and Fecal Coliform Studies* (Rensel 2003).

It is anticipated that the warming of Washington's temperate climate will contribute to fundamental changes along the coast, including but not limited to shifts in the timing and intensity of coastal storms, changes in precipitation and the delivery of freshwater inputs, sea level rise, and increased inundation of the shallow tidal basins. Regional coastal climate change may also result in changes in the intensity and timing of coastal upwelling, shifts in temperatures and dissolved oxygen concentrations, and alteration of the carbonate chemistry of nearshore waters. The combination of these changes will alter chemical concentrations in tidally influenced areas (Ruggiero et al. 2010). Dungeness Bay may experience changes in the salinity regime in response to changes in precipitation and snow melt in the watershed (resulting in changes in freshwater inflows) and increased intrusion of seawater associated with rising sea levels. However, the effect of climate change on salinity will vary with location and the magnitude of the relative sea level rise rate.

3.2.3 Sea Level Rise

Sea level rise on the Washington coast is the result of three major forces: global mean sea level rise driven by the melting of land-based ice, local dynamical sea level rise driven by changes in wind

which pushes coastal waters toward or away from shore, and localized vertical land movements driven primarily by tectonic forces (Mote et al. 2008, McKay et al. 2011). Mean sea level is defined as the average sea level over a 19-year period, about which other fluctuations (e.g., tides, storm surges, etc.) occur (Smerling et al. 2005). Global mean sea level rise has been in the range of 1.3 to 2.3 millimeters per year (0.05 to 0.09 inch/year) between 1961 and 2003 (IPCC 2007a). But since 1993 the rate has increased about 50% above the 20th century rise rate to 3 millimeters/year (0.12 inch/year) (Bromirski et al. 2011), and the latest global satellite sea level observations have risen to 3.19 millimeters/year (0.13 inch/year) (NASA 2012). This acceleration is primarily the result of ice field and glacier melt-off (McKay et al. 2011). For example, the total global ice mass lost from Greenland, Antarctica and Earth's glaciers and ice caps between 2003 and 2010 was about 4.3 trillion tons (1,000 cubic miles), adding about 0.5 inch (12 millimeters) to global sea level in a seven year period (Jacob et al. 2012).

In addition, vertical land movements are occurring as the North American plate and the off-shore Juan de Fuca plate collide. Uplift, which may offset local sea level rise, occurs along the Washington coast, while subsidence occurs off-shore. For example, while tide gauge data in Seattle reflect the global trend of about 2 millimeters/year (0.08 inch/year), at Neah Bay at the western end of the Strait of Juan de Fuca, relative sea level is falling because rapid uplift of the Olympic Peninsula outpaces global sea level rise. An interpolation of regional uplift rates based on an analysis of 29 tide gauges and 113 pairs of level lines provides an estimate of approximately 1-1.5 millimeters/year (0.04-0.06 inch/year) uplift in the vicinity of Dungeness NWR (Verdonck 2006).

Based on monthly mean sea level data from 1975 to 2006, the mean sea level trend at Port Angeles is 0.19 millimeter/year (0.007 inch/year) with a 95% confidence interval of ±1.39 millimeters/year (±0.054 inch/year), which is equivalent to a change of approximately +0.06 feet per century (NOAA 2011e). Data for Port Townsend were recorded from 1972 to 2006 and indicates a mean sea level trend 1.98 millimeters/year (0.077 inch/year) with a 95% confidence interval of ±1.15 millimeters/year (±0.045 inch/year), which is equivalent to a change of +0.65 feet per century (NOAA 2011e).

Future Trends

The IPCC Special Report on Emissions Scenarios (SRES) forecasted that global sea level would increase by approximately 12 inches (30 centimeters) to 39 inches (100 centimeters) by 2100 (IPCC 2001). However, more recent analyses (Chen et al. 2006, Monaghan et al. 2006) indicate that the eustatic rise in sea levels is progressing more rapidly than was previously assumed, perhaps due to the dynamic changes in ice flow omitted within the IPCC report's calculations. Vermeer and Rahmstorf (2009) suggest that, taking into account possible model error, a feasible range by 2100 might be 30 inches (75 centimeters) to 75 inches (190 centimeters) (Vermeer and Rahmstorf 2009).

Tebaldi et al. (2012) show that even seemingly low increases in sea level will have impacts in the short term when storm surges are taken into account. An analysis of historic data is combined with future projections of sea level rise to estimate future return periods for what today are considered 50-year and 100-year events. This magnifies sea level rise by a factor of five, on average, and dramatically increases the occurrence, or return periods, of storm surge events.

Rising sea levels may result in tidal marsh submergence (Moorhead and Brinson 1995) and habitat migration as salt marshes transgress landward and replace tidal freshwater and brackish marsh (Park et al. 1991). Changes in tidal marsh area and habitat type in response to sea level rise were modeled using the Sea Level Affecting Marshes Model (SLAMM 6), which accounts for the dominant

processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989, Clough et al. 2010, Clough and Larson 2010). Within SLAMM, there are five primary processes that affect wetland fate under different scenarios of sea level rise: inundation, erosion, overwash, saturation, and accretion. There are currently several active projects involving the use of SLAMM 6 to estimate the impacts of sea level rise on the coasts and salt marshes of the Pacific Northwest (e.g., Glick et al. 2007).

For Dungeness NWR, SLAMM 6 was run using mean and maximum estimates from scenario A1B from the SRES. Under the A1B scenario, the IPCC AR4 (IPCC 2007a) suggests a likely range of 0.21 to 0.48 meter (0.7 to 1.6 feet) of sea level rise by 2090-2099 "excluding future rapid dynamical changes in ice flow." The A1B-mean scenario that was run as a part of this project falls near the middle of this estimated range, predicting 0.40 meter of global sea level rise by 2100. The A1B-maximum scenario predicts 0.69 meter of sea level rise by 2100. To allow for flexibility when interpreting the results, SLAMM was also run assuming 1 meter, 1.5 meters, and 2 meters (3.3 feet, 4.9 feet, and 6.6 feet) of eustatic sea level rise by the year 2100. Pfeffer et al. (2008) suggests that 2 meters (6.6 feet) by 2100 is at the upper end of plausible scenarios due to physical limitations on glaciological conditions. Model results through 2025 for Dungeness NWR are presented in Table 3-8 (Clough and Larson 2010). All model results are subject to uncertainty due to limitations in input data, incomplete knowledge about factors that control the behavior of the system being modeled, and simplifications of the system.

Table 3-8. Predicted Change in Acreage of Land Categories at Dungeness NWR by 2025 Given SLAMM-modeled Scenarios of Sea Level Rise (Clough and Larson 2010)

	Initial Condition	Sea Level Rise Scenarios*				
		A1B Mean (0.39 m by 2100)	A1B Maximum (0.69 m by 2100)	1 m by 2100	1.5 m by 2100	2 m by 2100
Open Ocean	249.8	257.3	296.4	411.9	469.9	476.8
Tidal Flat	620.9	611.2	606.5	598.7	584.2	568.4
Undeveloped Dry Land	394.7	306.1	299.3	287.6	271.1	258.0
Estuarine Beach	145.5	146.6	146.5	146.4	146.2	145.9
Ocean Beach	130.1	204.0	170.1	62.9	16.7	19.6
Brackish Marsh	25.0	25.0	25.0	25.0	25.0	25.0
Salt Marsh	18.6	18.9	19.0	19.0	19.2	19.5
Swamp	7.8	7.8	7.8	7.8	7.8	7.8
Developed Dry Land	6.8	6.8	6.8	6.8	6.8	6.8
Estuarine Open Water	2.5	12.3	17.0	25.1	39.9	55.9
Inland Open Water	0.7	0.7	0.7	0.7	0.7	0.7
Transitional Salt Marsh	0.0	5.7	7.3	10.5	15.0	18.1

* 0.39 m = 1.3 feet, 0.69 m = 2.3 feet, 1 m = 3.3 feet, 1.5 m = 4.9 feet, and 2 m = 6.6 feet.

3.3 Ocean Chemistry

The ocean will eventually absorb most carbon dioxide released into the atmosphere as a result of the burning of fossil fuels and other sources. Current rates of carbon dioxide emissions are causing and an increase in the acidity of ocean surface waters and a decrease the saturation of calcium carbonate ($CaCO_3$), a compound necessary for most marine organisms' development of shells and skeletons (Hönisch et al. 2012). Oceanic absorption of CO_2 from fossil fuels may result in larger acidification changes over the next several centuries than any inferred from the geological record of the past 300 million years (with the possible exception of those resulting from rare, extreme events such as meteor impacts). In the past 300 million years, three analogous ocean acidification events have been identified and these events coincided with mass extinctions of marine organisms, however it should be noted that warming and corresponding oxygen depletion co-occurred during these events and contributed to the extinctions (Hönisch et al. 2012).

Virtually every major biological function of marine organisms has been shown to respond to acidification changes in seawater, including photosynthesis, respiration rate, growth rates, calcification rates, reproduction, and recruitment. Much of the attention has focused on carbonate-based animals and plants which form the foundation of our marine ecosystems. An increase in ocean acidity has been shown to impact shell-forming marine organisms from plankton to benthic mollusks, echinoderms, and corals (Doney et al. 2009). Many calcifying species exhibit reduced calcification and growth rates in laboratory experiments under high-CO_2 conditions. Ocean acidification also causes an increase in carbon fixation rates in some photosynthetic organisms (both calcifying and noncalcifying) (Doney et al. 2009, Smith and Baker 2008, OCBP 2008). These potential impacts to the marine food web may obviously negatively affect Refuge resources such as seabirds, shorebirds, and salmonids. Localized acidification rates within Dungeness Bay have not been evaluated.

3.4 Topography and Bathymetry

The topography of Dungeness and Graveyard spits is largely flat, with most areas below 15.0 feet North American Vertical Datum 1988 (NAVD88) in elevation (PSLC 2001). The spits are comprised of series of shallow dune ridges and troughs with accumulation of drift logs on the surface. The narrowest portion of Dungeness Spit measures only approximately 50 feet wide, and intermittent overwash events have been documented during and after large storms.

Tidelands of the second class located within Dungeness Bay and surrounding the spits are managed by the Service under a perpetual easement with the Washington Department of Natural Resources and include mud and sand flats exposed only at low tide. The average depth of the inner Dungeness Bay is 8.3 feet (Rensel 2003). Shallower areas occur at the north part of the inner bay, while the deepest areas are located just west of Graveyard Spit and northwest of Cline Spit. A comparison of bathymetry, between 1967 and 2000, shows that the bay became shallower during that time period (Rensel 2003).

Bluffs at the base of Dungeness Spit are approximately 90-100 feet high while bluffs west of the spit rise to about 130 feet. The forested areas within the Dungeness Unit are primarily between 90 to 130 feet (NAVD88).

The northeastern portion of the Dawley Unit fronts Sequim Bay. The topography then generally slopes upward from northeast to southwest. Dean Creek flows from south to north through the

southeastern corner of the unit. Maximum elevations within the Dawley Unit are approximately 650 feet (NAVD88).

3.5 Geology and Geomorphology

3.5.1 Regional Geologic Context

Dungeness NWR is located on the northeast coast of the Olympic Peninsula along the Strait of Juan de Fuca. South of the Refuge, the jagged peaks of the Olympic Mountains loom over a deep, forested labyrinth of canyons. The Olympic Mountains originated from subduction of the denser Juan de Fuca Plate of oceanic crust underneath the North American Plate of continental crust in an area known as the Cascadia Subduction Zone. This subduction caused the superficial rocks of the descending oceanic plate (an accretionary wedge) to be progressively scraped off and accreted to the continental margin (Tabor and Cady 1978). Due to the subduction and the accretionary wedge, there are two lithologic assemblages that can be found on the Olympic Peninsula: the peripheral and core rocks.

The peripheral rocks, part of the Coast Range Terrane, consist of oceanic crust that was accreted onto the continent by either the collision of an intra-Pacific seamount province or by backarc or forearc rifting at the North American plate margin (Wells et al. 1984, Clowes et al. 1978, and Babcock et al. 1992 cited in Brandon et al. 1998). The Coast Range Terrane is composed of a basal unit called the Crescent Formation and an overlying Eocene to lower Miocene marine clastic sequence known informally as the Peripheral sequence (Brandon et al. 1998). The Crescent Formation consists of thick basalt flows such as pillow lava that are cut by dikes and interbedded with pelagic limestone and mudstone (Brandon et al. 1998). On the present day Olympic Peninsula, the peripheral rocks form a horseshoe shaped belt that rings the core rocks on the northern, eastern, and southern sides of the peninsula.

The core rocks are known as the Olympic Subduction Complex and they encompass mélange scraped off the subducting Juan de Fuca plate and thrust, or underplated, on the bottom of the continental crust. This stacking of successive scrapes thus continually thickens and raises the older, top surface. As the subduction process at the Cascadia Subduction Zone continues, uplift occurs. At the same time, erosion eats away at the oldest, top sediments. Rocks of the Olympic Subduction Complex were first thrust above sea level about 12 million years ago and accretion and uplift presently outpace erosion in some parts of the range and so the Olympic Mountains are still rising, with the fastest rates occurring within the western part (Thackray and Pazzaglia 1994, Brandon et al. 1998).

Extensive glaciation over time has greatly shaped the Olympic Peninsula. The latest glaciation, the Fraser, lasted from about 23,000 to 11,000 years ago. The last major advance during the Fraser Glaciation occurred during the Vashon Stade, roughly 14,000 to 17,000 years ago (Hellwig 2010). At its maximum during the Vashon Stade, the margin of the Cordilleran ice sheet that influences the Olympic Peninsula originated in British Columbia, moved down through Georgia Strait on a base of advance outwash sands and gravels, proceeded south through the Puget Lowland to below the present city of Olympia (the Puget Lobe), and extended out the Strait of Juan de Fuca to beyond Cape Flattery (the Juan de Fuca Lobe).

The upper parts of watersheds draining into the Strait of Juan de Fuca were carved by alpine glaciers, which formed in the high mountain peaks of the Olympic Range and moved downstream. As the ice sheet retreated, widespread glacial deposits (outwash, drift, and till) were left behind. The lower

watersheds were cut by glacial water outflows and formed gently sloping plains of glacial till and outwash. Since glaciation, landforms have been modified by mass wasting, surface erosion, and deposition.

3.5.2 Refuge Geology

Dungeness and Graveyard spits are elongate spits primarily composed of well-sorted sand, gravel, and cobble which originate from erosion of adjacent mainland bluffs, alongshore sediment transport (shore-drift), and from washover deposits where the spits are narrow enough for overwash processes (Schwartz et al. 1987). The feeder bluffs are typically composed of Holocene-Pleistocene undifferentiated surficial (clay, silt, sand, gravel, till, diamicton, and peat) and landslide deposits (clay, silt, sand, gravel, and larger blocks deposited by mass wasting) that are at the edge of Pleistocene glaciomarine drifts (Schasse 2003). Net shore-drift patterns at the Dungeness Spit are driven primarily by fetch exposure. Sediment eroded from the glacial bluffs to the west is transported to the east, around the end of Dungeness and then along the recurve of Graveyard Spit. On the mainland, shore-drift converges from the east and west upon Cline Spit (Schwartz et al. 1987).

Using a comparison of historic maps of Dungeness Spit from dating 1855, 1926, and 1979 in conjunction with field surveys conducted in 1985, Schwartz et al. (1987) measured an eastward growth of the spit of about 1,900 feet (575 meters) over a period of record of 130 years. This elongation of Dungeness Spit was confined to that portion of the spit east of the junction with Graveyard Spit, as both Graveyard Spit and the west end of Dungeness Spit have remained relatively unchanged since the 1855 land survey. The study found an average elongation rate of 14.4 feet/year (4.4 meters/year) for the spit which agreed closely with 14.8 feet/year (4.5 meters/year) calculated by Bortleson et al. (1980). The volumetric increase in Dungeness Spit was estimated at about 65,305,000 cubic yards (1,850,000 cubic meters) from 1855 to 1985.

At the Dawley Unit, a portion of the unit adjacent to Dean Creek is underlain by Crescent Formation (middle and lower Eocene) basalt and basalt breccia. The lower part of Dean Creek, as it passes through the Refuge, is underlain with Vashon Stade advance glacial outwash, which is comprised of stratified, well-sorted sand, gravel, lacustrine clay, and silt deposited by meltwater during the glacial advance. The remainder of the unit occurs on Vashon Stade glacial till, which consists of unstratified, poorly sorted clay, silt, sand, gravel, and boulders directly deposited by the glacier (Schasse and Logan 1998).

3.6 Soils

All soil types and descriptions are mapped and described in the Soil Survey of Clallam County, Washington (USDA 2012). The principal soil types at the base of Dungeness Spit are Dick loamy sand (0 to 15 percent slopes) and Hoypus gravelly sandy loam (0 to 15 percent slopes). The Dawley Unit is made up of several soil types: Hoypus gravelly sandy loam (0 to 15 percent slopes, 15 to 30 percent slopes, and 30 to 65 percent slopes), Dick loamy sand (0 to 15 percent slopes), and Clallam gravelly sandy loam (15 to 30 percent slopes).

Dick loamy sand and Hoypus gravelly sandy loam are very deep, somewhat excessively drained soils formed in glacial outwash and found on outwash terraces. Permeability of these soils is rapid with a low water capacity. Consequently, runoff is slow. The effective rooting depth for both soils is 60 inches or more. Below a mat of organic material, the surface layer of Dick loamy sand is grayish

brown and dark brown loamy sand about 3 inches thick. The next layer is brown sand about 19 inches thick. The upper 26 inches of the underlying material is light olive brown and yellowish brown, stratified sand to loamy sand, and the lower part to a depth of 60 inches or more is olive brown and dark yellowish brown, stratified gravelly sand to gravelly loamy sand. The surface of Hoypus gravelly sandy loam is typically covered with a mat of organic material 1 inch thick. The surface layer is very dark grayish brown gravelly sandy loam 3 inches thick. The upper 7 inches of the subsoil is dark brown gravelly sandy loam, and the lower 21 inches is dark yellowish brown very gravelly loamy sand. The upper 14 inches of the substratum is dark brown very gravelly sand, and the lower part to a depth of 60 inches or more is dark yellowish brown gravelly sand.

Clallam gravelly sandy loam is a moderately deep, moderately well drained soil formed in compact glacial till and found on hills. Permeability of this soil is moderate to the compact glacial till and very slow through it. Available water capacity is low. Runoff is medium, and the hazard of water erosion is slight. The effective rooting depth is 20 to 40 inches. Water is perched above the compact glacial till from January through April. Typically, the surface is covered with a mat of organic material 2.5 inches thick. The surface layer, where mixed to a depth of 6 inches, is dark brown gravelly sandy loam. The upper part of the subsoil is brown gravelly sandy loam about 4 inches thick, and the lower part is brown very gravelly sandy loam about 18 inches thick. Compact glacial till is at a depth of 28 inches. Depth to glacial till ranges from 20 to 40 inches.

3.7 Fire

3.7.1 Presettlement Fire History

Dungeness NWR is in the driest area in western Washington (please refer to the Precipitation section for further discussion). Consequently, prior to Euro-American settlement, the predominant vegetation on lowlands west of the Cascades, from the Willamette Valley of Oregon north to the Georgia Basin of southwest British Columbia, was a mosaic of grasslands, oak and conifer forests, savannas, and various types of wetlands (Chappell and Crawford 1997). These forests, savanna, grassland, and herbaceous bald ecosystems generally rely on fire to maintain their vegetative structure and species composition. In addition to lightning-caused fires, historical accounts have also established that Native Americans used prescribed burning to create habitat for game animals and to promote the growth of weaving materials and food (Agee 1993, Chappell et al. 2001). The historic frequency with which a given area burned depended directly upon the number of natural and human ignited fires. Other factors affecting fire frequency and fire intensity include plant community types, changes in topography (i.e., slope and aspect), varying fuel accumulations, and variation in seasonal precipitation. The advent of Euro-American settlement interrupted Native American land management practices and altered the natural fire regime by eliminating prescribed fires and suppression of natural fires.

The watershed of the Dungeness River has experienced repeated large, intense wildfires prehistorically as a result of a number of climatic patterns, including long-term temperature cycles, a rain shadow effect from the adjacent Olympic Mountains, jet stream patterns, and prevailing west-to-east winds (DAWACT 1995, BOR 2002). Large, intense, stand-replacement wildfires have swept across the watershed at intervals of approximately 200 years with surviving older trees generally restricted to higher elevations and along riparian corridors. Present data indicate that large, stand-replacing fires occurred in A.D. 1308, 1508, and 1701 in the Dungeness watershed (DAWACT

1995). The intervals between these fires were long enough to permit growth of a replacement stand and accumulation of both ground and ladder fuels within the forest (BOR 2002).

3.7.2 Postsettlement Fire History

In the areas dominated by Douglas-fir, such as on the mainland portion of Dungeness NWR and the Dawley Unit, the natural fire regime was probably similar to that described by Agee (1993) in coastal Douglas-fir forests. The majority of fires in the region are human-caused and starts occur during the dry summer months. A large, human-caused fire occurred in 1890 in the foothills between Port Angeles and Sequim, smoldered over the winter, and flared up again in 1891. Although not as extensive as the prehistoric fires, the 1890-1891 fire burned large areas of the lower Dungeness watershed. Numerous smaller fires have also occurred in the watershed with significant ones reported in 1860, 1880, 1896, 1902, 1917, and 1925. Few fires have occurred in the watershed since 1930, largely as a result of improved fire prevention techniques and increased levels of summer precipitation (DAWACT 1995, BOR 2002).

All known fires at Dungeness NWR were human-caused. The 1969 Dungeness Annual Narrative related the investigation of a fire started on June 3, 1969 when U.S. Coast Guard personnel were burning their garbage dump behind the residence. High winds caused the fire to quickly spread into the dry grass and driftwood affecting a total of 17 acres. Driftwood logs tend to smolder for weeks after the initial burn. The 1971 Dungeness Annual Narrative reported a fire at the junction of the main spit and Graveyard Spit on June 27 and 28, of that year. The 1983 Dungeness NWR Fire Management Plan states that between 1980 and 1983, two small unwanted fires originated on the spit from Native American campfires. In June 1989, the Ravine Fire burned 0.1 acre near the eastern boundary of the mainland portion of the Refuge. In June 1999, the Dungeness Fire burned 1 acre on Dungeness Spit, and a month later, the Lighthouse Fire burned 50 acres at the extreme end of the spit. The latter fire burned around New Dungeness Light Station with no damage.

3.8 Environmental Contaminants

3.8.1 Air Quality

The air quality may be affected by various activities on and adjacent to the Refuge including: marine vessels, industrial facilities, automobiles, and other human caused activities such as outdoor burning, wood stoves, and operation of various vehicles and machines (e.g., gasoline powered equipment, motorboats). The Refuge staff uses various types of equipment and transportation methods to achieve the Refuge habitat conservation projects and research. Habitat improvement projects and monitoring activities may include the use of tractors, heavy equipment, and/or the operation of trucks, boats, or other transport. Refuge visitors generally drive their automobiles to visit the various units of the Refuge and others operate motor boats within Dungeness Bay to fish or access the lighthouse.

3.8.2 Water Quality

A state is required to identify waters that do not meet that state's water quality standards under Section 303(d) of the Clean Water Act (CWA). These waters are considered "water quality limited" and placed on the state's 303(d) impaired waters list. Section 303(d) requires the state to develop Total Maximum Daily Loads (TMDLs) for impaired water bodies. TMDLs are the amount of each

pollutant a water body can receive and not exceed water quality standards. Water quality standards for Washington include beneficial uses, narrative and numeric water quality criteria, and antidegradation policies. The Washington Department of Ecology (WDOE) assesses water segments according to parameters including bacteria, bioassessment, contaminated sediments, dissolved oxygen, pH, total phosphorus in lakes, temperature, total dissolved gas, toxic substances, and turbidity.

Dungeness Bay was listed as impaired in the 2008 303(d) reporting cycle for the following parameters: fish habitat and fecal coliform bacteria. A TMDL for fecal coliform was established in 2004 to address elevated fecal coliform levels that were impairing water quality and shellfish harvest. The Dungeness River has been identified as a source for nutrient loading and elevated fecal coliform problems from agricultural and residential runoff. Fecal coliform bacterial contamination and nutrient loading from animal waste were found on both commercial and small farms with high livestock concentrations and poor management. Existing on-site sewage disposal systems continue to have the potential to contribute bacterial contamination and nutrients to both surface and groundwater due to soil conditions and inadequate maintenance. Terminating near the Dungeness River delta and in several locations along the shoreline of the southern side of Dungeness Bay are outfalls for approximately 97 miles of irrigation ditches that divert water from the Dungeness River to agricultural and residential lands. These ditches are also likely contributing to the elevated fecal coliform problems in Dungeness Bay. Within 10 miles of the Refuge, there are five additional major subdrainages within the Dungeness River area watershed. These include McDonnell, Siebert, Bagley, Cassalery, and Gierin Creeks. There are approximately 546 miles of streams and tributaries in the overall watershed as identified in the 1993 Dungeness River Area Watershed Management Plan. Similar agricultural/residential runoff issues are likely associated with these drainages and are likely contributing to the existing problems with elevated fecal coliform bacteria.

Because of the shallow depth to groundwater, the lack of a confining layer in many areas, and porous soils, groundwater in this area is highly susceptible to nonpoint chemical contamination. In 1990, wells sampled by Clallam County showed levels of nitrate, although generally well below the drinking water standard, were elevated in some areas, and it was concluded that this was an upward trend. The source or sources for this contaminant is likely attributable to failing septic systems, livestock waste and agricultural/residential fertilizer usage combined with the presence of highly permeable soils and nearly 100 miles of irrigation ditches.

3.8.3 Contaminants

Considering the historical uses of Dungeness NWR and the Dawley Unit, environmental assessment studies have revealed some threats to the Refuge from contaminants. Some of these contaminant issues have already been addressed while others remain. Jurisdiction issues and other factors (e.g., exposure risks, funding, location, concentration, potential for movement of the hazard, and accessibility) influence the timing of remediation. Historical uses included military, navigational aids (lighthouse), residential, and commercial.

In 1857, prior to the establishment of the Refuge, a lighthouse station was constructed on the terminal end of Dungeness Spit. The United States Coast Guard (USCG) operated and maintained this facility in accordance with acceptable laws and practices during their years of operations. In 1974, the station was automated with aids to navigation. In March of 1994, the Coast Guard stationed the last keeper; then from March–September the USCG auxiliary staffed the lighthouse. September

of the same year the lease for the maintenance and operation of the historical structures transferred to the newly formed New Dungeness Chapter of the U.S. Lighthouse Society (Society). In 2003, the New Dungeness Chapter separated from the Society and formed the New Dungeness Light Station Association. The agreement between the USCG and the New Dungeness Light Station Association was modified to reflect this change and continues today. As identified in this CCP, in the event that the USCG declares the light station property excess to its needs, the Service will work with the USCG to bring the lighthouse and surrounding land into the Refuge System. As part of that transfer the Service would work with the USCG on any unresolved contaminants issues concerning the lighthouse site. Several known issues have already been identified by the USCG through their own investigations.

In 2003, the USCG contracted Tetra Tech, Inc., to conduct a Phase I environmental site assessment also called an Environmental Due Diligence Audit (EDDA). The purpose of this audit was to "evaluate a particular property for potential environmental contamination and liabilities from past or present use of the site" in this case the New Dungeness Light Station. There were two underground storage tanks, and one above ground tank, on site which were removed in 1998 and soils tested for total petroleum hydrocarbons. The results were below the Model Toxic Control Act concentrations and no remediation was required.

The USCG, in 2009, contracted with Engineering/Remediation Resource Group, Inc. to conduct a Phase II (EDDA). The objectives were to evaluate (1) the presence and concentrations of lead in paint on the interior and exterior walls of the present site structures; (2) the concentrations of lead in soil around structures compared with background concentrations; (3) the presence of asbestos-containing material (ACM) inside site structures; (4) the presence and concentrations of petroleum hydrocarbons quantified as total petroleum hydrocarbons (TPH) and metals in the cisterns at the station; (5) the presence and concentration of petroleum hydrocarbons quantified as TPH in soil associated with former aboveground storage tanks (ASTs), former underground storage tanks (USTs), former fuel lines, and the present and former oil houses; (6) the concentrations of metals in soil around the current and former paint locker compared with background concentrations; (7) the presence and concentrations of polychlorinated biphenyls (PCBs) in soil in the vicinity of the transformer building; (8) the presence of mercury in the lighthouse lantern room; and (9) background metal concentrations. Based on the findings and recommendations of this report further sampling and remediation actions would be required.

In 2006, the Dawley rental house, located on the south side of Highway 101 and the mobile home west of the main residence, were sampled for Asbestos Containing Material (ACM) and Lead Based Paint (LBP). The test results were negative for all samples. The beach house along Sequim Bay, northwest of the Dawley main residence, was also sampled for ACM and LBP with test results showing positive for ACM but negative for LBP. There was an UST removed, also in 2006, near the garage west of the Dawley main residence and a vehicle oil changing rack. From both of these there was soil contamination by petroleum products that required the removal of 26 tons of soil from the UST and 5 tons from the rack areas. The Mellus Cabin, located in the Dungeness Unit, was surveyed for Asbestos Containing Material (ACM) and Lead Based Paint (LBP) in 2010 by the USFWS Regional Environmental Compliance Coordinator. A small area of interior floor tile contains low levels of ACM and there was no detection for LBP on any surface. The Dawley main residence was also surveyed at the same time for ACM and LBP. These compounds were detected at various levels and locations in and around the structure. For any of the structures that tested positive for either survey, the Service would be required to contract remediation services prior to any construction work.

The Dawley forest unit contains several small dump sites of waste construction material, household appliances, and other miscellaneous debris. In 2006, the Service conducted a Phase I and Phase II Environmental Site Assessment of the Dawley Unit revealing ACM in two locations. These sites were cleaned up by a contractor in 2009. No other containments, other than personal structural debris remains on the site.

Creosote pilings and rogue creosote logs are also a source of contamination on the Refuge and removal is an on-going management activity. Contamination by creosote is a concern because of the presence of toxic polycyclic aromatic hydrocarbons (PAHs) that can leach into water and sediments where they accumulate and impact marine and nearshore organisms. Sometimes levels of these compounds can reach above Washington State Department of Ecology sediment quality standards (Holman et al. 2009). In 2006, the Service partnered with the Washington State Department of Natural Resources and removed 150 tons of these logs from the Refuge. In 2011, a survey was again conducted for creosote rogue logs accumulation levels and locations. The U.S. Navy removed creosote treated sight target pilings from Dungeness Bay in 2010 that were on Refuge tidelands.

The threat of oil spills is another concern that can affect all of the Refuge's nearshore habitats. According to the Washington State Department of Ecology over 41 million gallons of oil are delivered over sensitive waterways every day in Washington. The Strait of Juan de Fuca is one of the most critical maritime highways for both the United States and Canada. Tanker traffic alone through this area carries over 15 billion gallons of oil each year (WDOE 2009a). The Refuge works with many partners on oil spill prevention, preparedness, and response programs to protect the natural shoreline and marine resources.

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Chapter 4
Biological Environment

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Chapter 4. Biological Environment

This chapter addresses the biological resources and habitats found on Dungeness National Wildlife Refuge (NWR or Refuge). However, it is not an exhaustive review of all species and habitats. The chapter begins with a discussion of biological integrity (historic conditions and ecosystem function), as required under the Refuge Administration Act. The bulk of the chapter is then focused on the presentation of pertinent background information for habitats used by each of the Priority Resources of Concern (ROCs) and other benefitting species designated under the CCP. That background information includes descriptions, locations, conditions, and threats (stresses and sources of stress) to the habitats and/or associated ROCs. This information was used to develop goals and objectives for the CCP (see Chapter 2).

4.1 Biological Integrity, Diversity, and Environmental Health

The National Wildlife Refuge System Administration Act, as amended, directs the Service to ensure that the biological integrity, diversity, and environmental health (BIDEH) of the Refuge System are maintained for the benefit of present and future generations of Americans. The BIDEH policy (601 FW 3) defines *biological integrity* as "the biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities." *Biological diversity* is defined as "the variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur." *Environmental health* is defined as the "composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment." In simplistic terms, elements of BIDEH are represented by native fish, wildlife, plants, and their habitats, as well as those ecological processes that support them.

The Refuge System policy on BIDEH (601 FW 3) also provides guidance on consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on the Refuge and in associated ecosystems that represents BIDEH.

4.1.1 Historic Conditions

Dungeness NWR is located along the southern shore of the Strait of Juan de Fuca within the Salish Sea of Washington State. For the purposes of this document, we define the Salish Sea as encompassing the Strait of Juan de Fuca, Puget Sound (Olympia north to Deception Pass and west to Hood Canal), San Juan Archipelago, and the Strait of Georgia (See Figure 1-1).

Dungeness and Graveyard spits were formed following the last glaciation in the Vashon Era ten to twenty thousand years ago. After the withdrawal of the glacier, the coastline of the Strait of Juan de Fuca was characterized by prominent headlands and embayments. In the course of time, tidal currents and waves filled the embayments with material eroded from the headlands. A dominant eastward-flowing longshore current aided by prevailing westerly and northwesterly winds caused an eastward drift of material, which formed the current barrier beach (USFWS 1986). Prior to Euro-American settlement, the condition of sandy/gravelly and rocky shorelines within the Salish Sea was primarily affected by natural processes and disturbances (i.e., accretion and erosion) and regional variations in geology, climate and precipitation, wave action, tidal currents, and local sea level.

Historic vegetation types in the nearshore areas of the Refuge were comprised of sandy feeder bluffs, coastal spit and strand (i.e., barrier beach), tidal lagoons and associated salt marsh and mudflats located at the base of both Dungeness and Graveyard spits (Figure 4-1) (USC&GS 1855a, Collins 2005, Todd et al. 2006). Additionally, early bathymetric maps show extensive areas of "thick grass," kelp or eelgrass, located within Dungeness Bay and Harbor (Figure 4-2) (USC&GS 1855b). Dungeness Spit was described early in the 1900s in the U.S. Coastal and Geodetic Survey (USC&GS) Topographic sheet (T-Sheet) General Description (Dibrell 1908) as a:

> "narrow reach of sand rising a few feet above high water with occasional grassy areas in the widest parts and practically covered with drift wood… (From the spit origin, the bluff) recedes inland to the eastward and slopes down into a low flat upon which is built the village of Dungeness. Considerable marshy land is found along the shore line here, the village being built on ground about 5 feet above high water…"

Prior to Euro-American settlement, the area surrounding the Refuge and the Olympic Peninsula generally was heavily forested to the saltwater edge, except for occasional meadows, prairies, open water, and wetland areas. Western redcedar and Douglas-fir were the dominant conifer tree species. Western hemlock was scattered in all native conifer stands. The climax forests were renowned for producing trees of impressive size. Deciduous hardwoods were found within the conifer stands, primarily in riparian zones such as stream corridors and wetlands, including red alder, bigleaf and vine maples, willow, and black cottonwood. Pacific madrona, a broadleaf evergreen, was also found at lower and drier elevations. The presence of glacial materials from the Vashon glaciation and of the Olympic rain shadow has resulted in a particularly unusual vegetative community in some dry coastal areas within the vicinity of the Refuge where drought-tolerant plants such as prickly-pear cactus, Rocky Mountain juniper, and lodgepole pine are present.

The area surrounding the Refuge has a long history of human habitation. Evidence of prehistoric occupation shows that people inhabited the region as early as 12,000 years ago – not long after the Vashon ice sheet had departed (Bergland 1984, also see Section 5.1, Cultural Resources). In the late 1700s when the earliest European explorers came into the Strait of Juan de Fuca, they found native villages and camps along the shores and bays, indicating that bands of people moved between preestablished sites according to the seasons and availability of food resources. The S'Klallam Tribes have inhabited the Olympic Peninsula for thousands of years. They lived off the land collecting shellfish in Dungeness Harbor, fishing for salmon in Dungeness Bay and building temporary camps on the spit for use while gathering.

4.1.2 Habitat Alterations since Presettlement Times

The BIDEH of the Salish Sea ecosystem, including and surrounding the Refuge, have undergone dramatic alterations since Euro-American settlement. The most discernible changes are related to: (1) the conversion and development of large portions of coastal areas into agriculture, residential, commercial, and industrial lands; (2) human-caused wildlife disturbance; (3) the introduction of contaminants and marine debris into the aquatic environment; (4) the loss of native species accompanied by a large influx of nonnative and invasive plants and animals into the system; and (5) climate change. Additional landscape-level changes such as the alteration of fire regimes and logging are also addressed in subsequent sections.

Figure 4-1. Historic Vegetation of the Dungeness Unit Based on 1855 USC&GS T-Sheet

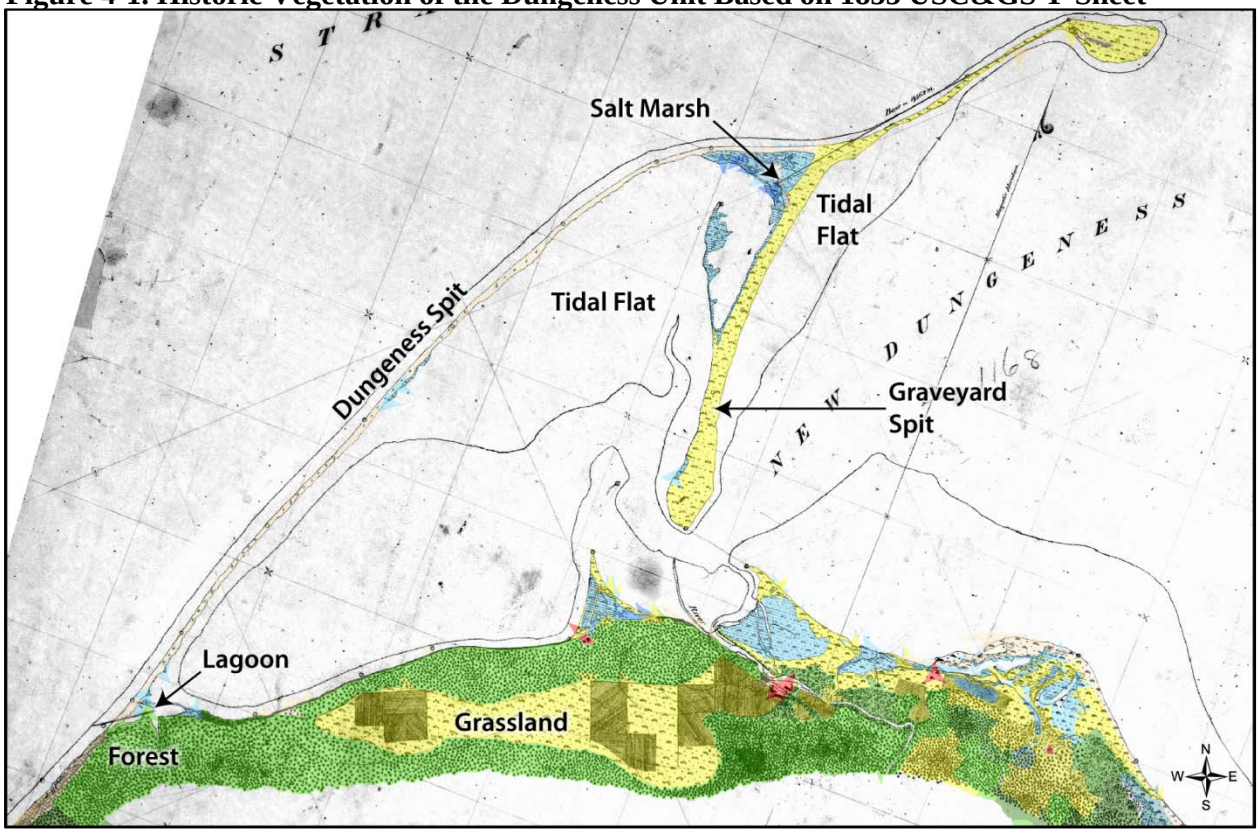
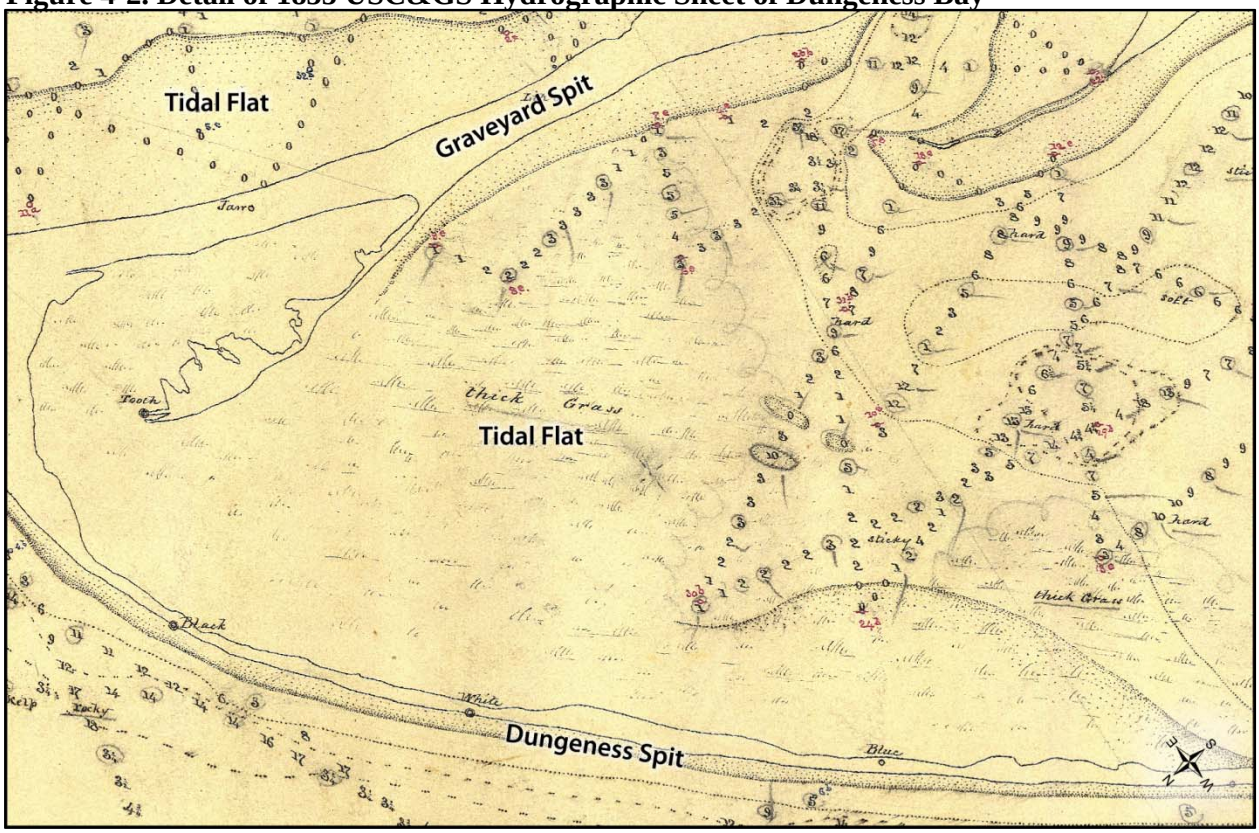


Figure 4-2. Detail of 1855 USC&GS Hydrographic Sheet of Dungeness Bay



The back sides of maps are blank to improve readability.

Many of the habitat changes and the spread of nonnative and invasive species were underway before the Refuge was established. This section discusses the connection between some of these main landscape-level changes with the current vegetation and wildlife on the lands and waters managed by the Refuge. This summary is not a complete analysis of all factors related to changes in native vegetation, fish, and wildlife.

Habitat Loss or Degradation due to Conversion and Development

The first European settlers arrived within the vicinity of the present-day Refuge in 1851. Habitat conversion for human use within the Salish Sea has been rapid since the mid-late 1800s and continues today, bringing profound and widespread alterations to the watersheds and shorelines of the region. Lower floodplains and tidal wetland areas were diked and drained in order to become prime locations for agricultural settlement. Major river delta areas such as Seattle and Tacoma were converted into centers of industrial and urban development. Today, over 40% of the region has been converted to urban or agricultural uses while most of the remainder is in production forestry (Floberg et al. 2004). In addition, as residential, commercial, and industrial development occurs in close proximity to water, spit features and other low-lying sediment depositional areas along the shoreline were modified by armoring (bulkheads consisting of rock, concrete and timber), large revetments (sloped face to protect a bank or shore structure, usually constructed of rock), causeways (fill corridors that extend across embayments), groins (cross-shore structures designed to trap sediment), overwater structures, fill, and dredging (Johannessen and MacLennan 2007). Approximately 34 percent, or 805 miles, of the shoreline inventoried by the Washington State ShoreZone Inventory has undergone such modifications (WDNR 2001). Shore modifications, almost without exception, impact the ecological functioning of nearshore coastal systems. The proliferation of these structures has been viewed as one of the greatest threats to the ecological functioning of coastal systems (PSAT 2003, Thom et al. 1994). Armoring increases longshore currents and diverts sediments into deeper waters thereby reducing the natural deposition of sediment and driftwood to barrier beaches.

Construction of the New Dungeness Light Station was completed in 1857 and the light became the first in operation along the Strait of Juan de Fuca. From 1942 to 1946, there was a small naval station on Graveyard Spit. Old concrete foundations, cisterns, and rubble still remain (USFWS 1997a). Washington State Parks loosely maintained a small State Park on the end of Graveyard Spit. The areas was abused and overrun with people. Careless campers left fires unattended resulting in habitat damage. There was also a direct conflict with wildlife using the area. State Parks abandoned the site in the early 1980s (USFWS 1986).

A tidal lagoon and marsh located at the base of Dungeness Spit was evident in both the 1855 and 1907-1908 T-Sheets, though the channel openings were shown in different locations in the 50 years that separated the two maps (USC&GS 1855a, Todd et al. 2006). A narrow ravine and small stream enters at this location, and at the time of the 1907-08 T-Sheet, a railroad grade ran down the ravine leading to a “wharf” that crossed the lagoon and extended about 500 meters (more than ¼ mile), paralleling the inside of the spit. Today, two dikes or old roadbeds, possible remnants of the old railroad grade or wharf, alter the hydrology of this tidal lagoon.

Human-caused Wildlife Disturbance

This is a pervasive threat which has been identified as a conservation concern for wildlife by many of our partners (Floberg et al. 2004, WDFW 2005, Mills et al 2005, Tessler et al 2007, USFWS 2005b, USFWS 2007a). The Olympic Peninsula has become an increasingly popular tourist destination, particularly during the summer months. As a result, activities such as fishing, boating, recreational aviation, camping, and other economic and recreational activities have increased within the coastal

areas. On the Refuge, visitation ranged from 76,000 – 80,000 visitors per year for the last five years. The majority of use occurs primarily from May through September. Public use closures have been set in place to protect the integrity of habitat and reduce introduction of invasive species. For example, Graveyard Spit is closed to protect fragile coastal strand plant communities from trampling, inadvertent introduction of invasive plant species, and illegal fires as well as to provide a refugia for wildlife. The majority of invasive plant species in nearshore habitats of the Refuge can be found within the area surrounding the New Dungeness Light Station and an abandoned Navy facility on Graveyard Spit, areas of historically high public use.

Oil Spills, Other Contaminants, and Derelict Gear

Nearshore habitats of the Refuge are particularly at risk of contamination from oil spills and rogue creosote-covered logs. The U.S. Coast Guard determined that Dungeness Spit is one of the top five high-risk areas in the U.S. for oil related spill events due, in part, to its prominent location within the Strait of Juan de Fuca and proximity to the high level of shipping traffic within the Salish Sea (Melvin et al. 2001). Approximately 15 billion gallons of oil are shipped through the Strait of Juan de Fuca each year on over 1,000 tankers (WDOE 2009b). Any spill from these tankers could potentially be devastating to Refuge wildlife and habitats. Recognizing this threat, Refuge staff has participated in drills testing implementation of the Strait of Juan de Fuca Geographic Response Plan within Dungeness Bay and Harbor. In addition, nonpoint source oil tarballs or slicks periodically wash up and impact wildlife. These chronic sources of contaminants may be products of vessels illegally pumping bilges, recreational outboard motors, and improper use of petroleum products in marinas.

Predominantly westerly currents have transported oil and/or oiled birds from recent oil spills in Port Angeles Harbor (e.g., T/V Arco Anchorage in 1985). Creosote-covered logs, derelict gear, and marine debris are similarly transported. Creosote is of conservation concern because it contains chemicals (notably polycyclic aromatic hydrocarbons or PAHs) that are considered “highly” or “very highly” toxic to fish and aquatic invertebrates according to the U.S. Environmental Protection Agency (USEPA 2008). Effects range from decreased productivity to low survival rates. Washington Department of Natural Resources removed 150 tons of creosote-covered logs from Dungeness Spit in 2006. During the same time frame, a study of creosote contamination on Dungeness Spit revealed that 2 of 9 creosote-covered logs contained PAH levels that exceeded Washington State Department of Ecology conservative standards (Holman and Lyons 2009). Studies have shown that PAHs tend to leach and remain in sediments with less oxygen such as those found in salt marshes, mudflats and the protected shore of barrier beaches (USEPA 2008, Holman and Lyons 2009). Therefore, removal is a priority for Refuge management. In 2006, contractors for the Northwest Straits Commission and Clallam County removed 42 derelict crab pots from Dungeness Bay and Harbor, 11 (26%) of which were still fishing (NRC 2006). This is particularly of concern off-Refuge, however could also be a problem in eelgrass beds on the Refuge.

Invasive Plants in Nearshore Systems

Exotic plant invasions are a serious threat to the biological integrity of any refuge. If unchecked invasive plant species can displace native vegetation, alter the composition and structure of vegetation communities, affect food webs, and modify ecosystem processes (Olson 1999).

Ultimately, invasive plant and animal species can negatively impact native wildlife. Although the Refuge is fortunate in that no single habitat type has been severely altered by any single invasive species, the threat posed by existing invasive species requires regular monitoring and responsive treatment. Introduced invasive plants (e.g., common cordgrass, Dalmatian toadflax, cheatgrass, etc.) are an issue within some of the nearshore habitats. Many nonnative plant species can directly out-

compete native plant species by reducing light at the ground level and aggressively capturing water and nutrients. They also have the potential to alter ecosystem processes by producing nitrogen-enhanced litter, changing ground-level microclimates, altering fire regimes as a result of their flammability, and contributing toward soil moisture deficits.

The ballast water of ships is a vector for the transport of marine invasive species (Carlton and Geller 1993) which threaten the conservation and sustainable use of biological diversity (Bax et al. 2003). These are some of the newest and least understood threats to the Refuge due to difficulties in monitoring and jurisdictional controls. Plants such as Japanese eelgrass, common cordgrass (i.e., *Spartina* spp.) and the algae *Sargassum* have been recorded within the Salish Sea. Many of these species have infested large areas along the outer coast of Washington and removal has been costly. Other species of algae such as Japanese kelp and *Caulerpa* have not yet been found in the Salish Sea. To date, the only species listed in the Puget Sound Marine Invasive Species Monitoring Program's Target Species List (Eissinger 2009) found within the Refuge is common cordgrass.

Invasive Invertebrates in Nearshore Systems

Marine invertebrates with high reproductive capacity and wide environmental tolerances are a threat to Refuge resources. For instance, European green crabs prey on native Dungeness crabs, reduce populations of native clams, and out-compete native invertebrates for food resources where they have become established. Since 2001, Refuge staff have been monitoring for European green crab. To date none have been found on the Refuge or within the Salish Sea. However, one green crab was observed in the ballast water of a cargo ship in Port Angeles Harbor in 2011.

Invasive Plants in Upland Systems

Major invasive weeds that have invaded Refuge upland habitats include Bohemian knotweed, English holly, spurge laurel, Canada thistle, Scotch broom, and English ivy. These species occupy a small percentage of Refuge lands individually, but combined they have displaced native vegetation on the Refuge. More recently, Herb Robert has been found in several small patches of the Dawley Unit, along the upper most reaches of the main road (approximately <1/4 acre).

Climate Change

Predicted threats from climate change include increased inundation, erosion, and overwash, leading to loss of nearshore habitats due to sea level rise and an increase in the intensity and frequency of storm events (Mote et al. 2008). Additionally, climate-driven changes in ocean currents, sea temperatures, pH, salinity and the timing of resource availability have the potential to affect intertidal communities (Menge et al. 2008), eelgrass beds (Snover et al. 2005), seabirds, and marine mammals that use nearshore habitats on the Refuge.

Climate change may have drastic effects on the Refuge, but due to the complexity of the issue and unknown severity of change, the magnitude of the effects of climate change on the BIDEH of the Refuge during the term of this CCP cannot be fully predicted. However, climate change will likely further exacerbate all of the environmental stressors imposed by the threats listed in this and the following sections as they will likely be additive or synergistic. It is important to note that these effects may not be readily apparent until a disturbance, such as fire, is introduced to the habitat. Once disturbance is introduced, it may become more readily apparent through vegetative response or regrowth. Additional effects of climate change on Refuge wildlife and habitats are addressed in Chapter 6 of the Draft CCP/EA (USFWS 2012a).

4.1.3 Early Refuge Management

Dungeness NWR was managed as an unfunded satellite within the Willapa NWR Complex until 1974. The Dawley Unit was willed to the Refuge in 1973; however, active management was not initiated until Cecil Dawley passed away in 2005 (USFWS 1997a). Dungeness NWR was transferred to Nisqually NWR and was staffed with a seasonal employee in 1974 and then a permanent employee in 1978. The emphasis on management was to protect resources and habitat; later, an additional emphasis was placed on interpretation and education. In addition, maintenance and visitor interpretation projects were bolstered by the help of volunteers, Northwest Youth Services and Youth Conservation Corps in 1977.

In 1982, the following wildlife-related management objectives were identified for the Refuge:

- To provide and preserve habitat for the enhancement of wintering waterfowl and other migratory birds with emphasis on brant;
- To protect and maintain natural habitat capable of supporting a diversity of wildlife;
- To cooperate with other agencies, educational institutions, private organizations, and individuals in providing technical assistance and research opportunities consistent with Refuge objectives and management needs.

By 1986, a Refuge Management Plan was developed to guide implementation of the management objectives listed above (USFWS 1986).

National wildlife refuges are the only lands in Federal ownership managed primarily for wildlife. In 1989, two U.S. congressional committees requested that the General Accounting Office (GAO) evaluate management of national wildlife refuges to see if they were being managed for their stated purposes. The GAO report found that refuges throughout the country were not meeting expectations. Many secondary uses were responsible for the destruction of wildlife habitats and diverting management attention from wildlife. Secondary uses are those activities that are not directly related to managing an area for wildlife. As a result of the report, refuge managers were interviewed to identify and review all secondary uses occurring on refuges to determine compatibility. A use was not compatible if it materially interfered with or detracted from the purpose(s) for which a refuge was established (Refuge Manual, Section 5 RM 20.6A).

In 1990, in cooperation with The Nature Conservancy, the Graveyard Spit Research Natural Area (RNA) was established. This RNA is recognized for its high-quality examples of a low intertidal, high salinity sandy marsh; a coastal spit with native vegetation and; a high salinity coastal lagoon. Establishing documentation provides guidelines for management of the RNA as an "area where natural processes are allowed to predominate without human intervention," and limits activities to research, study, observation, monitoring, and educational activities that are nondestructive, nonmanipulative, and maintain unmodified conditions (Refuge Manual, 8 RM 10.7). Currently, management in the RNA is limited to invasive species management (e.g., Dalmatian toadflax) and year-round closure to protect native strand plants and provide refugia for wildlife.

A lawsuit was filed on October 22, 1992 against the FWS by the national Audubon Society, Wilderness Society, and Defenders of Wildlife (Audubon et al. v. Babbitt, C92-1641), which alleged that the Service had, "violated the Refuge Recreation Act of 1962, the National Environmental Policy Act of 1969, and the Administrative Procedure Act in authorizing and allowing secondary uses of the National Wildlife Refuge System without ensuring that such uses are compatible with the

purpose of the National Wildlife Refuge on which they occur, without ensuring that funds are available for the development, operation and maintenance of secondary recreational uses, and without considering the environmental impacts of such secondary uses pursuant to NEPA…"

The lawsuit resulted in a settlement agreement on October 20, 1993, which required another comprehensive review and evaluation of all secondary uses occurring on refuges, and the identification of uses found to be incompatible with refuge purposes. Compatibility determinations were to comply with the National Environmental Policy Act (NEPA) process and those uses found not to be compatible would either be modified to assure compatibility or eliminated by October 20, 1994.

An Environmental Assessment of the Management of Public Use for Dungeness National Wildlife Refuge was released in 1997 (USFWS 1997a). This document assessed 16 secondary uses of the Refuge (e.g., beach use, wildlife observation, etc.) to determine if they were compatible with the purpose of the Refuge. It found the following:

- Compatible as currently occurring: environmental education, tribal fishing, research, fishing enhancement, and permitted special uses.
- Compatible with modifications: hiking, wildlife observation, wildlife photography, nonmotorized and motorized boating, recreational fishing/shellfishing, jogging, beach use (e.g., swimming and other recreational beach activities) and horseback riding.
- Incompatible and no longer allowed: use of personal watercraft (e.g., Jet Skis and windsurfing).

In 1998, Dungeness NWR, San Juan Islands NWR, Copalis NWR, Quillayute Needles NWR, and Flattery Rocks NWR were combined into one complex known as Washington Maritime NWR Complex.

4.2 Selection of Priority Resources of Concern

4.2.1 Analysis of Resources of Concern

Refuge management priorities are derived from the National Wildlife Refuge System (Refuge System or NWRS) mission, individual refuge purpose(s), NWRS policy that identifies NWRS Resources of Concern, and the mandate to maintain the BIDEH of the Refuge. These mandates are consistent with the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997. The management direction of Dungeness NWR is driven by Refuge purposes and statutory mandates, coupled with species and habitat priorities. The latter are identified in various USFWS conservation plans, as well as those developed by our state, federal, and private partners (USDI 2008). The Service also sought input from Washington State conservation agencies, nongovernmental organizations, and the general public. In developing ROCs, the team followed the process outlined in the Service's draft Identifying Refuge Resources of Concern and Management Priorities: A Handbook (USFWS 2009). As defined in the Service's Policy on Habitat Management Plans (620 FW 1), ROCs are:

> "all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect 'migrating waterfowl and shorebirds.' Federal or

> State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts (620 FW 1.4G)…"

Habitats or plant communities are resources of concern when they are specifically identified in refuge purposes, when they support species or species groups identified in refuge purposes, when they support NWRS resources of concern, and/or when they are important in the maintenance or restoration of biological integrity, diversity, and environmental health.

As a result of this information gathering and review process, a comprehensive list of potential resources of concern was developed (Appendix E).

4.2.2 Priority Resources of Concern Selection

Early in the planning process, the planning team cooperatively identified Resources of Concern (ROC) for the Refuge. Negative features of the landscape, such as invasive plants, may demand a large part of the Refuge management effort, but are not designated as ROCs. The step-by-step process to prioritize ROCs and management priorities for a refuge is displayed in Figure 4-3. The team then selected priority resources of concern from the ROC list. The main criteria for selecting priority resources of concern included the following requirements:

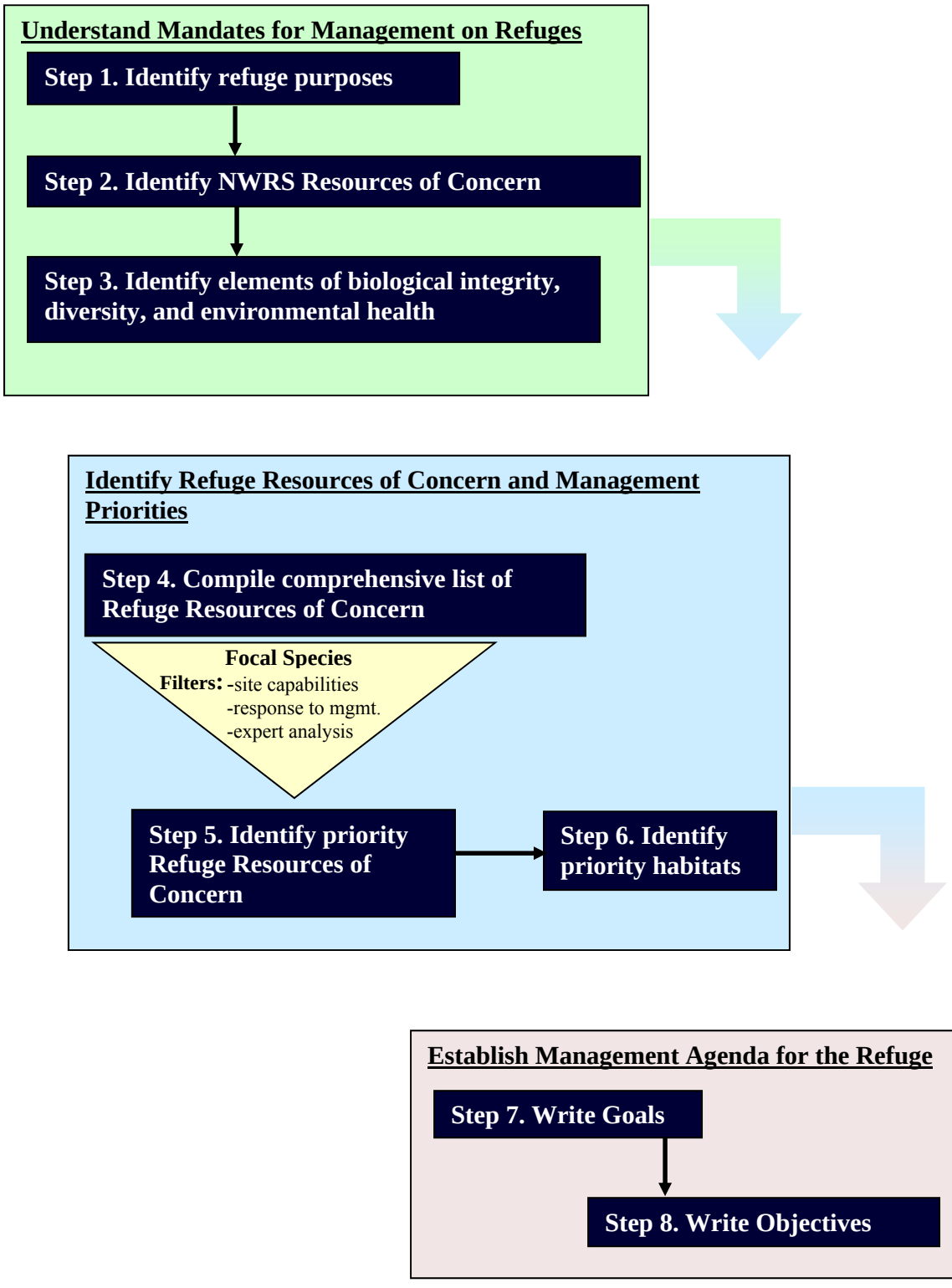
- The resource must be reflective of the Refuge's establishing purposes and the Refuge System mission;
- The resource must include the main natural habitat types found at the Refuge;
- The resource must be recommended as a conservation priority in the Wildlife and Habitat Management Review; or
- The resource must be federally or state listed, a candidate for listing, or a species of concern.

Other criteria that were considered in the selection of the priority resources of concern included the following:

- Species groups and/or Refuge features of special management concern;
- Species contributing to the biological diversity, integrity, and environmental health of the ecosystem;
- Species where it is feasible to estimate abundance and distribution (needed for future monitoring and adaptive management).

In developing its listing of priority resources of concern, the planning team selected not only species mentioned in establishing documents for the Refuge, but also species that captured the ecological attributes of habitats required by larger suites of species. The ecological attributes of habitats should meet the life history requirements of ROCs, and are therefore important to sustain the long-term viability of the priority resource of concern and other benefitting species. Ecological attributes of habitats include vegetation structure, species composition, age class, patch size and/or contiguity with other habitats; hydrologic regime; and disturbance events (e.g., flooding, fire). These provide measurable indicators that strongly correlate with the ability of a habitat to support a given species. Tables listing the desired conditions for habitat types found on the Refuge incorporate "desired" conditions that were based on scientific literature review and team members' professional judgment. These desired conditions for specific ecological attributes were then used to help design habitat goals and objectives, as presented in Chapter 2. However, not all ecological attributes or indicators were

Figure 4-3. Overview of the Process to Prioritize Resources of Concern and Management Priorities for a Refuge (USDI 2008)



deemed ultimately feasible or necessary to design an objective around. Other factors, such as the Refuge's ability to reasonably influence or measure certain indicators, played a role in determining the ultimate parameters chosen for each habitat objective. Thus, ecological attributes should be viewed as a step in the planning process.

Limiting factors were also considered in developing objectives. A limiting factor is a threat to, or an impairment or degradation of, the natural processes responsible for creating and maintaining plant and animal communities. In developing objectives and strategies, the team gave priority to mitigating or abating limiting factors that presented high risk to ROCs. In many cases, limiting factors occur on a regional or landscape scale and are beyond the control of individual refuges. Therefore, objectives and strategies may seek to mimic, rather than restore, natural processes. For example, pumps and water control structures may be used to control water levels in wetlands in areas where natural hydrology has been altered by hydropower operations and dike construction. The structure of plant communities utilized by ROCs can be created, rather than restoring the original native species composition. Mowing and/or grazing may be used to maintain a desirable vegetation structure, when restoring native grassland communities may be impractical. Through the consideration of BIDEH, the Refuge will provide for or maintain all appropriate native habitats and species. Refuge management priorities may change over time, and because the CCP is designed to be a living, flexible document, changes will be made at appropriate times.

A further distinction has been made within the priority resources of concern for plant and animal species which are labeled focal resources. Therefore, the following habitats were selected as Priority Resources of Concern: (1) Nearshore Habitats (North Pacific Coastal Cliff and Bluff, North Pacific Maritime Coastal Sand Dune and Strand, Temperate Pacific Intertidal Flat, North Pacific Maritime Eelgrass Bed, and Temperate Pacific Tidal Salt and Brackish Marsh), (2) Mixed Coniferous Forest (North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest and North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest), and (3) Wetlands (North Pacific Hardwood-Conifer Swamp and North Pacific Lowland Riparian Forest and Shrubland). Vegetation type descriptions according to the International Terrestrial Ecological System Classification under development by NatureServe and its natural heritage program members (refer to Appendix E for further discussion) are listed in parentheses. In addition, the following species were selected as Focal Resources for this CCP: Pacific harbor seal, American dunegrass and large-headed sedge (barrier beach), dunlin (barrier lagoon and mudflat), eelgrass (eelgrass beds), marine invertebrates (salt marsh), pileated woodpecker (mixed coniferous forest), and amphibians (wetlands).

In the following sections, information is provided on the ecological processes of formation and maintenance; regional distribution; condition and threats; key species supported; and management activities for each Priority Resource of Concern. A similar analysis is presented for focal resources (e.g., dunlin, harbor seal, etc.) following the analysis for Priority Resources of Concern.

Tables describing focal resources associated with a particular habitat type are included at the end of each Priority ROC section in Chapter 4. Definitions for the column headings are as follows:

- **Focal Resources:** Species or species groups selected as representatives or indicators for the overall condition of the priority resource of concern. In situations where the conservation target may include a broad variety of habitat structures and plant associations, several different conservation focal resources may be listed. In addition, species with specific "niche" ecological requirements may be listed as a focal resource. Management will be

focused on attaining conditions required by the focal resource. Other species utilizing the associated habitat type will generally be expected to benefit as a result of management for the focal resource.

- **Habitat Type:** The priority resource of concern utilized by the focal resource.
- **Desired Habitat Characteristics:** The specific and measurable habitat attributes considered feasible on the Refuge and necessary to support the focal resource.
- **Life History Requirement:** The general season of use for the focal resource.
- **Other Benefiting Species:** Other species that are expected to benefit from management for the selected focal resource. The list is not comprehensive.

4.3 Nearshore Habitats

4.3.1 Overview

The Puget Sound Nearshore Ecosystem Restoration Study defines nearshore as: a complex of estuaries, deltas, bays and inlets, lagoons, beaches, bluffs, rocky shores, intertidal flats, and shallow subtidal areas, accompanied by eelgrass beds, seaweeds, kelps, and other biological communities (PSNERP 2012). For purposes of this document, we have selected the following nearshore habitats as priority resources of concern on Dungeness NWR: sandy bluff, barrier beach, barrier lagoon and mudflat, eelgrass beds, and salt marsh.

Sandy Bluffs
This habitat type is classified within the North Pacific Coastal Cliff and Bluff ecological system (NatureServe 2010). Sandy bluffs are also referred to as "feeder bluffs" because they are continuously eroding and contributing sediment to "down-drift" beaches. They are often steep and composed of a sequence of glacial and interglacial deposits of fine sand to coarse gravel with occasional sparse cover of forbs, grasses, lichens, and low shrubs.

Sandy bluffs are the primary source of sediment for nearshore habitats within Puget Sound and they cover >60% of the shoreline in the Sound (Johannessen and MacLennan 2007). The key processes that form and maintain sandy bluff habitat are erosional through exposure to wind and waves, geologic composition (e.g., slope stability and drainage capacity) and surface and groundwater hydrology (Bray and Hooke 1997, Johannessen and MacLennan 2007). The cyclical process of bluff erosion is initiated when wave action removes material at the bluff toe creating an unstable bluff profile or surface/groundwater weakens slope stability which eventually leads to landslides (mass-wasting). Either mechanism results in the delivery of new material to the base of the slope (Emery and Kuhn 1982). Key attributes include: physical structure and stability as indicated by the degree of slope and friability of soil; security and human impacts as indicated by the presence/absence of human activity on or near bluffs and presence of driftwood on the shoreline adjacent to bluffs; and plant community, structure and composition as indicated by percent of vegetative cover.

Dungeness NWR supports approximately ½ mile of sparsely vegetated, sandy bluff habitat along the Strait of Juan de Fuca. Since bluffs along the Strait of Juan de Fuca experience significant wind and wave exposure, bluff erosion and recession rates are higher than at other, less exposed areas of the Salish Sea. Slope failure rates are typically higher during winter months due to heightened storm intensity which acts to weaken bluffs with heavy precipitation and storm surges.

Barrier Beaches

Barrier beach habitats are associated with the North Pacific Maritime Coastal Sand Dune and Strand ecological system. This habitat type is defined as a relatively continuous ridge of sand and gravels raising a short distance above the high tide line. Barriers often form across embayments or other distinct coastal bends, and are represented by a variety of types such as spits, recurved spits, stream-mouth spits, bay barriers, or bay-mouth barriers (Shipman 2008). On this Refuge, barrier beach habitat consists of Dungeness and Graveyard spits. The lower shoreline component is traditionally referred to as "the spit" while the higher elevation portion of the barrier beach is referred to as strand. The shoreline is composed of substrata consisting of components of cobble size (10 inches in diameter) and smaller, including gravel, sand, mud, and organic materials (Dethier 1990).

Dungeness NWR is unique in that it contains one of the longest natural sand spits in the world. Dungeness Spit is 5.5 miles long and averages 300 feet wide (from Mean Low Water); however the narrowest portion measures approximately 50 feet wide during high tide. Dungeness Spit has an accretion rate of about 15 feet per year along the eastern tip (Schwartz et al. 1987). The beach substrate along the Strait (north) side of Dungeness Spit is in a constant state of flux shifting from primarily cobble in the winter months due to increased storm activity to a finer, sandier composite in the summer months. Graveyard Spit branches off of Dungeness Spit at approximately 3 miles from the mainland and extends due south. It is approximately 1.4 miles long and averages 475 feet wide. Cumulatively, Dungeness and Graveyard spits provide approximately fifteen miles of undeveloped shoreline. Above the high water line of Dungeness Spit, a backbone of driftwood helps to hold the sediment and provides beach stabilization. The interior of Graveyard Spit and tip of Dungeness Spit support a relatively stable native strand plant community. The composition of vegetation within this fragile plant community is affected by disturbance processes such as wave overwash during storm surges, sand deposition, and erosion.

Graveyard Spit was designated a Research Natural Area (RNA) in 1990 due to the intact plant community of native strand vegetation. The RNA consists of coastal lagoon, strand, and salt marsh habitats. Of the total, native strand habitat consists of 58 acres. The percent of plant cover within the strand habitat varies both from north to south and between the dune ridges and troughs. Dune ridges tend to support a higher percent cover (80-100%) while troughs support roughly 10-50%. Within the northern-most portion of the spit, percent cover appears to increase within the dune ridges and troughs adjacent to the abandoned Navy structures. The salt marsh areas (located along the northern and southern border of the RNA) support 100% cover and cover approximately 52 acres within the RNA.

Important processes include the natural erosion of sandy bluff habitat which is then transported by predominantly eastward-flowing longshore currents and prevailing westerly and northwesterly winds to down-drift nearshore habitats. The natural erosion of sandy bluffs is critical to the integrity of barrier beach habitat. Natural erosion supplies down-beaches with finer sediments on a gradual, protracted pace. Key ecological attributes include: natural deposition and erosion of sand, gravel, and driftwood; presence of native strand plants tolerant of dry salty conditions; absence of marine debris, man-made or natural fires; minimal to no impact from oil spills or creosote-covered logs; and no human-caused wildlife disturbance during seasonal and year-round closures. The deposition and retention of driftwood found along the "backbone" of Dungeness Spit serves an important role in stabilizing the upper portion of the beach by holding sediments in place, particularly during storm events that coincide with high tides. Native strand plants act in the same manner as driftwood within the more protected strand portion of this habitat type.

Barrier Lagoons and Mudflats

Barrier lagoons are tidal embayments that lack a significant freshwater source and are often associated with barrier beaches which protect them from wave action (Shipman 2008). Common elements include intertidal mudflats and high tidal, sandy flats. The mudflats of these lagoons are composed of fine silt combined with organic matter deposited by complex longshore currents along the Strait of Juan de Fuca and prevailing winds. Mudflats are found between Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW). They are often submerged, but are gradually exposed as the tide lowers. Since vascular plants are unable to persist on mudflats due to the diurnal tidal flooding of salt or brackish water, algae are the dominant vegetation, primarily sea lettuce. High tidal flats consist primarily of sandy shores with areas of salt marsh vegetation. The substrate of the sandy shores originates from erosion of nearby bluffs which is then transported by longshore drift or overwash. These low energy shorelines are often fringed by a thin ring of salt marsh vegetation where sufficient sediment is available in the upper intertidal zone.

Due to the protected nature of barrier lagoons, tidal processes predominate. These influence supply of sediment, water circulation, and salinity gradients. Barrier lagoons and mudflats consist of a substrate primarily composed of fine silt with a shallow-gradient benthic layer and minimal to no vegetation. This type of benthic layer is more conducive to marine invertebrate productivity and survival. Vegetation covering the benthic layers impedes oxygen and nutrient uptake for marine invertebrates and reduces foraging area and sight distances for dunlin. Other important processes include tectonic uplift or subsidence; isostatic rebound; prevailing winds, storm events; water and air temperatures.

Approximately 403 acres of barrier lagoon and mudflat habitats are found within the Refuge in Dungeness Harbor, the interior of both spits, and east of Graveyard Spit in Dungeness Bay. Approximately 47 of that acreage is barrier lagoon while 356 acres are intertidal mudflat. The mudflats east of Graveyard Spit are more exposed to freshwater influx from the Dungeness River and wave action compared to the areas west of Graveyard Spit. These tidelands of the second class are managed by the Service under a perpetual easement with Washington Department of Natural Resources.

Eelgrass Beds

Common eelgrass (eelgrass) is a rooted perennial vascular plant found in intertidal areas (Mumford 2007). Eelgrass is not a true grass, but a pondweed (Moore and Short 2006). Eelgrass completes its entire lifecycle underwater and low tide exposure is a limiting factor for distribution. Like many other plants eelgrass flowers in the spring; releases seeds in midsummer; the seeds overwinter in the substrate; and germinate in the spring (Churchill et al. 1985, DeCock 1980). Eelgrass can also spread vegetatively by rhizomes that branch forming tangled mats within the beds (Moore and Short 2006).

Important processes that influence eelgrass growth include water circulation (tides and freshwater inflow) as well as water temperature. These processes drive key ecological attributes such as salinity, water quality, sedimentation, and temperature. This plant prefers a high level of salinity with temperatures ranging from 41-46°F for optimal growth (59°F upper limit; Snover et al. 2005). Eelgrass can be found at depths ranging from +0.4 to -8.8 meters (+1.3 to -28.9 feet) within the Strait of Juan de Fuca with an average maximum depth of -3.5 meters (-11.5 feet), relative to MLLW, within the Puget Sound (Mumford 2007). Where conditions of water temperature, quality (nutrient and contamination levels), and light penetration (clarity) are optimal, the plants form continuous solid beds. As conditions and other environmental factors stress the plants, their coverage becomes patchier.

Approximately 314 acres of eelgrass beds are managed by the Service within the second class tidelands easement. The majority of these beds are located within Dungeness Harbor, due west of Graveyard Spit and south of Dungeness Spit. Additional beds can be found due east of Graveyard Spit in Dungeness Bay. The current acreage of eelgrass beds within the Refuge is estimated based on Wilson (1993) and Norris and Fraser (2009) and includes areas of sparse, patchy, and dense coverage. Thus, the actual footprint of eelgrass beds is smaller.

Salt Marsh
Salt marsh habitat is classified as Temperate Pacific Tidal Salt and Brackish Marsh (Estuarine Emergent Wetland). This system varies in location and extent with daily and seasonal dynamics of freshwater input balanced against evaporation and tidal flooding of saltwater. Salt marshes are confined to specific environments defined by ranges of salinity, tidal inundation regime, and soil texture. Summer dry periods result in decreased freshwater inputs and thus higher salinity levels. Characteristic plant species include American glasswort, seashore saltgrass, and seaside plantain. Due to high salinity levels, this system supports low plant species diversity.

Natural processes responsible for the formation of these marshes include the formation of the barrier beach which shelters the salt marsh from wave action and serves as a funnel for sediment in the water column to enter the marsh. Key ecological attributes that are responsible for the maintenance of these salt marshes include the hydrological regime and water quality. The hydrological regime in the salt marsh essentially determines the frequency of tidal inundation and therefore salinity of the marsh and plants that can tolerate that salinity as well as the rate of accretion or subsidence of sediment. Water quality is indicated by presence of creosote-covered driftwood and/or oil as well as the amount of other pollutants, temperature, and alkalinity.

Salt marshes are important components of the nearshore ecosystem due to the high nutrient concentrations resulting from decaying marsh vegetation. The resulting dissolved organic materials support especially high concentrations of phytoplankton (one-celled microscopic floating plants). In addition, nutrients are flushed from the marsh by tides and storms into adjacent nearshore habitats thereby enriching practically all nearshore habitats (Gosselink 1980). They also serve as a vital nursery area for commercially important species such as marine invertebrates (e.g., Dungeness crab) which seek these areas for refugia. Salt marshes filter pollutants from the water and break them down into less harmful forms (e.g., nitrogen) and buffer inland areas from the damaging effects of storm surges. Finally, salt marsh plants remove carbon from the atmosphere and store it in undecomposed materials in the soil.

Approximately 52 acres of salt marsh can be found on both the northern and southern ends of Graveyard Spit. In each salt marsh, one channel serves as the conduit for saltwater intrusion but the entire marsh is not typically flooded each day; inundation occurs only on the highest of high tides. Each salt marsh contains a bulwark of driftwood along their northern borders which adds to the organic material available for decomposition and provides cover for marine invertebrates. The predominant plant covering these marshes is American glasswort.

4.3.2 Regional Distribution, Conditions and Threats

Sandy Bluffs
Sandy bluffs constitute approximately 60% of Puget Sound shores; however one third of Puget Sound's shoreline has been effectively eliminated from this natural cycle through armoring.

Armoring is typically used to reduce erosion of bluffs adjacent to homes or important areas by placing sea walls or bulkheads parallel to bluff habitats (Johannessen and MacLennan 2007). Armoring has far-reaching negative effects on all nearshore habitats, primarily through the reduction of sediment deposition to sandy beaches. In addition, armoring can increase the wave energy reflected to down-drift beaches and bluffs, thereby increasing the potential erosion rates (Johannessen and MacLennan 2007).

Threats from climate change include sea level rise as well as the increase in the incidence and severity of storm events that can significantly erode the base (toe) of sandy bluffs and accelerate natural erosion. Bluff areas west of Dungeness Spit appear to be eroding at a rate of 0.5 to 3 feet per year on average but a single storm event or bluff failure can take as much as 28 feet of bluff at a time (ESA 2011). Thus, climate change is predicted to exacerbate erosion particularly when this threat results in elevated storm severity coinciding with elevated sea levels resulting in larger and more frequent mass-wasting events.

Development adjacent to bluffs and trespass within sandy bluff habitat have the potential to degrade or destroy the habitat through trampling and erosion as well as cause tremendous disturbance to wildlife and introduce invasive plant species into closed areas of the Refuge. No further development of Refuge lands is planned at this time; however replacement of the Dungeness caretaker cabin (Mellus Cabin) is an identified deferred maintenance project need. Should this project be funded within the time frame of this plan, we will strive to follow guidelines set in place by the current Clallam County Shoreline Master Plan (SMP) restricting building within 150 feet of the bluffs, as established for residential uses on Shorelines in the Natural Environment (WDEQ 1992). Currently, the County is developing the draft of a new Shoreline Master Plan. Once that plan has been approved by the County and the Washington Department of Ecology, the Service will adopt the guidelines in the final SMP. In addition, no hard armoring (e.g., rip rap) will be placed adjacent to bluffs on Refuge lands.

Barrier Beach

The natural erosion of sandy bluffs and presence of driftwood along the spit are critical to the integrity of barrier beach habitat. Natural erosion supplies down-drift beaches with fine sediments on a gradual, protracted pace. Increased armoring and increases in the incidences and severity of storm events as well as wave heights due to climate change can all lead to higher levels of erosion of barrier beaches. The driftwood found along the backbone of Dungeness Spit serves an important role in stabilizing the upper portion of the beach by holding sediments in place, particularly during high tide events that coincide with storms.

Native plant species continue to dominate on Graveyard and Dungeness spits even when associated with introduced species. Graveyard Spit represents a very stable sand spit; however the following invasive species are currently under management control on the spit: Dalmatian toadflax and Himalayan blackberry. Nonnative and invasive plant species threaten this habitat type by displacing native vegetation, altering intact communities, and modifying ecosystem processes. Due to the fragile nature of strand habitat, soil disturbing management activities can increase the risk of additional invasive species issues.

Climate change also poses a serious threat to this environment. According to sea level rise modeling using Sea Level Affecting Marshes Model (SLAMM), within the time span of this plan, roughly half of the spit or ocean beach habitat (not including the strand component of barrier beach) is predicted to be lost based on the 1-meter (3.3-foot) global average sea level rise scenario (through 2025;

Clough and Larson 2010). In 100 years, 98% of this component of the barrier beach on Dungeness Spit is predicted to be lost to sea level rise based on the same 1-meter (3.3-foot) scenario (Clough and Larson 2010). There is some uncertainty in the results due to a lack of precise geospatial data used in the models. For this reason, we will perform studies to assess variables that affect sea level rise rate scenarios (e.g., sedimentation, geospatial extent of the spit and salt marshes, etc.).

Barrier Lagoons and Mudflats

Intertidal life is affected by light level, temperature change, amounts of oxygen, pH, salinity, and exposure to air and wind. These ecological attributes are primarily determined by current, wind, and tidal processes. Predominant threats include contamination by oil spills, creosote, and other chemicals; invasive species; and climate change. By their very nature, barrier lagoons are partially protected from oil spill contamination; however due to the limited tidal action within this habitat type, they are also more vulnerable to persistence of contaminants (for more information, see Section 4.1.2; USEPA 2008).

Plate tectonic processes are currently causing geologic uplift along the shoreline of the northern Olympic Peninsula. These processes further complicate predictions of the effects of sea level rise on the barrier lagoons and mudflats of Dungeness NWR. For instance, the historic (100 year) trend of 1.085 millimeters/year (0.04 inch/year) rise in sea level for the Dungeness area is lower than the global 100 year trend of 1.7 millimeters/year (0.07 inch/year) (Clough and Larson 2010) as a result of uplift. In addition, according to a study completed in 2000, a 35% reduction in water volume has occurred in Dungeness Harbor from 1967 through 2000 (Rensel 2003). Several natural factors have influenced this loss of capacity including deposition of sediment from the longshore drift originating from the Strait of Juan de Fuca and the Dungeness River. Subsequently, an increase of 6% has been observed in tidal mudflats in the harbor (Rensel 2003). However, recent SLAMM results for Dungeness NWR reveal that the area of mudflats may be reduced by 4-6% based on 1-meter to 1.5-meter (3.3-foot to 4.9-foot) global average sea level rise scenarios respectively within the time span of this CCP (Clough and Larson 2010). Effects of climate change that will impact intertidal organisms have already been reported in the Puget Sound including warmer sea surface temperatures, decreased summer precipitation and decreases in snow pack. Research has shown that sea surface temperatures in the Strait of Juan de Fuca during the 1990s were the warmest recorded in written history (since the 1840s; Snover et al. 2005). Increased sea surface temperatures affect the productivity and survival of plankton, the base of the nearshore food web.

The Service is conducting an early detection monitoring program for European green crab on the Refuge and surrounding environments; however this species has not been detected on or near the Refuge. Green crabs are considered very invasive and have a negative impact on native species through competition (with native crabs) and predation (with native clams, mussels, juvenile fishes and other species; Eissinger 2009). Common cordgrass was initially found within the barrier lagoon on Dungeness Spit in 2007 and approximately 27 square feet was removed. It has been found and removed each year since that time. In 2011, approximately 6 square feet was removed. Mechanical means of control have been sufficient to keep up with this infestation. This species can significantly alter mudflat habitat by raising the elevation of the benthic layer to elevations above high tide by trapping sediment in the water column. During two surveys for eelgrass in 2003 and 2009 in Dungeness Bay, Japanese eelgrass was not observed (Norris and Fraser 2009, Dowty et al. 2005). This species typically grows within the intertidal zone and can be found in Puget Sound; however, it is a nonnative plant.

Eelgrass Beds

In 1987, approximately 300 acres of eelgrass beds were delineated via remote sensing in the tidelands (Wilson 1988). During a follow-up survey in 1991, the total area had been reduced with the loss of all areas designated as "sparse," a 39% reduction in "patchy," and a 27% loss of "dense" eelgrass beds in Dungeness Harbor (the largest area of eelgrass in Dungeness NWR; Wilson 1993). The reasons for this decline vary, but a portion of the loss was attributed to the dynamic nature of intertidal areas and former eelgrass beds covered by sea lettuce (Wilson 1993).

Research has shown that sea surface temperatures within the Strait of Juan de Fuca have increased with the 1990s noted as the warmest decade on record since the 1840s; researchers expect the warming trend to continue (Snover et al. 2005). Climate change may induce temperature stress which limits growth of eelgrass. In addition, sea level rise may increase water depths to levels that will no longer be suitable for eelgrass. However, this is complicated by a gradual infill noted in Dungeness Harbor as well as mild geologic uplift occurring on the northern Olympic Peninsula (for more information, see Barrier Lagoons and Mudflats above). Another mortality factor that may become more of a threat due to climate change-related impacts is a wasting disease that affects eelgrass through a slime mold-like pathogen (*Labyrinthula*). *Labyrinthula* occurs naturally in eelgrass beds, but high levels have caused significant mortalities in eelgrass on the east coast of the U.S. and in Europe. This pathogen is present in the Puget Sound; however, it has not caused significant mortality. When eelgrass begins to stress, such as at lower salinities or with increased pollution, the *Labyrinthula* pathogen is stimulated and mortalities ensue (Muehlstein et al. 1991, Burdick et al. 1993). While lower salinities are not predicted, other environmental stressors related to climate change may combine with wasting disease leading to unanticipated effects.

The Washington Department of Natural Resources began to monitor eelgrass distribution throughout the Salish Sea in 2000. The Puget Sound Submerged Vegetation Monitoring Project: 2000-2002 Monitoring Report, provided an estimate of eelgrass beds covering Puget Sound of 72 square miles or 45,961 acres (186 square kilometers or 18,600 hectares), which include beds on flat, narrow, and wide fringed areas (Berry et al. 2003). The report from 2009 showed that eelgrass covered 85 square miles or 54,363 ± 8,895 acres (220 square kilometers or 22,000 ± 3,600 hectares) in the same areas (Gaeckle et al. 2011). This shows a slight increase in the overall Salish Sea eelgrass population, but a declining trend on more individual sites within the Salish Sea is troubling.

Salt Marsh

Over half of the nation's population live and work within coastal counties. The cumulative impact within the watershed surrounding salt marshes can be substantial. Loss or degradation (e.g., in-filling, channelizing, or reducing inflow) of salt marshes has been greatly minimized due to federal and state laws, yet a number of threats to salt marsh habitats still exist. Nonpoint-source pollution from runoff originating from roads (petroleum products from cars), farms, and lawns (pesticides and fertilizers) is difficult to control. Pollution may disrupt the food web in the salt marsh by killing some species while prompting others to greatly increase in number.

Due to the limited extent of salt marsh habitats on the Refuge, minimal change is predicted as a result of sea level rise within the time span of this plan (i.e., 2025 under the 1-meter and 1.5-meter [3.3-foot and 4.9-foot] rise scenarios in SLAMM; Clough and Larson 2010). Sea level rise can cause loss of the salt marsh through increased erosion and excessive flooding of marsh plants (Chabreck 1988). This threat can be minimized by natural accretion (accumulation of sediment and organic matter within the marsh) if it can keep pace with sea level rise. Studies of accretion rate within the Salish Sea have shown that salt marshes in this area have the capacity to keep up with sea level rise so long

as the sediment supply remains similar to that received currently (Thom 1992). However, any significant erosion of the barrier beach would likely damage or eliminate the marshes. Model results using SLAMM can be improved, particularly by increasing the accuracy of the geospatial data used in the model (e.g., the south marsh is not delineated) and incorporating effects from other stressors due to climate change. As a result, we will perform studies to assess variables associated with climate change stressors (e.g., accretion, salinity, driftwood recruitment, etc.) and to improve the data used in local-scale sea level rise modeling.

For more information on the threat of oil spills and creosote-covered logs, see Section 4.1.2.

4.3.3 Key Species Supported

Sandy Bluffs
The concept of BIDEH, as defined by USFWS policy (601 FW 3.3), applies not only to species but also to habitats and those ecological processes that support them. Sandy bluffs are important to the maintenance of biological integrity and environmental health of associated nearshore habitats of the Refuge. Species supported by management of sandy bluffs include pigeon guillemot and glaucous-winged gulls.

Barrier Beach
Barrier beach habitat provides necessary haul out and pupping locations for harbor seals and the occasional northern elephant seal, particularly in the closed areas of the Refuge. Raptors such as northern harrier, peregrine falcon, bald eagle, and short-eared owl use the driftwood as hunting perches and/or shelter from the weather. Overwintering shorebirds (sanderling, dunlin and black-bellied plover) and harlequin ducks roost on the shoreline during the winter months. Breeding black oystercatchers, glaucous-winged gulls, Caspian and Arctic terns nest on the sandy shoreline particularly in the closed areas of the Refuge. Migrant birds such as the western and least sandpipers as well as Heermann's, mew and western gulls can also be seen in small flocks in barrier beach habitat during the spring and fall migration. The interior portion of the barrier beach on Graveyard Spit has been recognized for its unique native strand community supporting an abundance of American dunegrass, large-headed sedge, red fescue, silver burweed and black knotweed, to name a few. Focal resources for barrier beach habitat include Pacific harbor seal, American dunegrass, and large-headed sedge.

Barrier Lagoons and Mudflats
Barrier lagoons and mudflats provide foraging habitat for dunlin, western and least sandpiper, sanderling, black-bellied plover, black oystercatcher, and glaucous-winged gulls. Brant, American wigeon, northern pintail, mallard, and green-winged teal roost in this habitat type between foraging bouts especially during migration and the winter months. Dungeness crab, anadromous and forage fish forage within this habitat type throughout the year. Dunlin has been selected as a focal resource for this habitat type.

Eelgrass Beds
Eelgrass beds, or meadows, support a fantastic array of life. Many species are very dependent on these plants for their very existence, while others are more loosely connected to this habitat. Species such as brant, snails, and urchins eat the leaves directly, Pacific herring spawn on the leaves, and highly productive bacteria in the sediment are protected and nourish many invertebrates (e.g., crab larvae) because of the oxygen pumped into the sediment by the roots of the eelgrass. Anadromous

and forage fish are sheltered by the leaves and forage on invertebrates in the water column. Eelgrass beds provide important migrant staging and winter habitat for 1,000 to 3,000 brant composed predominantly of the black brant population. A small percentage of the intermediate or grey population can be found here. Other species of waterfowl such as northern pintail, mallard, and American wigeon are common during the winter months with abundance ranging from 500-1,500 per species. Eelgrass has been selected as the focal resource for management of eelgrass beds.

Salt Marsh

Salt marshes are among the most productive ecosystems on earth because they contribute greatly to the base of the food chain. In aquatic systems, this food chain starts with phytoplankton. These algae are consumed by minute floating animals called zooplankton; anadromous and forage fishes; and marine invertebrate larvae, to name a few. Because salt marsh productivity is often the key to the health of the surrounding estuary, marine invertebrates (e.g., Dungeness crabs) have been selected as focal resources of this habitat type. Other benefiting species that occasionally use the salt marsh include glaucous-winged gull, dunlin, mallard, American wigeon, northern pintail, great blue heron, northern harrier, and short-eared owl.

Table 4-1. Focal Resources Associated with Nearshore Habitats

Focal Resources	Habitat Type	Desired Habitat Characteristics	Life History Requirement	Other Benefiting Species
Biological Integrity	Sandy Bluffs	Limit impervious surfaces within 150 feet of the top of the bluff; No public use of the bluff toe or face at any time; No hard armoring (e.g., rip rap) on shoreline adjacent to the bluff	N/A	Pigeon guillemot and glaucous-winged gull
Pacific Harbor Seal	Barrier Beach	Natural deposition and/or erosion of sand and gravel; Continuous ridge of sand and gravel rising a short distance above high tide; Materials derived from erosion of nearby sandy bluffs; Absence of marine debris; Presence of driftwood along the "backbone" of Dungeness Spit and the eastern side of Graveyard Spit; No human-caused wildlife disturbance during seasonal and year-round closures; Absence of man-made or natural fires; Minimal to no impact from oil spills or other contaminants; Minimal creosote-covered logs	Year-round	Northern elephant seal; sanderling; western and least sandpiper; dunlin; black oystercatcher; Heermann's, western, and glaucous-winged gulls; Caspian tern; harlequin duck; bald eagle; peregrine falcon; northwestern crow

Focal Resources	Habitat Type	Desired Habitat Characteristics	Life History Requirement	Other Benefiting Species
American Dunegrass, Large-headed Sedge	Barrier Beach	Natural deposition and/or erosion of sand and gravel; Continuous ridge of sand and gravel rising a short distance above high tide; Materials derived from erosion of nearby sandy bluffs; Presence of native strand plants; Absence of marine debris; Presence of driftwood along the "backbone" of Dungeness Spit and the eastern side of Graveyard Spit; <1% total cover of Dalmatian toadflax and <20% total cover of cheat grass; No human-caused wildlife disturbance during seasonal and year-round closures; Absence of man-made or natural fires; Minimal to no impact from oil spills or other contaminants; Minimal creosote-covered logs	Year-round	Black knotweed, silver burweed, yellow sand-verbena, red fescue, northern harrier, peregrine falcon, snowy owl, short-eared owl
Dunlin	Barrier Lagoons and Mudflats	Absence of *Spartina spp.*; Substrate primarily composed of fine silt; Shallow gradient benthic layer (i.e., <10 cm [3.9 inches]); Absence of human-caused wildlife disturbance from Oct 1-May 14 on Refuge portions of Dungeness Harbor and Bay; no human-caused wildlife disturbance year-round to the lagoons within the spits; No creosote-covered logs on or near mudflats and the barrier lagoon habitats; Absence of marine debris	Winter, Migration	Black-bellied plover; black oystercatcher; western and least sandpiper; western and glaucous-winged gulls; bald eagle, northwestern crow; brant; American wigeon; northern pintail; mallard, green-winged teal; Dungeness crab; young salmon and forage fish
Eelgrass	Eelgrass Beds	Intertidal areas with muddy to sandy substrates; Depth range from +0.4 to -8.8 meters (+1.3 to -28.9 feet), average is -3.5 meters (-11.5 feet; relative to MLLW); Low- to moderately high-energy environments (waves and currents); Absence of marine debris; Absence of human-caused wildlife disturbance from Oct 1-	Year-round	Brant; American wigeon; northern pintail; mallard, green-winged teal; greater and lesser scaup; surf, white-winged and black scoters; common and Barrow's goldeneye;

Focal Resources	Habitat Type	Desired Habitat Characteristics	Life History Requirement	Other Benefiting Species
		May 14 on the Refuge portion of Dungeness Harbor and Bay		Dungeness crab; young salmon and forage fish
Marine Invertebrates	Salt Marsh	Vegetation dominated primarily by glasswort (*Salicornia* spp.); Infrequent inundation except at highest high tides; Maximum of 40% coverage by driftwood; Absence of man-made or natural fires; Absence of creosote-covered logs; <1% invasive plant species (e.g., Common cordgrass) cover; No human-caused wildlife disturbance year-round	Year-round	Glaucous-winged gull, dunlin, mallard, American wigeon, northern pintail, great blue heron, northern harrier, short-eared owl

4.3.4 Refuge Management Activities

Due to the dynamic nature of tidal habitats, there are relatively few viable actions available for management of nearshore habitats. As a result, current management activities are focused on reducing or eliminating invasive species, human-caused wildlife disturbance, and/or threats from contaminants and fires within nearshore habitats.

Because invasive plants and animals currently represent the greatest threat to the Refuge's wildlife and habitat, control of invasive species is a high priority management activity. Invasive species such as common cordgrass and State and County-listed noxious weeds are managed according to IPM policies. In addition, nonnoxious weeds such as Himalayan blackberry, English holly, and English ivy, and introduced animals such as feral cats are under management control to the degree that funding permits. Common cordgrass was initially found within the barrier lagoon on Dungeness Spit in 2007 and approximately 27 square feet was removed. It has been found and removed each year since that time. In 2011, approximately 6 square feet was removed. Mechanical means of control have been sufficient to keep up with this infestation. The Service has been participating in an early detection monitoring program for European green crab with WDFW. Currently the green crab has not been detected in the Salish Sea.

Public use closures have been set in place to protect the integrity of habitat and reduce introduction of invasive species. The sandy bluff, Graveyard Spit and the tip of Dungeness Spit are closed year-round; the tideland areas and the first half mile of the bay side of Dungeness Spit are closed seasonally from October 1 through May 14. Under the management direction in this CCP, public use activities on the Refuge will include saltwater fishing, shell-fishing (clams and crabs), wildlife observation, wildlife photography, hiking, no-wake boating, jogging, horseback riding (should alternative access be obtained per compatibility determination), beach use (wading, other recreational beach uses), environmental education, and environmental interpretation.

Refuge staff actively coordinates with the Washington Department of Ecology and others in preparing Area Geographic Response Plans and conducting periodic drills to test preparedness for oil spill response. Staff also participates in local marine resource committees and water quality action

teams to address water quality issues within Dungeness Bay and Harbor, such as reduction of contaminants recently through removal of creosote-covered logs and removal of derelict crab pots in 2006. In addition, fire suppression techniques follow the Fire Management Plan completed for the entire Complex in 2004 which includes the prevention of catastrophic wildfire to promote the retention of driftwood and vegetation on the barrier beaches.

4.4 Mixed Coniferous Forests

4.4.1 Overview

This habitat type occurs in a mosaic of two ecological systems: North Pacific Maritime Dry Mesic Douglas-fir-Western Hemlock Forest and North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest. Sites where moisture is high are codominated by western redcedar, Douglas-fir, Western hemlock and/or grand fir, with significant amounts of sword fern in the understory. Red alder is found as an overstory tree in some forests where clear-cut harvest formerly occurred, along riparian areas, and as an understory tree in younger conifer forests and areas of recent disturbance. Understory shrub and herbaceous vegetation in these forest types typically include salal, oceanspray and sword fern.

Forests currently occupy approximately 180 acres of Dungeness NWR. There are approximately 57 acres of second-growth forest within the Dungeness Unit and 123 acres of second-growth within the Dawley Unit. A relatively homogenous stand of Douglas-fir is located along the western boundary of the Dungeness Unit with DBH ranging from 10-20 inches and canopy cover ranging from 40-70%. This stand supports few short snags (up to 20 feet) and a dense understory composed primarily of oceanspray and salal. To the north and west, the forest becomes a more complex stand of second-growth dominated by Douglas-fir, western hemlock, and western redcedar. This forest supports a mosaic of snags; downed woody debris; broken-top or candelabra-shaped trees; live trees of various heights and diameters; as well as a varied understory dominated by sword fern, oceanspray and salal. The Dawley Unit supports a similar stand as that found within the north and west of the Dungeness Unit.

There are approximately 5 acres of hardwood forest adjacent to the second-growth conifer forest along the southeast corner of the Dungeness Unit. Vegetation in this habitat consists primarily of red alder with an understory of red elderberry, Oregon grape, false lily-of-the-valley and sword fern. Canopy cover is roughly 75-95% with average tree heights of 50-60 feet. A small (<0.10 ac) seasonal palustrine wetland and adjacent small depressions that hold standing water in wet winters can be found within the center of this stand.

Historically, a moderate-severity fire regime involving occasional stand-replacement fires and more frequent moderate-severity fires created a complex mosaic of stand structures across the landscape. Currently, logging also plays a key role. Key attributes in maintaining or enhancing mixed coniferous forest include the presence of fire as a management tool, forest structure (e.g., diversity of tree species, canopy cover and layers, shrub and forb understory snags and downed woody debris), connectivity to adjacent forested habitats, and minimizing human-caused wildlife disturbance.

4.4.2 Regional Distribution, Conditions and Threats

Forests in western Washington have been extensively managed for timber production; today, 3% of forests in this area are considered old-growth (WDFW 2005). Managed forests are typically composed of Douglas-fir and western hemlock. Harvest of old-growth and mature forests for commercial timber and paper production has resulted in loss of species diversity and forest complexity on most of the landscape due to planting of even-aged, monotypic stands, and short harvest rotations.

The first saw mill on the northern Olympic Peninsula was established in Port Ludlow in 1852. However, logging activity expanded when a steam mill was completed in Port Gamble in 1853. By the end of its first full year in operation, the mill had cut more than 3.5 million board feet in the mid- to late-1800s. From 1915 to 1980, the Milwaukee Road operated the rail line from Port Townsend to Port Angeles and then west to connect with several logging railroads. The primary cargo carried by the railroad was Olympic Peninsula timber. Logging peaked in the 1980s prior to enactment of environmental legislation limiting timber harvest.

The forest stands within both units are currently second-growth with remnant patches of mature forest, but also lack key old-growth forest characteristics such as downed woody debris and snags. In addition, both stands support small (<5 acre) red alder stands located in near or around small wetlands. Blow down is a recurring natural event, particularly within the Dungeness Unit which is exposed to significant wind events along the Strait. Historically, occasional intense winter windstorms occurred with a frequency of once or twice every few decades, although their frequency has increased during this decade. Major stand-replacement fires impacted much of the Olympic Peninsula in the early 1500s and 1700s. There are signs of fire scars and areas of dense regrowth (180 trees/acre vs. 50-100 trees/acre found in typical stands) within the Dawley Unit, but there is no record of the event. Mistletoe has been found in the northwest section of the Dawley Unit.

Threats facing the forested habitats on Dungeness NWR include altered fire regime, climate change, invasive species, insect or disease infestation and human-caused wildlife disturbance. Response to climate change will vary according to regional and local topography, forest type, soil moisture, productivity rates, species distribution and competition, and disturbance regimes. Many of the effects of climate change may not be readily observed until a disturbance mechanism, such as fire, occurs. Once disturbance alters the landscape, vulnerable species may not be able to regenerate in altered stand-level environments such as low summer soil moisture levels. However, based on the projected changes in the spatial and temporal patterns of temperature and precipitation associated with climate change, some general patterns can be described (adapted from Aldous et al. 2007):

- Species distributions are likely to change. Cool coniferous forests in the western part of the Pacific Northwest will contract and be replaced by mixed temperate forests over substantial areas. Douglas-fir appears relatively sensitive to low soil moisture, especially on drier sites.
- Increasing temperature will generally increase forest fire frequency and extent by increasing rates of evapotranspiration leading to a decrease in fuel moisture.
- The change in seasonality of precipitation could lead to a drier growing season, increasing water stress and higher mortality of forest vegetation unable to adapt.
- Warmer temperatures could lead to a change in the timing of reproduction, which may lead to asynchronies between flowering and pollinator activity, fruit ripening and foraging by fruit consumers or predator behavior by pest-eating species.

- An increase in extreme weather events (e.g., wind storms) could change the frequency of disturbance, leading to a shift to forests that are younger and species that are more fast-growing, short-lived, and disturbance-tolerant.
- Warmer temperatures could increase development of insect and other pathogen outbreaks, as well as extend their growing season, potentially leading to an increase in the frequency and extent of outbreaks.
- Some tree species may experience an increase in productivity if carbon dioxide acts as a fertilizer and allows trees to increase their water use efficiency. However, this increased productivity, coupled with warmer temperatures, longer growing seasons and prolonged drought may also increase fire frequency and severity.

Human-induced wildfires, as well as fire suppression, are potential catastrophic threats to forested habitats. Conversion of habitat to residential and nonforest uses has accelerated forest fragmentation. Additionally, illegal activities such as firewood collection, trail proliferation, and general trespass have the potential to cause disturbance to wildlife and also have the potential for introduction of invasive plant species into closed areas of the Refuge. Introduced invasive plants (e.g., English ivy and holly) pose threats to forested habitats on the Refuge. Potential insects or diseases that could affect the Refuge's forests include aphids, scale and bark beetles, root rot, leaf cast, and other fungi.

4.4.3 Key Species Supported

The focal species for Mixed Coniferous Forests is the pileated woodpecker. Mixed coniferous forests provide nesting habitat for downy and hairy woodpeckers; red-breasted sapsucker; rufous hummingbird; bald eagle; sharp-shinned and Cooper's hawks; Pacific-sloped flycatcher; northwestern crow; chestnut-backed chickadee; Bewick's wren; golden-crowned kinglet; Townsend's warbler; spotted towhee; and pine siskin, to name just a few. Other species such as varied thrush visit during the winter months. American black bear, bobcat, elk, deer, and ermine can be found here year-round. Many bats and amphibians are associated with mixed coniferous forests including Townsend's big-eared bat; Keen's, long-eared and long-legged myotis; ensatina and northwestern salamander.

Table 4-2. Focal Resources Associated with Mixed Coniferous Forests

Focal Resources	Habitat Type	Desired Habitat Characteristics	Life History Requirement	Other Benefiting Species
Pileated Woodpecker	Mixed Coniferous Forest	Multi-aged, multi-layered, multi-species canopy consisting of Douglas-fir, western redcedar, western hemlock, and bigleaf maple; Natural gaps in the canopy that promote regeneration of the dominant tree species; 8 dominant (old-growth and mature) trees 100-200+ years old with tree diameters >32 inches DBH/ acre; 12 sub dominant trees with >16 inches DBH/acre; >4 snags	Year-round	Marbled murrelet; downy and hairy woodpeckers; red-breasted sapsucker; rufous hummingbird; bald eagle; sharp-shinned and Cooper's hawks; northern saw-whet owl; Pacific-slope flycatcher; Hutton's vireo; northwestern crow; chestnut-backed chickadee; Bewick's

Focal Resources	Habitat Type	Desired Habitat Characteristics	Life History Requirement	Other Benefiting Species
		of >20 inches DBH and >15 feet tall/acre; 4 pieces of downed woody debris >24 inches diameter and > 50 feet long/acre; Density range of 50-100 trees/acre; <10% of invasive species (e.g., spurge laurel, English ivy, English holly) in the forest structure		wren; golden-crowned kinglet; varied thrush; orange-crowned and Townsend's warbler; spotted towhee; pine siskin; Townsend's big-eared bat; Keen's, long-eared and long-legged myotis

4.4.4 Refuge Management Activities

Since becoming part of the National Wildlife Refuge System, there have been very limited management actions within the forested habitat of either unit. Both units were harvested selectively prior to acquisition by the Refuge. Active IPM has occurred in both units primarily in control of English holly and English ivy. Additional invasive species under control on the Dawley Unit include spurge laurel. Although no fires have been noted within the forested habitats in recent history, the Refuge ascribes to a full fire suppression policy.

4.5 Wetlands

4.5.1 Overview

Seasonal Freshwater Wetlands
A small (< 0.05 acre) seasonal palustrine wetland is located in the uplands of the Dungeness Unit. This linear wetland is dominated by slough sedge and water hemlock. It is capable of supporting two pools with 8-10 inches of standing water. This wetland is likely formed over a high water table with either clay or compacted soil forming a barrier to drainage. A similar 0.05 acre wetland is located on the Dawley Unit; however, this wetland is deeper and holds water longer into the summer.

This habitat is driven largely by precipitation and, to a minimal extent, snow melt. Key ecological attributes include water quality (sedimentation, pH, alkalinity, dissolved oxygen and phosphorous, etc.) and hydrologic regime (annual precipitation cycle and temperature), plant community structure (presence/absence of invasive species, density of vegetation, etc.), and absence of human-caused wildlife disturbance.

Instream and Riparian Forest
A short (0.25 mile) reach of Dean Creek runs through the Dawley Unit beginning at river mile 0.6 from Sequim Bay. The western half of this intermittent creek is dominated by cascades (ranging from 1-6 feet tall) with some small pools (approximately 3 feet in diameter) and averages 3 feet wide (during spring runoff). Most of the small pools are ~1-1.5 feet deep; however, there are a few larger pools that are deeper. The eastern half of the creek as it runs through the property is primarily made up of ripples with little pooling. The creek widens to approximately 8 feet with an average depth of 1

foot. The banks of the creek are very steep and highly erodible with a primary substrate of loose gravel.

A limited amount of lowland riparian forest occurs along Dean Creek. Riparian and wetland forests are highly variable in their composition, size, and structure. Functioning floodplains are influenced by high-flow events that shape stream channels and riparian vegetation through a process of pulse disturbances. The high density of edges contributes to habitat and species diversity and productivity.

This system is driven by the amount and timing of snow melt and precipitation. Key ecological attributes include water quality (sedimentation, pH, alkalinity, dissolved oxygen and phosphorous, etc.) and hydrologic regime (annual precipitation cycle and temperature), plant community structure (presence/absence of invasive species, density of vegetation, etc.), and absence of human-caused wildlife disturbance.

Ownership of the property includes water rights to Dean Creek dating back to 1960 for irrigation and domestic water uses.

Managed Wetland
A small (0.39 acre) impoundment is located within the center of the Dawley Unit. This impoundment is capable of holding up to 8 feet of water. It is surrounded by shrubs, trees and understory vegetation on three sides and an earthen dam on the southern edge which is dominated by forbs and grasses. A small (8 feet in diameter) island is located near the northern edge of the impoundment.

Water levels are maintained largely by a man-made, gravity fed system which delivers water from Dean Creek to the impoundment. Water is also supplied by runoff and precipitation. Key ecological attributes include water quality (sedimentation, pH, alkalinity, dissolved oxygen and phosphorous, et.) and hydrologic regime (annual precipitation cycle and temperature), plant community structure (presence/absence of invasive species, density of vegetation, etc.), and absence of human-caused wildlife disturbance.

4.5.2 Regional Distribution, Conditions and Threats

Seasonal Freshwater Wetlands
The condition of these two wetlands is unknown; however, they appear to be healthy as indicated by the presence of amphibians, native vegetation, and aquatic invertebrates.

The amount of water and consequently the duration of the seasonal wetlands vary with the level of precipitation and temperatures throughout the year. Therefore, these wetlands could be threatened by climate change-induced alteration of temperature and precipitation cycles. In fact, wetlands are predicted to be the most vulnerable to climate change of all aquatic systems (Lawler and Mathias 2007) due to predicted effects.

Instream and Riparian Forest
Clallam County Streamkeepers rates Dean Creek as Highly Impaired due to development in the upper reach, poor bank stability, stream bed scour, low flows, and barriers to passage for aquatic species. The main road adjacent to the western section of this habitat has steep cut banks and signs of slope failure. However, partially submerged downed woody debris, falls and ripples are present throughout this reach.

Because the stream flow is determined largely by the amount of snowpack, timing, and rate of melt, climate change has the potential to heavily impact instream habitat conditions. Climate change has already affected the hydrologic cycle in Washington with earlier and more extreme spring floods and reduced spring/summer flows. From 1948-2003, the total annual inflow of freshwater into the Puget Sound declined by 13% due to changes in precipitation (Snover et al. 2005). In addition, temperatures have increased by 2.7° F since 1950 in the Puget Sound (Snover et al. 2005). These changes have resulted in lower summer stream levels, increased incidences of flooding events, particularly in the winter months, and increased incidences of streambed scour. Lawler and Mathias (2007) predict a variable increase in precipitation in the winter months with a decrease in the summer months.

Further, development or logging of adjacent uplands and potential erosion also pose a serious threat to water quality in instream habitats.

Managed Wetland
The condition of the impoundment appears to be healthy as indicated by the presence of amphibians, native vegetation, and aquatic invertebrates. It is surrounded by forested habitat on all sides which adds nutrients to freshwater inflow. Suitability for amphibians is limited due to lack of submerged woody debris and a water control structure to manage for shallow water.

4.5.3 Key Species Supported

Seasonal Freshwater Wetlands
The focal resources for this habitat type are amphibians (Pacific chorus frog, rough-skinned newt, and northwestern salamander with a potential for long-toed salamander, western toad and red-legged frog). Bat species associated with seasonal freshwater wetlands for foraging include: Keen's and long-legged myotis.

Instream and Riparian Forest
Focal resources for these habitats include instream amphibians (potential for Cope's giant and Olympic torrent salamanders, and Cascades and coastal tailed frogs). Bat species associated with instream habitats for foraging include Townsend's big-eared and silver-haired bats and long-legged myotis. Historically, Dean Creek likely supported coho salmon and steelhead trout; however due to the low flow at the mouth of the creek and several barriers to passage, presence is highly unlikely.

Managed Wetland
The focal resources for this habitat type are amphibians (red-legged frog, Pacific chorus frog, rough-skinned newt, and northwestern salamander with a potential for long-toed salamander, and western toad). Mallard, great blue heron, wood duck, and Canada goose occasionally forage and rest in the impoundment during the nonbreeding period. Wood ducks historically nested within the wood duck boxes placed around the impoundment; however, these have since aged beyond repair. Bat species associated with wetlands for foraging include: Keen's and long-legged myotis.

Table 4-3. Focal Resources Associated with Wetlands

Focal Resources	Habitat Type	Desired Habitat Characteristics	Life History Requirement	Other Benefiting Species
Amphibians	Seasonal Freshwater Wetlands	Conditions vary from dry in late summer to as high as 3 feet in spring; Up to 80% short emergent vegetation (e.g., *Scirpus*, *Carex*, and *Juncus* spp.); Up to 10% cover of downed woody debris from the shoreline into the wetland; Absence of aquatic invasive plants and animals (e.g., American bullfrog, purple loosestrife, or Bohemian knotweed).	Year-round	Mallard, great blue heron, long-toed salamander, western toad, red-legged frog, Keen's and long-legged myotis
Instream Amphibians	Instream	Intact riparian corridor providing stream surface shade of 60-80%; Overstory riparian vegetation characterized by red alder, bigleaf maple, Douglas-fir, and western redcedar; Understory riparian vegetation characterized by Pacific rhododendron, salal, salmonberry, sword fern; <10% cover of invasive plants; Low amounts of fine sediments; Cool temperatures (<73°F) with a preferred temperature range (40-58°F); Well-oxygenated water, with dissolved oxygen levels >5 parts per million; Instream presence of large woody debris.	Varies	Cope's giant and Olympic torrent salamanders; Cascades and coastal tailed frog; coho (potential); steelhead (potential); Townsend's big-eared and silver-haired bats; long-legged myotis
Amphibians	Managed Wetland	Up to 80% short emergent vegetation (e.g., *Scirpus*, *Carex*, and *Juncus*); <20% of tall emergent vegetation (e.g., cattail); 10% cover of partially submerged, downed woody debris along the shoreline; <30% cover of shrubs and trees on the shoreline (e.g., salmonberry, redcedar, and hemlock saplings); Absence of invasive and nonnative species (e.g., American bullfrog and nonnative fish).	Year-round	Mallard, great blue heron, long-toed salamander, western toad, red-legged frog, Keen's and long-legged myotis

4.5.4 Refuge Management Activities

The impoundment was created at the Dawley Unit prior to acquisition by the Refuge. It appears to have been maintained by Mr. Dawley to support wildlife (a small nesting island and wood duck nesting boxes can be found in the impoundment). In addition, this structure may also support water levels in a nearby spring box which is part of the water delivery system for an adjacent residential parcel down slope. Consequently, high water levels are maintained by an existing water control valve which does not allow for maintenance of shallow water. Additional management includes control of woody vegetation on the dike along the southern shoreline of the impoundment to maintain the dike's structural integrity.

The only management action within the instream habitat has been limited water withdrawal to maintain water levels in the impoundment. No management activities have been implemented within the small seasonal wetlands on either unit.

4.6 Pileated Woodpecker

4.6.1 Overview

Pileated woodpeckers can be found year-round on the Olympic Peninsula. This species has been selected as a focal species for this plan because it plays a key role in the creation of habitat for other forest wildlife (e.g., owls, forest carnivores, etc.) through cavity excavation activities. Cavity excavation also facilitates creation of new snags and downed woody debris, a key component that is currently lacking in the forest structure of the Dawley Unit. Partners in Flight have identified this species as indicative of large snags located in multi-layered, mature forest (Altman 1999). Key attributes include forest structure and composition (see Section 4.6.3, Key Habitat Used, below). Important processes include natural disturbance regimes (e.g., fire, windthrow, and flood intervals) particularly as they maintain a mosaic of mature to old-growth forested habitat with a variable age class of appropriately sized snags.

Foraging activity has been observed on both units within small, remnant stands of mature forest.

4.6.2 Regional Distribution, Conditions and Threats

This species is a fairly common resident within suitable habitat throughout Washington. However, distribution is limited to elevations that support large trees for nesting, roosting and foraging. In addition, suburban landscapes with a higher percentage of forested habitats had higher densities of pileated woodpeckers in the rapidly urbanizing region around Seattle, WA (Blewett and Marzluff 2005). Historic distribution has declined concurrently with the loss of mature and old-growth habitat. This species is listed as Sensitive by the State.

Threats include loss of habitat, especially the decrease in density of large snags (>21 inches DBH) and large hollow trees, as well as loss of mature to old-growth forest mosaic with a size sufficient to support the species. Timber harvest has the most significant impact on habitat in the western U.S. Forest fragmentation and removal of large-diameter live and dead trees reduce habitat suitability and makes birds more vulnerable to predation. In addition, burning slash piles as a fuel reduction treatment after harvest effectively eliminates habitat (logs, snags and stumps) for prey species (e.g.,

carpenter ants). Bull et al. (2005) found that foraging activity was more abundant in untreated stands or in stands where fuels were reduced mechanically, largely because carpenter ants were more abundant in these stands when compared to the harvested and burned stands. Pileated woodpeckers have continued to use a 15-hectare (37-acre) old-growth stand for nesting and roosting before, during, and after it was selectively logged with a treatment that reduced fuel loads and accelerated regeneration because all green trees of any size and all snags and logs >37 centimeters (14.6 inches) DBH were retained; only small-diameter dead wood was removed (Bull and Jackson 2011).

4.6.3 Key Habitat Used

This species requires larger snags (5-18 snags >21 inches DBH and >25 feet tall/acre) or decadent trees (live trees with dead or broken tops) in early to moderate stages of decay for foraging, roosting and nesting (Mellen-McLean 2011). They occupy a relatively large home range size (minimum of 2,100 acres) within mature to old-growth, mixed coniferous forests.

4.7 Dunlin

4.7.1 Overview

Dunlin are one of the most abundant migrant shorebirds in the northern hemisphere. Within the Refuge, highest abundance is found along the inner side of Dungeness Spit and the coastal lagoon of Graveyard Spit where this species forages and roosts during low tide. Dunlin are the most abundant shorebird in this area during the winter months (Nov-Feb) with numbers regularly reaching 4,000 on the Refuge (Sue Thomas, pers. obs.). Numbers are somewhat reduced during spring with estimates ranging from 675-1,220 (Apr-May; Evenson and Buchanan 1997). Limited abundance (typically no more than 40) of roosting birds can be found along the outer side of Dungeness Spit and on the driftwood of the salt marshes during high tide.

Environmental processes important to dunlin include those that affect their preferred habitat type (coastal lagoon and mudflat) including continual, natural erosion of sandy bluff habitat and longshore drift sufficient to maintain the deposition of fine sediment to mudflats and driftwood logs (roosting substrate).

4.7.2 Regional Distribution, Conditions and Threats

Dunlin are one of the northernmost overwintering shorebirds on the Pacific coast. The race found in this area breeds on the Yukon-Kuskokwim Delta (Fernandez et al. 2010). Distribution within the Puget Sound appears to be fluid with flocks frequently moving between several estuaries within the Sound as a response to disturbance, predation, and/or availability of foraging resources. They can be found within the Salish Sea from mid-October to early-May.

The population estimate for dunlin in North America is 1,525,000 with estimates for the *pacifica* subspecies ranging from 500,000 to 600,000; however, confidence in this population estimate is low (Fernandez et al. 2010). The *pacifica* subspecies is listed in the U.S. Shorebird Conservation Plan (Brown et al. 2001) as a subspecies of high concern. Due to a long life span (up to 14 years) and low reproductive output (fledging success estimated at roughly 36%), and limited migration stop-over locations, this species is particularly vulnerable to threats.

Human-caused wildlife disturbance is perhaps the single, most pervasive threat to dunlin in the Salish Sea due to increasing tourism and residential development. Any disturbance, however brief, can reduce the amount of time spent foraging and increase energetic demands through flight. These effects are compounded in the spring staging period when dunlin have a particularly short period of time in the spring to fatten up for the long flight back to their Arctic breeding grounds. If they do not manage to acquire sufficient reserves to arrive on the breeding grounds, lay and incubate eggs, reproductive success will be negatively affected. On the nonbreeding grounds, adult survival is the key limiting factor for this species. Dunlin typically lose body mass over winter and researchers believe this is due to the need to balance good physical conditioning necessary to escape predation, with the high energy costs of foraging (Warnock and Gill 1996). If continually disturbed during this time, dunlin may not be able to consume enough prey to survive, particularly through severe winter storm events, given the low body mass maintained during this time period (Buchanan 2006). If disturbed too frequently in one location, they will avoid that site even if suitable habitat is available.

Due to the vulnerability of this species' preferred habitats (see description of Barrier Lagoon and Mudflat in Section 4.3), dunlin are considered highly susceptible to oil spill contamination. Oil spills can result in direct mortality due to plumage fouling and toxicity, or indirect threats due to reduced invertebrate food resources. Creosote contamination can reduce the abundance of invertebrate food resources as well. A high abundance of forage species is especially important for dunlin prior to migration because an inability to build up fat reserves here can reduce survival and/or reproductive success on the breeding grounds.

Habitat loss and degradation resulting from changes in the influx of freshwater and nutrients; shoreline armoring and changes in deposition of sediment and nutrients; and encroachment of mudflats by invasive plant species (e.g., Common cordgrass; Fernandez et al. 2010) or aquaculture all pose serious threats to dunlin, particularly on the wintering grounds. In fact, the subspecies has experienced a 30-91% loss of wintering grounds throughout its range (Warnock and Gill 1996). This can result in reduced foraging efficiency and overwintering survival as a result of increased density at remaining sites.

Predicted threats associated with climate change include sea level rise inundating low lying coastal habitats such as mudflats and increased frequency and intensity of storms and wave heights, which will negatively affect dunlin due to their vulnerability during the overwintering period and potentially further reduce habitat suitability. For more information, see description of Barrier Lagoons and Mudflats in Section 4.3.

4.7.3 Key Habitat Used

Dunlin primarily forage on mudflats and coastal lagoons. Specifically, they prefer substrates composed of fine silt virtually devoid of vegetation. Dunlin will forage in water up to 2 inches deep. Their main prey includes polycheate worms and tiny, shrimp-like amphipods and tanaids (Warnock and Gill 1996). During high tide they typically roost on the sandy beach and driftwood found on the Refuge, but in a considerably lower abundance.

4.8 Pacific Harbor Seal

4.8.1 Overview

The most abundant, widespread marine mammal on the Refuge is the Pacific harbor seal (harbor seal). They primarily use the barrier beach to pup or molt. Coming on shore is referred to as "hauling out" and is typically dependent on time of day and tidal height. Pinnipeds also haul out to sleep and conserve energy. Within the Salish Sea, they haul out in greatest numbers during their summer/fall pupping and molting season. Pupping season begins in mid-June, peaking from mid-July through August, with some pups born as late as the end of September (Calambokidis et al. 1978).

Key attributes include protection from human-caused wildlife disturbance at haulouts; habitat free of contaminants and marine debris; degradation or loss of habitat; and reduction in food supply. Important processes include ongoing, gradual erosion of bluffs and longshore drift to maintain haulout beaches and processes that affect prey (see Section 4.10, Anadromous and Forage Fish).

4.8.2 Regional Distribution, Conditions and Threats

Harbor seals can be found throughout the northern hemisphere in nearshore waters of the Atlantic and Pacific Ocean. They are nonmigratory, but long distance movements among sites in the North Pacific have been documented (Calambokidis and Baird 1994).

Until 1960, Washington State managed this species through a "bounty" and it was severely depleted until it was protected by the Marine Mammal Protection Act. Currently, the population estimate for Washington is approximately 22,380 (NOAA Fisheries 2011). In Washington and Oregon, harbor seals are divided into two stocks: coastal and inland. Based on summer haulout counts, the population estimate for the Strait of Juan de Fuca is approximately 2,000 seals, which is considered "optimum sustainable population" (Jeffries et al. 2003). Haulout numbers can range from 100-500 seals, particularly near the tip of Dungeness Spit and along the shorelines of Graveyard Spit, all areas closed to public use (Jeffries et al. 2000). This species exhibits strong site fidelity to their usual haulout locations during pupping and molting seasons (Suryan 1998).

The primary threats to harbor seals in the Salish Sea are human-caused wildlife disturbance and habitat contamination. Although harbor seals react differently to disturbance depending on their degree of previous experience, age, sex, location, and life cycle stage, they are all vulnerable to human-caused wildlife disturbance (Sanguinetti 2003). For instance, the first hours after pupping are critical for the pup to imprint on the mother. Without proper imprinting, the mother will not recognize the pup if separated. Abandonment of pups was found to be the primary cause of pup mortality at Grays Harbor (Stein 1989); the most typical cause of abandonment is due to human-caused wildlife disturbance. Within 30-40 days, pups double their birth weight prior to weaning. Without adequate time to nurse, weight gain is impaired and pup mortality rates increase. Some pups are found within the public use area of the Refuge. Typically the mother is nearby foraging or waiting for visitors to pass. The mother will not approach the pup until humans have left the area. This often results in the misconception that the pup has been abandoned. If people remain with the pup for long periods of time, the pup will weaken due to lack of nourishment and stress. If left alone, the mother may return to shore and coax the pup back into the water and to a more protected site.

Seals are popular ecotourism targets, which can multiply the number of disturbances in a day. Increasing ecotourism combined with an increasing human population and marine recreation in the Salish Sea pose a threat to pinnipeds in the area. Several studies have noted that pinnipeds have a disproportional, negative response to approach by kayaks in contrast to other recreational vessels (Szaniszlo 2001, Grella et al. 2001) potentially due to the stealthy, low profile approach of a kayak. In fact, Calambokidis et al. (1991) noted that harbor seals in the southern Puget Sound were disturbed by kayaks at a significantly greater distance than other boats. Persistent human-caused wildlife disturbance can change haul-out patterns.

Catastrophic events, such as oil spills or persistent contaminants, present a threat to harbor seals. High concentrations of chlorinated hydrocarbons (e.g., PCBs) have been noted in harbor seals of the Puget Sound. These contaminants can accumulate in the blubber and lead to birth defects or premature births (Calambokidis et al. 1991). In addition, curious juvenile seals can become entangled in derelict gear or become inadvertently captured in active fishing nets and aquaculture (net pen) operations.

Predicted effects due to climate change include loss of protected haulout habitat to rising sea levels; changes in sea-surface temperatures adversely affecting foraging resources and potentially increasing instances of bacterial infections.

4.8.3 Key Habitat Used

This species primarily uses the barrier beach habitat to haulout. During pupping, mother seals haulout for longer periods of time to care for their pups (Stein 1989, Watts 1991, Kroll 1993). Mothers with nursing pups can spend more than 90% of their time onshore (Jefferies et al. 2003). Mother-pup pairs usually segregate from main haulout groups (Kroll 1993) and can be found anywhere along the shoreline of the barrier beach. The barrier beach surrounding Graveyard Spit is considered a nursery area (Jeffries et al. 2000).

4.9 Amphibians

4.9.1 Overview

Four species of amphibians are known to occur on Refuge lands: red-legged frog, rough-skinned newt, northwestern salamander, and Pacific chorus frog. These species can be found primarily within the forested and wetland habitats of the Dungeness and Dawley units. An additional eight species have the potential to occur on Refuge lands but have not been confirmed: ensatina; Cope's giant, Olympic torrent, long-toed and western red-backed salamanders; Cascades and coastal tailed frogs and western toad.

4.9.2 Regional Distribution, Conditions and Threats

Pacific chorus frog, northwestern salamander red-legged frog, and rough-skinned newt are common in western Washington. The remaining species have the potential to occur on the Refuge because the Refuge occurs within their ranges and appears to provide suitable habitat.

Very little information is available on historic distribution or trends of amphibians. However, since there can be significant year to year variation in population size, long-term monitoring is necessary to determine population trends (Graham and Powell 1999, Paton 2002). In addition, abundance varies widely in relation to annual variation in weather. Consequently, assessment of management practices is challenging for these species.

Degradation, fragmentation, and loss of habitat all pose serious threats to amphibians. Many amphibians are long lived and reach sexual maturity after many years of growth. As a result, adult survival is considered a limiting factor for amphibians. In addition, their dispersal or migration distance is relatively limited to the immediate area around their breeding ponds, streams, or forests. For these reasons amphibian populations are relatively isolated and habitat buffers are increasingly important. Buffers provide cover, protection from siltation, filtration of pollutants, and protection from trampling. Suitable buffers can also mitigate changes in the microclimate around breeding ponds or streams. For instance, tree cover will reduce harmful UV rays and also decrease evapotranspiration of soil moisture. Human disturbance from road and trail construction, timber harvest and fire management may result in fragmentation of terrestrial habitat and breeding ponds (Graham and Powell 1999, Paton 2002). Logging activities should be scheduled to occur during the winter months to minimize soil compaction and litter layer disturbance (Graham 1997, Paton 2002).

Introduction of invasive or nonnative predators and contamination are additional threats. Nonnative species can have devastating effects on amphibian abundance. American bullfrogs are an introduced species in the Pacific Northwest and compete with native frog species and consume native amphibians. Since American bullfrog tadpoles require two years to mature, seasonal wetlands can be drawn down in July at least every two years and screens put in place at the outlet to isolate American bullfrog tadpoles for removal. In addition, the presence of nonnative fish such as trout can significantly reduce frog and toad tadpoles and amphibian larvae (Tyler et al. 1998).

Because their skins are permeable, amphibians are more susceptible to airborne contaminants and disease. In the Pacific Northwest, amphibians are sensitive to UV-B exposure as well. Possible effects of exposure to UV-B include increased mortality and incidence of deformities, slowed growth, and skin darkening (Belden and Blaustein 2002). The effects of climate change on amphibians are uncertain; however, impacts are anticipated as a result of changes in key habitat attributes (e.g., reduced soil moisture, increased temperatures, and changes in prey species phenology).

4.9.3 Key Habitat Used

Most amphibians spend a large part of their life near streams and wet environments within the forested habitats. Northwestern and long-toed salamanders, western toad, red-legged and Pacific chorus frogs, and rough-skinned newt require wetlands or ponds with tall emergent vegetation or downed woody debris to provide some degree of structure within the shallow water margin to support eggs. In addition, these species all require rotting logs, rodent burrows, and moist crevices found in downed woody debris of forested habitats during the remainder of their life cycle. There are four species of amphibians endemic to the Northwest that breed and deposit eggs in small streams (less than 6 feet or 2 meters wide). Dean Creek has the potential to support four of these secretive species: Cope’s giant and Olympic torrent salamanders and Cascades and coastal tailed frogs. These species require rocky, fast flowing streams with cool, oxygenated water and forested canopy cover that provides shade and leaf litter which nourishes aquatic invertebrate prey. In addition, many other

species of amphibians use riparian habitats as corridors for movement. Amphibians typically require more than one habitat type for their life history needs. For instance, many amphibians lay their eggs in ponds, the larva develop and metamorphose in those same ponds. They then spend their adult life in the forests within a ½ mile of those ponds, returning in later years to lay eggs and the cycle continues. Thus, providing suitable corridors between habitat types is important, particularly to maintaining adult survival. Ensatina and western red-backed salamanders differ in that they rely exclusively on forested habitats with no wetland component to their life history needs. Woody debris, bark piles, and snags all provide important habitat components for these species, particularly in mature or old-growth forests.

While home ranges of salamanders tend to be very small, on the order of a few meters to a few dozen meters in diameter, some salamanders will disperse up to several hundred meters. Frogs and toads can move up to 1.5 miles; however, frogs especially appear to prefer to remain close (<700 meters [2,297 feet]) to their breeding sites (NatureServe 2011).

4.10 Anadromous and Forage Fish

4.10.1 Overview

Anadromous Fish
Anadromous fish spend most of their life at sea and return to freshwater habitats to breed. The Dungeness River is home to various populations of chinook, chum, bull trout, pink, and coho salmon; and steelhead and cutthroat trout (Shared Salmon Strategy 2007). Three populations are particularly dependent on nearshore habitats within Dungeness Bay and Harbor during the juvenile rearing period: Puget Sound chinook (Dungeness chinook), Hood Canal/Strait of Juan de Fuca summer chum (Dungeness summer chum) and Puget Sound/Strait of Georgia chum (Dungeness fall chum; Shared Salmon Strategy 2007). The remaining populations migrate through the estuary on route to more open waters in the Salish Sea or the Pacific Ocean and will not be covered in detail here. Chinook typically emerge from the river in early spring and spend up to a year rearing in the estuary. Timing of emergence from the river varies for chum based on life history stage and environmental conditions; however, they typically rear in the estuary for a few weeks before dispersing to other nearshore environments to continue development (Fresh 2006).

Important processes that affect anadromous fish use of nearshore habitats on the Refuge include gentle to moderate tidal circulation (maintains fine sediment and eelgrass) as well as precipitation and watershed drainage (influences salinity, temperature levels, sediment transport and contaminant levels). Due to their reliance on nearshore habitats, processes that affect these habitats are also important to salmonids, particularly those occurring in eelgrass beds and salt marshes which provide a high proportion of the prey species for juvenile salmonids and concealment from larger predators. Not only do juvenile salmonids rely on nearshore habitats for rearing, but all populations use the nearshore environment during some stage of their life cycle to undergo the physiological changes necessary to transition between predominantly freshwater and saltwater environments (e.g., emerging juveniles or returning adults). Key attributes of nearshore environments for anadromous fish include water temperature and salinity levels (affects development and transition from a freshwater “parr” to a saltwater “smolt”); presence of fine-grained substrates (promotes diverse food and cover) as well as a variety of habitat types (shallow sandy beach for prey, deeper water habitats for refugia as salmonids develop, eelgrass for cover); and absence of contaminants or altered nutrient input. The effects of these key attributes differ widely based on the species, population, size (fry vs. yearling)

and life history strategy (rear in the estuary for up to a year vs. rearing in freshwater for 6 months; Fresh 2006). Further, limited information is known about how these components are affected by each attribute (Fresh 2006, Shared Salmon Strategy 2007).

Approximately 0.25 mile of Dean Creek runs through the Dawley Unit beginning at river mile 0.6. The lower 0.5 mile of this intermittent creek potentially supports coho, winter steelhead and cutthroat trout. Unknown species of resident fish have been noted in the stretch of Dean Creek that runs through the Refuge; however, no record of anadromous fish exists for the Refuge (EDPU 2005). According to the Elwha-Dungeness Watershed Plan (EDPU 2005), impassable fish barriers are located at river mile 0.5 and 1.2, effectively blocking return of any historic stocks found on Dean Creek. The plan also notes that fish passage can be severely limited at the confluence with the bay during the spawning period due to extreme low flows which often go underground near the bay.

Forage Fish
Nearshore habitats provide vital habitat for forage fish (Pacific herring, surf smelt, and Pacific sand lance) during their life cycle. They spawn within Dungeness NWR annually and larvae spend a portion of their first year drifting in the water column. Pacific herring spawn on marine benthic vegetation which drives processes and key attributes. For all of these species, key attributes are directly related to habitat needs. Pacific herring require healthy beds of eelgrass while surf smelt and Pacific sand lance require maintenance of sandy spawning beaches through functioning drift cells and sediment input from sandy bluffs and barrier beaches (Penttila 2007).

The known Dungeness/Sequim Bay Pacific herring stock spawning grounds are located in the west end of Dungeness Harbor encompassing a small portion of the eelgrass beds on Refuge lands. They typically spawn within Dungeness Bay from mid-January through the end of March. Surf smelt and Pacific sand lance can be found on the inside of the barrier beach of Dungeness and Graveyard spits as well as the southern shore of Dungeness Bay and Harbor. The surf smelt spawning season within Dungeness Bay occurs from May through February while Pacific sand lance can be found here from November through February (PSWQAT 2001). Pacific sand lance remain in the area during their first year of life.

4.10.2 Regional Distribution, Conditions and Threats

Anadromous Fish
The Endangered Species Act considers status of salmonids by evolutionary significant units (ESU). An ESU is a population or group of populations of Pacific salmon that is substantially reproductively isolated from other populations and that represents an important component of the evolutionary legacy of the species.

The boundary of the Puget Sound chinook salmon ESU extends from the Nooksack River in the north to southern Puget Sound, includes Hood Canal, and extends westerly out the Strait of Juan de Fuca to the Elwha River (Shared Salmon Strategy 2007). The proportion of this ESU originating in the Dungeness River has access to the historic spawning range, though return rates are low (200 spawners currently vs. an estimated capacity of 699) and reaches of the Gray Wolf River are underutilized (Shared Salmon Strategy 2007). This ESU appears to migrate north to the Canadian coastline via the east or west side of Vancouver Island (Shared Salmon Strategy 2007). Return rates vary from 3-6 years and they exhibit a high degree of natal stream fidelity. The status of the Puget Sound chinook ESU is listed as threatened and the status of the Dungeness population is listed as

critical as indicated by the Salmon Stock Inventory compiled by WDFW (see http://wdfw.wa.gov/mapping/salmonscape/index.html). The return rate of Dungeness chinook has been less than 200 adult fish for the past 20 years compared to an estimated historic abundance of 8-9,000 (Shared Salmon Strategy 2007). Productivity has increased from 0.12 in 1986-1990 to 0.70 from 1994-1998, yet it is still below 1.0, the amount necessary to maintain the population. Approximately 83% of the population originates from hatchery-raised stock (Shared Salmon Strategy 2007).

There are two populations of chum that use the nearshore habitats of Dungeness NWR for rearing, including summer and fall chum. Limited population-specific information exists for summer vs. fall chum. However, due to the listed status, the Hood Canal summer chum ESU distribution is well defined and includes all naturally spawned populations of summer-run chum salmon in tributaries to the Hood Canal, Discovery Bay, Sequim Bay, and the Dungeness River. Reports of chum spawning in the Dungeness River are collected from incidental observations taken during surveys for chinook and pink salmon. They are typically observed in the lower Dungeness River, but have been noted as high as the Dungeness Hatchery. There are no data prior to 1980 that indicate the presence of a summer chum stock in the Dungeness River (http://wdfw.wa.gov/webmaps/salmonscape/sasi/full_stock_rpts/2528.pdf). Chum are known to migrate to the North Pacific and Bering Sea, spend 2-4 years at sea, and return to natal spawning grounds. Some evidence exists that this species is less faithful to natal streams. The status of the Hood Canal summer chum ESU is listed as threatened. According to the Shared Salmon Strategy (2007), the Hood Canal summer chum experienced a severe drop in abundance in the 1980s, and returns decreased to all-time lows in 1989 and 1990 with less than a thousand spawners each year. Recently, trends have shown a slight increase in naturally spawning stocks through 2002. The status of the Dungeness River component of this ESU is unknown as there have been no systematic surveys conducted for this species in this river. Researchers note that their numbers are so low that they may not represent a self-sustaining stock but could be strays from other stocks (http://wdfw.wa.gov/webmaps/salmonscape/sasi/full_stock_rpts/2528.pdf). The status of the Puget Sound/Strait of Georgia fall chum is not warranted for listing, while the status and trends of the Dungeness population of fall chum is unknown due to a lack of systematic surveys.

Forage Fish

Pacific herring spawning stocks have been surveyed annually since the mid-1970s. Pacific herring spawning beaches within the Puget Sound are geographically distinct and location does not vary among 20 known sites which includes Dungeness Bay. The Dungeness/Sequim Bay Pacific herring stock is listed as depressed; however, this stock may be the same as the Strait of Juan de Fuca regional stocks which are listed as critical.

Pacific sand lance and surf smelt are considered Washington Species of Greatest Conservation Need within the State Wildlife Action Plan (WDFW 2005). Pacific sand lance and surf smelt spawning grounds are considered widespread in the area with new beaches discovered each year. For more information see http://wdfw.wa.gov/conservation/phs/list/. Very little is known about the historic distribution, condition, or trends of Pacific sand lance and surf smelt within the Puget Sound due to the lack of a cost-effective survey methodology (Penttila 2007).

Threats

Threats to forage and anadromous fish relative to nearshore habitats include habitat loss or degradation, environmental contamination, degradation of water quality (salinity, temperature, and nutrients) and climate change. As with all nearshore habitats and species, shoreline armoring is the primary, persistent threat to these species. Essentially, armoring interferes with natural erosion from

bluffs to nearby shoreline and drift cells, this in turn reduces the input, particularly of fine-grained sediment, to spawning beaches. Pacific herring and juvenile salmonids are susceptible to any limitations in eelgrass beds as they are essential to providing a rich mix of prey species and cover. One critical period of time in the life cycle of Pacific herring is the period approximately one week after hatching, at which point larvae drift in the water column. If they do not encounter sufficient plankton to survive, the entire year class of that stock may be at risk (Stick and Lindquist 2009). This is particularly significant considering that Pacific herring live for only 4-5 years (PSWQAT 2001). In addition, aquaculture practices threaten the persistence of eelgrass beds and therefore Pacific herring spawning grounds.

Impacts from climate change are more difficult to predict for salmonids due to differences in adaptive strategies which vary by species, population, life history stage, etc. However, change in temperature is a well-known threat. A small increase in temperature can change migration timing, reduce growth, and increase the susceptibility of fish to toxins, parasites, and disease (Shared Salmon Strategy 2007). In fact, the distribution of salmon is in part dictated by temperature tolerances with most adult salmon unable to survive in water over 70° F (Lawler and Mathias 2007). Both rearing and completion of the physiological transition are affected by salinity and temperature levels with tolerance varying by species, population, time of year, and life history strategy (Fresh 2006). In addition, changes in salinity and temperature can change the composition of prey species as well as degrade habitat (reduce the supply of dissolved oxygen). Sea level rise threatens Pacific sand lance and surf smelt spawning habitat particularly if the rate of loss does not allow sufficient time for the upper intertidal zone to migrate into the backshore zone, or other impediments to migration exist such as armoring. This in turn threatens juvenile salmonids because forage fish are a primary source of prey to some life stages.

All fish are vulnerable to oil spills either directly or indirectly through habitat degradation and mortality of prey species (e.g., phytoplankton and zooplankton). Excessive nutrient input can be just as harmful as oil or contaminant spills leading to increases in algal blooms which, in turn, lead to decreased dissolved oxygen, decreased light levels, and increases in water temperatures.

4.10.3 Key Habitat Used

Anadromous Fish
Adult and juvenile salmon can be found within the matrix of nearshore habitats (e.g., eelgrass beds, mudflats, marshes, and shallow water adjacent to barrier beaches) year-round depending on the species and time of year. Chum spend more of their life history in marine waters than any other Pacific salmon species. Juvenile chum migrate to saltwater almost immediately after emerging from gravel, thus their continued survival depends on healthy estuarine environments. In Dungeness Bay and Harbor, this species typically spends a few weeks in the eelgrass beds. Pocket estuaries and small channels that end in the upper sections of salt marshes can be important for chinook fry rearing in the nearshore habitats. One limiting factor to fish distribution in these habitats is water temperature. As temperatures rise above 59°F, salmonids will limit their use. As juvenile chinook increase in size, they move deeper into the waters of the adjacent nearshore environment.

Forage Fish
Pacific herring spawn almost exclusively on marine benthic vegetation (e.g., eelgrass beds). In fact, Penttila (2007) indicates that Pacific herring spawning habitat is the critical life history element that can be identified and managed. The most important component is the presence of marine vegetation,

primarily eelgrass. The key element of both surf smelt and Pacific sand lance spawning habitat is the availability of a suitable spawning substrate. For surf smelt, this exists from approximately 7 feet to extreme high water and consists of sand or gravel of 1-7 millimeters (0.04-0.28 inch) (Penttila 2007). Pacific sand lance prefer a smaller grain size from 0.2-0.4 millimeters (0.01-0.02 inch) (Penttila 2007).

4.11 Threatened, Endangered, and Sensitive Species

One goal of the Refuge System is "To conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered." In the policy clarifying the mission of the Refuge System, it is stated, "We protect and manage candidate and proposed species to enhance their status and help preclude the need for listing." In accordance with this policy, the CCP planning team considered all species with Federal or State status, and other special status species in the planning process. Table 4-4 lists species that are federally endangered, threatened, or candidate species and that are known to occur on or near Dungeness Refuge. A discussion of the federally listed species follows the table in Section 4.11.2.

A total of 5 federally listed species are known to occur on or adjacent to the Refuge. Marbled murrelet is known to occur adjacent to the Dawley Unit; however, the unit currently does not support suitable habitat. Limited observations of western snowy plover and sand-verbena moth have been noted on Dungeness Spit (see below), but habitat quality appears to be marginal. Two species of anadromous fish likely occur within the nearshore habitats of the Dungeness Unit including Puget Sound chinook and Hood Canal summer chum (see Section 4.10, Anadromous and Forage Fish, above).

Table 4-4. Federally Listed Species Known to Occur on or Adjacent to Dungeness Refuge

Common Name	Scientific Name	Federal Status	Current Occurrence on Refuge
Marbled murrelet	*Brachyramphus marmoratus*	Threatened	Adjacent to Refuge
Sand-verbena moth	*Copablepharon fuscum*	Candidate species	One collected in 2002
Western snowy plover	*Charadrius alexandrinus nivosus*	Threatened	Occasional observations according to historic records
Puget Sound chinook	*Oncorhynchus tshawytscha*	Threatened	Probable use of nearshore habitats
Hood Canal summer chum	*Oncorhynchus keta*	Threatened	Probable use of nearshore habitats

4.11.1 Habitat Needs, Conditions, and Threats of Federally Listed, Proposed, or Candidate Species

Marbled Murrelet

The marbled murrelet is a small diving seabird that breeds along the Pacific coast of North America. In the Pacific Northwest, it forages almost exclusively in the nearshore marine environment (mainly within a few kilometers of shore), but flies inland to nest in mature to old-growth conifers. Behavior

indicative of marbled murrelet nesting has been documented to occur adjacent to the Dawley Unit; however, the unit does not currently provide suitable habitat (B. Ritchie, pers. comm.).

The range of the marbled murrelet extends from Bristol Bay, Alaska, south coastally through British Columbia, Washington, Oregon, to northern Monterey Bay, California. Limited anecdotal information exists on the historic distribution and numbers of this species throughout its range. In the Puget Sound, marbled murrelets were considered "common," "abundant," or "numerous" as summarized in Speich et al. (1992).

The marbled murrelet is federally listed as a threatened species in California, Oregon, and Washington. The current overall estimate for the listed population is >18,000. Trend data indicate an annual decline of between 2.4% to 4.3% (Falxa et al. 2009). The combination of low demographic potential, small population size, and increased threats from human-caused habitat destruction or degradation could lead to extirpation of the marbled murrelet in portions of its range. This species reaches breeding maturity in two to four years (De Santo and Nelson 1995); however, they have a low rate of reproductive success. Murrelets may not nest every year, especially when food resources are limited (Nelson 1997). Breeding pairs produce a single offspring during reproductive years. The life span of marbled murrelets is unknown, but other members of the Alcid family live from 5-32 years (De Santo and Nelson 1995).

The Federal Recovery Plan for the Marbled Murrelet (USFWS 1997b) identifies the primary cause of population decline as loss of older forests. This species requires suitable canopy structures primarily found in mature and old-growth forest stands for nesting. Habitat degradation or fragmentation resulting in increased densities of nest predators and reduced prey availability also limit long-term productivity and survival of this species. Predation rates at marbled murrelet nests have been found to be extremely high in some areas. Corvids are thought to forage using visual cues and have been identified as primary marbled murrelet nest predators. A more complex forest has larger canopy mass in multi-dimensions that can help to conceal the location of nests from such visual predators (Rudnicky and Hunter 1993, Wilcove 1985, Yahner and Cypher 1987). Adult mortality caused by predation, impacts from the effects of oil spills, entanglement in fishing gear, chronic water pollution, aquaculture, and disturbance at nesting and foraging sites have also been identified as potential limiting factors.

While the Dawley Unit does not currently provide suitable habitat, appropriate habitat management over the next 50-75 years may produce habitat with a high probability of recruitment due to the proximity of marine foraging habitat as well as occupied territories immediately to the south. Stands that lie further from feeding areas require the adults to expend more energy to provision the nest. Newly fledged chicks may have a greater likelihood of successfully reaching the marine waters if their nest is closer to the shoreline. Suitable nesting habitat adjacent to or near an occupied stand offers more opportunities for population expansion. This may also help maintain localized breeding productivity if a catastrophic event such as a wildfire or wind storm destroys a nesting stand. Within the range of the listed population, marbled murrelets are found in the vicinity of large tracts of older forests and within 50 miles of marine waters. Marbled murrelet nests are often located in the largest trees in the stand (Jordan and Hughes 1995, Singer et al. 1995) which typically require 200 to 250 years or more to attain necessary attributes (USFWS 1996). However, younger stands with an abundance of dwarf mistletoe, or stands with numerous older legacy trees remaining from a previous stand can develop characteristics of nesting habitat at a younger age. Nest site selection is highly dependent upon the availability of potential nesting surfaces, or platforms (Nelson 1997). The minimum requirements of suitable nesting platforms are defined by the recovery plan as large

diameter branches (>4 inches) at > 33 feet above the forest floor within trees of 28 feet DBH or greater (USFWS 1997b). Potential nesting platforms can be found in the form of large lateral limbs; branches creating a fork with the space between bridged by canopy litter; a high incidence of dwarf mistletoe infestation which creates witches brooms; or an abundance of canopy defects due to damage caused by environmental conditions (ice, lightning and wind storms), insects, or other processes that create growth abnormalities. Nest limb diameters in Washington range from 14 to 50 centimeters (5-20 inches); limb heights from 20 to 53 meters (66-174 feet) with the majority of nests located in the upper half of the tree crown (Hamer and Nelson 1995).

Other factors which appear to contribute to the suitability of habitat for marbled murrelet nesting are cover, stand size, and location on the landscape. Cover directly above and adjacent to the nest appears to be an important attribute. Occupied stands in Washington have a mean canopy cover of 81% (Hamer 1995) and 87% of all nests in the Pacific Northwest had greater than 74% immediate overhead cover (Hamer and Nelson 1995). Stand size may influence the quality of the stand by affecting the amount of available interior habitat, nest predation and disturbance levels. Reduced levels of predation were shown to occur where nests were higher in a tree, farther from a recently disturbed edge, and in mature stands with higher and deeper canopies (Naef 1996). Nelson and Hamer (1995) noted that marbled murrelet reproductive success was correlated to distance from an edge with all but one successful nest greater than 55 meters (180 feet) from an edge.

Sand-verbena Moth

The Sand-verbena moth is a nocturnal moth that was first described in 1996 from specimens collected near Sidney, British Columbia, and Whidbey Island, Washington (COSEWIC 2003). Currently, the moth's known global population is restricted to the Salish Sea (Wild Earth Guardians and the Xerces Society 2010). It has been recorded at 10 sites throughout its range (4 sites in Canada and 6 sites in Washington) one of which is Graveyard Spit. One moth was collected on the spit in 2002.

This species is currently a candidate for listing in the United States and is listed in Canada as Endangered under the Species at Risk Act. Since the moth was first described in 1996, trends are unknown. However, the listed population in Canada is estimated to total less than 10,000 (COSEWIC 2003) and a rough estimate of the U.S. population has been noted as "likely just a few thousand, but possibly more than 10,000" (Wild Earth Guardians and the Xerces Society 2010). The primary threat to this species is limited habitat availability, particularly for its sole obligate host plant, yellow sand-verbena. Vegetation stabilization as a result of natural succession on strand habitat often results in more dense cover of native strand plants. Yellow sand-verbena requires "chronic natural disturbance to maintain open sand areas…or new sand deposition…" (Wild Earth Guardians and the Xerces Society 2010). Additional reasons for loss of habitat are due to human development, coastal erosion, and invasive plant species (e.g., European beachgrass). Climate change poses a serious threat to this species' habitat because it is predicted to increase the intensity and number of storm events which in turn could lead to increased coastal erosion particularly of low-lying barrier beaches. Ultimately, sea level rise could limit habitat availability.

The sand-verbena moth requires large (>500 square meters or 0.1 acres), dense (>25% cover) patches of yellow sand-verbena. Yellow sand-verbena in turn requires open sand habitat free of competition from other plants (COSEWIC 2003). The host plant, and therefore sand-verbena moth, are typically found within 5 meters (16 feet) of the high tide line, rarely >50 meters (164 feet) (COSEWIC 2003).

Western Snowy Plover
The western snowy plover is a subspecies of the snowy plover with an isolated breeding population found only along the Pacific Coast from Midway Beach, Washington, to Bahia Magdalena, Baja California, Mexico. Currently, distribution of this species in Washington is limited to Midway Beach and Leadbetter Point (Pearson et al. 2010). Up to 6 individuals were observed on Dungeness Spit in May and June of 1995; one was observed in May of 1996 and a final observation was reported on Dungeness Spit in April, 2012.

This population was listed as threatened under the ESA in 1993. A recent population estimate suggests that the population in Washington is declining and is not maintained by local production (Nur et al. 1999). According to the USFWS (2007b) habitat degradation caused by urban development and introduced beachgrass; human-caused wildlife disturbance; and expanding predator populations have resulted in a decline in active nesting areas and in the size of the breeding and wintering populations. In Washington, egg predators, inclement weather, shoreline modification, dune stabilization, and recreational activities have been attributed to reduced nest success and have been cited as the causes of local population declines (WDFW 1995). Lafferty (2001) found that disturbances to wintering snowy plovers are 16 times higher at a public vs. a protected beach. Humans, dogs, American crows, and other birds were the main sources of disturbance. Human-caused wildlife disturbance has been shown to negatively affect hatching rates, chick survival, and feeding rates for various plover species (Lafferty 2001, Dowling and Weston 1999; Flemming et al. 1988).

The coastal population of snowy plover nests primarily above the high tide line on a variety of nearshore habitats including sparsely vegetated barrier beaches (USFWS 2007b). In winter, snowy plovers are found on beaches used for nesting as well as on beaches where they do not nest (USFWS 2007b). Dungeness and Graveyard spits do not appear to provide suitable habitat for nesting due to the density of native strand vegetation covering all but limited overwash locations on the tip of Dungeness Spit.

4.12 Invasive and Nuisance Species

One of the most striking attributes of invasive plants and animals are their impacts on refuge natural resources. Invasive plant species displace native vegetation, altering the composition and structure of vegetation communities, affecting food webs, and modifying ecosystem processes, which result in considerable impacts to native wildlife.

4.12.1 Exotic and Invasive Plant Species

Many invasive plant species infest and degrade the terrestrial habitats on the Refuge. Several plant species were introduced as ornamental plants (e.g., Bohemian knotweed and Dalmatian toadflax) and have escaped and spread into barrier beach, grassland, forest, and riparian habitats. Some highly invasive species (e.g., common cordgrass and Canada thistle) can produce monotypic stands that completely displace native and desirable plant communities. Native plant communities provide essential habitat that supports high priority species and species groups on the Refuge (e.g., migratory birds). The Refuge's overall strategy to manage invasive plants is based on an IPM approach. Mechanical, physical, and chemical methods are used to control invasive plants as a basis for achieving desirable habitat conditions. Many factors affect efficacy of control efforts for invasive plants. For species with the largest infestations within the Refuge (e.g., Canada thistle), IPM

strategies involve treating new spot infestations while working to eradicate the main infestation areas.

There are twelve species of plants found on the Refuge (Table 4-5) which are classified by the Washington Department of Agriculture as noxious weeds.

Table 4-5. Washington Department of Agriculture Noxious Weeds Found on Dungeness Refuge

Common Name	Scientific Name
Common Cordgrass	*Spartina angelica*
Bohemian Knotweed	*Polygonum x bohemicum*
Herb Robert	*Geranium robertianum*
Dalmatian Toadflax	*Linaria dalmatica*
Oxeye daisy	*Leucanthemum vulgare*
Poison Hemlock	*Conium maculatum*
Scotch broom	*Cytisus scoparius*
Spurge Laurel	*Daphne laureola*
Bull thistle	*Cirsium vulgare*
Canada thistle	*Cirsium arvense*
Common (English) Ivy	*Hedera helix*
Himalayan Blackberry	*Rubus armeniacus*

The plants listed below are of the highest priority for the Refuge and are part of invasive species management.

Common Cordgrass
Found along the shoreline on the northeast side of Graveyard Spit. The Refuge has worked with the Washington Department of Agriculture since 2008 on the monitoring and removal of this invasive species. Currently, abundance of common cordgrass is considered very low.

Bohemian Knotweed
Originally found at the Dawley Unit residential area in 2009, treatment was initiated in 2010 resulting in only a few individual plants remaining in three separate clumps. These clumps were retreated in 2011. Monitoring will continue for the next several years to ensure that the plants have been eradicated

Dalmatian Toadflax
This species is found within the RNA of Graveyard Spit in an area associated with former military structures. It is unknown when this species first appeared, but it was listed in the Washington Native Plant Society's inventory of plants for Dungeness Spit in 1986. It may have arrived with a hiker or camper before the area was closed to the public in the early 1990s. Refuge staff and volunteers began eradication efforts in 2001 which has continued to the present time.

Control Efforts
An IPM approach is used, which includes a variety of tools such as mechanical/physical control, cultural control (e.g., crop rotation, prescribed fire, and weed-free mulch), biological control, pesticides, habitat restoration, and protocols preventing new introductions (see Appendix G, Integrated Pest Management Plan). Control efforts are planned annually, and Pesticide Use Proposals

(PUPs) are submitted to regional and/or national IPM coordinators for approval. All annual chemical applications are recorded and entered into the national PUPs database. Mechanical, physical, and chemical methods have been used to combat invasive plants in a variety of habitats. Pulling, cutting, and digging of shrubs, annual and biannual forbs have been very effective in our small patches. Cut-stump, injection, broadcast, and spot spray chemical applications have been used to treat the largest shrubs and perennial forbs.

4.12.2 Exotic Wildlife Species

Currently, there is no documentation of known exotic wildlife occupying Refuge lands. Refuge staff and volunteers have been monitoring for European green crab since 2001; however, none have been captured to date. Within the freshwater wetlands and the impoundment, American bullfrogs are considered a species of concern but no sign of American bullfrogs has been observed.

Occasionally, feral and domestic cats, and trespass dogs have been recorded on the Refuge. They prey on small mammals, birds, reptiles, and amphibians. In fact, domestic cats are considered the primary cause of extinction for 33 species of birds, worldwide, since the 1600s (Winter and Wallace 2006). It is estimated that these cats kill one billion birds annually in the United States (Dauphine and Cooper 2008). These predators are of management concern and are treated under the Refuge's IPM plan (See Appendix G).

4.13 Wildlife and Habitat Research, Inventory, and Monitoring

A Wildlife Inventory Plan was drafted in 1985 for all refuges under management of the Puget Sound NWRC which included Dungeness NWR. This plan recommended formal and opportunistic survey efforts to be implemented at Dungeness NWR for waterfowl (aerial brant surveys), shorebirds (point counts), raptors (area searches for peregrines and bald eagles), and marine mammals (aerial harbor seal surveys). Upon completion of this CCP, Refuge staff will begin development of an updated Inventory and Monitoring Plan for the Washington Maritime NWRC, to include Dungeness NWR.

The following is a list of surveys, research, and monitoring projects that have been conducted on the Refuge since it was established, including surveys identified in the original Inventory Plan. Many of these efforts consist of collaborations between the Service, other State and Federal agencies, nongovernment organization (NGOs) and universities. This list may not be inclusive.

Surveys and Scientific Assessments:

- Mid-winter Waterfowl Survey
- Winter/spring brant surveys
- Fall/winter shorebird surveys
- Snowy plover breeding season survey
- Taylor's checkerspot habitat assessment
- Bald eagle and peregrine falcon surveys
- Eelgrass inventory and mapping
- Common cordgrass inventory
- European green crab surveys
- Dalmatian toadflax inventory
- Water quality monitoring

- Forage fish spawning survey
- Sand-verbena moth survey
- Creosote-covered driftwood inventory
- Creosote assessment in Puget Sound beaches
- Water circulation study in Dungeness Bay and Harbor

Research projects:

- Brant and harbor seal disturbance study
- Caspian tern breeding success
- Benthic macroinvertebrate community monitoring
- Harbor seal genetic sampling and disease screening
- Salmonid distribution and habitat use in Dungeness Bay

Citizen science projects:

- Coastal Observation And Seabird Survey Team (COASST)
- Microplastics monitoring
- Project Feederwatch
- Christmas Bird Count
- Bird-a-thon

4.14 Paleontological Resources

4.14.1 Geological Background

During the late Jurassic and early Cretaceous periods, numerous blocks of exotic terranes were added to the western edge of the North American continent to form Washington, British Columbia, and Oregon. These terranes consist mostly of rock sequences that formed far from their current location. They include volcanic island rocks and fossiliferous marine sediments that originated elsewhere in the Pacific Ocean. Jurassic and Cretaceous fossils from these rock sequences occur in the north-central and northwestern part of Washington.

Marine fossiliferous sandstone and siltstone of Cenozoic age cover most of Washington west of the Cascades Mountains. The Olympic Mountains consist of marine sedimentary rocks uplifted about 10 million years ago. The Cascade volcanic chain began to form in the mid-Cenozoic and has been active ever since. During the late Cenozoic, the Cordilleran Ice Sheet covered the northern third of the state and alpine glaciers covered the higher elevations of the Cascade and Olympic Mountains.

The landscape of the Puget Lowland and Strait of Juan de Fuca is largely the product of repeated glaciations by the Cordilleran Ice Sheet during the Pleistocene Epoch (~ 2 million years ago to ~11,000 years ago). Dated samples of wood, peat, and shell from southern British Columbia and northern Washington provide age control on the growth and decay of this sector of the Cordilleran Ice Sheet during the last (Fraser) glaciation (Clague and James 2002). Starting about 22,000 years ago, the ice sheet first began to form in the Coast Mountains and on Vancouver Island of British Columbia, but did not extend south of the international border. This advance was followed by a period of climatic amelioration and glacier retreat about 19,000 to 18,000 years ago. Shortly after 18,000 years ago, the Cordilleran Ice Sheet started to advance again. After passing Vancouver Island, it advanced southward as two lobes. At its maximum extent 14,500 years ago, the Puget Lobe filled

the Puget Lowland, where it was nearly 1,000 meters (3,280 feet) thick over Seattle, and its southern edge extended south to its maximum position near present-day Olympia (Thorson 1980). At about the same time, the Juan de Fuca lobe moved westward along the Strait of Juan de Fuca, where the ice sheet covered southern Vancouver Island, filled the Strait of Juan de Fuca, and rose against the Olympic Mountains to an elevation of 840 m (2,756 feet). Retreat of both lobes began shortly after 14,500 years Before Present (yr BP), and by 12,000 yr BP the northeastern Olympic Peninsula and northern Puget Lowland were ice free.

4.14.2 Paleontological Resources

Paleontological resources, also known as fossils, are the remains or traces of prehistoric plant and animal life that are found in the geologic formations in which they were originally buried, typically within units of limestone, sandstone, mudstone, and shale. Paleontological resources are considered to be nonrenewable and sensitive scientific and educational resources. The major laws protecting paleontological resources on Service lands are the National Environmental Policy Act of 1969 (NEPA), the Paleontological Resources Preservation Act of 2009 (PRPA), and various sections of Service regulations.

Fossil record in Northwest Washington
Because of their large size and taphonomic durability, mastodon and mammoth remains (mostly molars) are the most commonly reported Pleistocene vertebrate fossils in Washington (Barton 1998). Unlike mastodons, which were not elephants, mammoths (genus *Mammuthus*) were large specialized elephants that were common during the Pleistocene epoch. This genus first evolved in the early Pliocene (4.0 to 5.0 Ma) of Africa, and by the early Pleistocene (ca. 1.7 Ma), mammoths had spread throughout Asia and into North America (Shoshani and Tassy 1996 and Webb et al. 1989 cited in Barton 1998). Mammoths were obligate herbivores with a dietary preference for grasses and sedges, herbs, and meadow-bog mosses, ferns and aquatic plants.

In western Washington, mammoth finds are heavily concentrated in the central and northern Puget Lowland. The earliest mammoth finds recovered from western Washington were discovered at Scatchet Head on Whidbey Island (located approximately 37 miles southeast of Dungeness NWR) around 1860, but these were destroyed in the San Francisco earthquake and firestorm of 1906 before they could be identified to species level (Lawson 1874 cited in Barton 1998). Another specimen from the same locality was recovered in the 1880s and is currently part of the University of California, Berkeley paleontology collections. This specimen is clearly from a Columbian mammoth. Of two species of mammoth found in Washington (*M. imperator* and *M. columbi*), Barton (1998) states that the Columbian mammoths are by far the most common. Of 31 previously reported finds that could be analyzed to species level in the Puget Lowland, 27 proved to be from Columbian mammoths (Barton 1998). The Columbian mammoth formally became the Washington state fossil in 1998.

Dungeness NWR
In 1989, a two-foot section of a mastodon tusk was discovered by a visitor at the base of the bluff near the sanitary facilities on Dungeness Spit and turned over to the Refuge's manager (Raymond 1989). An April 1990 incident report notes that a visitor found what was identified as a mammoth tooth on Dungeness Spit approximately ½ mile out on the outer beach (Strait side). The tooth was turned over to a Refuge volunteer. According to the project leader (K. Ryan, personal communication 21 February 2012), there are some paleontological specimens being curated in the Refuge office. Whether they are the above-described specimens has not been verified, but it is likely that they are.

In March 1994, a Sequim resident examining the cliff of glacial till after a storm discovered the stump end of a mammoth tusk. The find was confirmed by paleontologist Bruce Crowley of the Burke Museum. The specimen was reported to be 6 feet long. According to USFWS Regional Cultural Resources Team records, a loan agreement was prepared for long-term curation of the tusk at the Burke Museum. The agreement is long-expired, and no additional action has been taken regarding the item. A newspaper article prepared at the time of the discovery noted that the "mammoth tusk appears to be entombed in a 100,000 year-old layer of glacial debris and clay known to contain a lot of fossils and to be possibly associated with volcanic mud flows" according to amateur paleontologist Richard Dobbs, who discovered the fossil (Seattle Times, accessed online at http://community.seattletimes.nwsource.com/archive/?date=19940329&slug=1902831, 21 Feb 2012).

Although no other known specimens have been documented, the possibility of finding paleontological resources on the Refuge is considered high. The collection and curation of paleontological resources should be managed under the Department of the Interior's Museum Property program and the Paleontological Resources Preservation Act (PRPA) of 2009.

Document continues on next page.

Chapter 5
Human Environment

Chapter 5. Human Environment

5.1 Cultural Resources

5.1.1 Native American Overview

Prehistory
Jeanne M. Welch and R.D. Daugherty prepared a compilation of the prehistoric era on the Olympic Peninsula as part of their background information for a 1988 survey project on Dungeness NWR (Welch and Daugherty 1988). The following information is paraphrased from their report.

The five periods of occupation for the region proposed by Eric Bergland (Bergland 1984) cover approximately 12,000 years and include: Early Prehistoric, Middle Prehistoric Early Maritime, Prehistoric, Northwest Coast Pattern, and Historic. On the Olympic Peninsula, the prehistoric people are characterized as small groups of hunters and gatherers who moved around to utilize both terrestrial and maritime resources. This period on the peninsula is represented by the Manis Mastodon site (45CA218) which attests to the hunting of large game animals. It is likely that the onset of the Middle Prehistoric saw an increase in the use of maritime resources such as anadromous fish. By the Early Maritime period, proposed to have begun around 3,000 years before present (BP), the use of maritime resources was well established. It is likely that the cultural manifestations of these later prehistoric periods resembled those of the ethnographic period, but details such as the existence of villages with large, cedar plankhouses are uncertain.

During the Prehistoric Northwest Coast Pattern period, which began 1,000 years BP, chipped stone assemblages virtually disappeared while large plankhouse villages became prominent. As Welch and Daugherty note, however: "Bergland's presumed appearance of cedar plank house villages at this time is based largely upon negative evidence and it may be that this type of settlement pattern is somewhat older, thus, there may have been many significant elements of continuity between the Early Maritime and Prehistoric Northwest Coast periods" (Welch and Daugherty 1988).

Ethnography
Ethnographically, the Refuge is located within the territory of the "Central Coastal" or "Straits" Salish Klallam people (Welch and Daugherty 1988). Tribal groups lived in large winter villages along the shoreline or at mouths of rivers to access the marine resources. The villages housed extended families. They utilized spits for gathering shell resources and as launch sites for fishing. Spits were also used for burial grounds (Kennedy 1981). During the summer season the villagers would break into smaller groups and move inland to gather plants and berries and to hunt. Along with the Quinault, the Klallam were the only Coast Salish who hunted whales (Suttles 1990). Canoes made of red cedar were central not only to the survival of the Klallam as a source of transportation, but also featured in their burial practices. In 1868, Graveyard Spit was the site of a massacre of Tsimshian Indians that gave the spit its name. The massacre is discussed in more detail in Section 5.1.3.

Contemporary
The Klallam continue to occupy the Olympic Peninsula with tribal communities in three locations, consisting of the Port Gamble S'Klallam, the Lower Elwha S'Klallam, and the Jamestown S'Klallam, all of whom were signatories to the Point No Point Treaty of 1855. The transition from

ethnographic period to the establishment of the Bureau of Indian Affairs over their tribal structure has not been seamless. Initially, many Native Americans patented lands under the Indian Homestead Act, but policy changes reversed the trend toward private ownership. Suttles notes that "around 1875 the Dungeness people were forced off their traditional site and bought land nearby to establish the settlement of Jamestown….Jamestown received federal acknowledgment in 1980" (Suttles 1990).

According to Jamestown S'Klallam tribal history, despite the fact that they were nearly reorganized into a larger S'Klallam tribe with the other two groups during the Indian Reorganization Act period (1935-1939), the tribe chose to stay on the land they had purchased in 1875 rather than relocate (Jamestown S'Klallam Tribe 2012). Among the consequences of this decision was the termination of their recognition by the federal government in 1953. The continuity and stability of their land base contributed to a sense of group identity and independence. The push for recognition lasted from 1974 until achieved on February 10, 1981.

Known Prehistoric Sites

While there are no prehistoric archaeological sites recorded on the Refuge, there has been very little systematic archaeological survey or testing conducted. A large portion of the approved boundary is tidelands, generally not a conducive environment for archaeological survey. Evidence of buried prehistoric archaeological use of the bluff above Dungeness Spit is unlikely because of the glacially deposited sediments. The dense forest stand generally precludes observation of the surface. However, the presence of known cultural resources in areas adjacent to the Refuge indicates that the potential exists for sites to be identified within Refuge boundaries in future.

5.1.2 Euro-American Overview

Although first visited by explorers as early as 1790 when Captain Manuel Quimper inspected the area, the first Euro-American settlers came to the Dungeness area in 1851 while the region was still part of the Oregon Territory. The Washington Territory, which separated from Oregon Territory in 1853, established Clallam County in 1854 (Welch and Daugherty 1988). Within the next few years, a thriving community was established east of what is now the Refuge. Whiskey Flat was named as the county seat in an 1860 election, though two years later New Dungeness was designated as such. These two communities were located essentially in the same location; the latter was located above the former on the bluffs. By 1892, the present location of the town of Dungeness was established as the community center (Kennedy 1981). The heavily forested bluff margin northwest of the Whiskey Flat and Dungeness communities was not developed during the early historic period.

The New Dungeness Light Station, which began operating in 1857, was built by the Lighthouse Board at the behest of Congress. The lighthouse, located at the end of Dungeness Spit, is discussed in more detail in Section 5.1.3. Travel during the nineteenth century was primarily along the coastline by watercraft, few roads were constructed through the very dense, rugged terrain of the interior. The earliest road from Sequim to Port Angeles was not developed until 1890-1891. The timbered slopes and old growth forests supplied lumber to San Francisco during the gold rush along with the spruce trees needed for manufacture of World War I aircraft (Welch and Daugherty 1988). Lumber mills and shingle mills were established on nearly every water way around the peninsula as fluming logs down the rivers was the easiest method for getting the logs out of the mountains. The timber industry continued to be the largest economic employer into the twentieth century.

Agriculture and ranching is productive in pockets where micro-climates provide shelter from the very wet conditions of the Salish Sea. Cold weather crops such as potatoes, wheat, oats, peas, hay, and hops thrive. Located on the inland road system, Sequim was incorporated in 1913 and by 1914 the town had its own telephone franchise and electricity (Welch and Daugherty 1988).

Establishment of Dungeness NWR

The Refuge was established by Executive Order (E.O.) 2123 on January 20, 1915, by President Woodrow Wilson, for the purpose of preserving land "…as a refuge, preserve and breeding ground for native birds." The original 226.02 acres were known as the Dungeness Spit Reservation. The name was changed to Dungeness National Wildlife Refuge on July 25, 1940, by Presidential Proclamation 2416. Over the years, various tracts of land and tidelands have been acquired in fee title or easement within the approved Refuge boundaries. Today, Dungeness NWR is 772.52 acres in size.

During World War II, the general area was used as an Army encampment, and a 147-acre tract on Dungeness Spit acquired in 1940 was reserved for use by the Navy until the requirement was terminated in 1955. Additional tracts were added in the following decades, including the Mellus and Dawley properties, both acquired in the early 1970s. However, very little development of the Refuge was undertaken until the 1980s when the parking lot, hiking trails, and interpretive signs were installed.

Dawley Unit

The Dawley Unit is a noncontiguous parcel of the Refuge, located near the base of Sequim Bay. Born in Sequim in 1915, Cecil L. Dawley engaged in numerous successful local business ventures both before and after his stint in the Army, which ended in 1945. He and his family lived in the home on the Dawley Unit from 1957, purchasing property and developing ponds and pens for his bird collection. Mr. Dawley donated 125 acres of uplands and bay frontage to the Service in 1973. He continued to live on the property until his death in 2005. It was Dawley's specific intent that the land be preserved as a wildlife sanctuary.

Known Historic Sites

With the exception of the small inholding owned by the U.S. Coast Guard (USCG) at the end of Dungeness Spit, all parcels within the approved boundary of Dungeness NWR are currently owned under fee title or managed through easements, and consist primarily of tidelands and beach.

On those parcels where habitation is feasible, historic features associated with previous landowners can and do occasionally occur. Some upland habitat occurs in the bluff above Dungeness Spit and on the Dawley Unit. However, historic use of the bluff was isolated, with just a few homesteads and settlers in the nineteenth century. Use was limited until roads were established. In the 1940s, the military used the area for an encampment and training ground.

The bluff area is heavily forested, far from transportation corridors, and lacks productive agricultural values. Therefore, settlement and development of this area lagged behind property closer to the community centers. Based on previous surveys and background research, prehistoric, ethnographic, and early historic period archaeological resources are not expected in the bluff area.

5.1.3 Current Knowledge of Local Cultural Resources and Archeological Sites Occurring On Refuge Lands

Graveyard Spit: 45CA238H – T31N R4W Section 24, 25 and T31N R3W Section 13, Dungeness 7.5-minute USGS quad

The 1969 National Register of Historic Places (NRHP) nomination form for Graveyard Spit describes the event that made Graveyard Spit significant at the local level:

> "On September 21, 1868, a party of Chimsean Indians consisting of 10 men, 8 women, and one child left Port Ludlow for Victoria. The Port Discovery Indians hearing of this, concocted a plan to murder and rob them, and started to Dungeness to obtain the assistance of the Sequim (Squim) and Dungeness Indians (in which they were successful). In the meantime, the Chimseans had camped on Dungeness Spit (Graveyard Spit) near the Lighthouse and erected a sail-tent to accommodate all 19; shortly after midnight, the Sklallams cut the tent ropes and let the tent fall on the sleeping Chimseans; when one party of the Sklallams drew their knives and spears and stabbed them through the tent indiscriminately; the other party of Sklallams seized their guns and revolvers, and shot and killed all excepting one women [sic] who secreted herself under a mat and thereby saved her life. Captain James G. Swan relates that the Indian woman was cared for by the wife of Benjamin Ranie of New Dungeness, a Chimsean. Later she was sent back to her home at Fort Simpson, Canada. With the woman went all the things recovered from the site and a lot of presents sent to the Chimseans, many of which were from the Clallam Indians. The British Columbia Colonist, the Seattle Intelligencer, the Port Townsend Weekly Argus, and the Olympia Territorial Republican for the year of 1868, tell of the massacre.
>
> From the report of the Secretary of Interior, 2nd session, 41st Congress, 1869-1870, No. 3414, Washington Government Printing Office, Washington Superintendency No. 1, T.J. McKenny, Superintendent of Indian Affairs, reports on August 14, 1869 to Bureau of Indian Affairs, on the Chimsean Indian massacre, saying some law should be passed for the punishment of the crimes of Indians committed among themselves. The offenders were arrested and required to work with ball and chain for 6 months on their reservation."

According to Jamestown S'Klallam history (Duncan 2012), the massacre was in retaliation for the theft by the Tsimshian:

> "of one of Lame Jack's wives and his son. Stealing members from other tribes was a common practice. The stolen person may be sold or kept for slavery. When an offence occurred there could have been a payment made to counteract the wrong done to Lame Jack. As a payment did not occur then the S'Klallam saw revenge as the means to right the wrong done to a member of their Tribe. Revenge was another common practice of Coastal Indians. After a couple of years Lame Jack's wife and child made it back after having escaped their captors."

Determination of Eligibility: Graveyard Spit was nominated for the NRHP by the Clallam County Historical Society at a local level of significance in 1969. It does not appear that the nomination form was ever forwarded for consideration.

Status: Although not listed on the NRHP, the resource "is listed on the State Register by being recognized for its value and determined a significant cultural resource of the state" (DAHP 2012).

Dungeness Canoe: Found on Graveyard Spit near its southern tip
According to Refuge records, a Native American canoe was recovered from Graveyard Spit in 1980. Although locals reportedly had known about its existence and location since the 1930s, it remained on the spit, susceptible to wildfires, winds, and illegal removal, prompting staff at the Refuge to urge for its recovery and protection. Experts estimated the age to ca. 1830s (150 years old in 1980) and considered it to be a significant find representing Pacific Northwest Indian craftsmanship (USFWS 1981). A Memorandum of Understanding (MOU) between the USFWS and the Sequim-Dungeness Museum was prepared for conservation and permanent exhibition of the canoe.

Status: The canoe was transferred to the Jamestown S'Klallam Tribe on September 4, 1994 through an agreement with the Sequim Museum and Arts Center. It is currently on display at the Jamestown S'Klallam tribal cemetery.

New Dungeness Light Station: 45CA242H – T31N R3W Section 18 Dungeness 7.5-minute USGS quad
The New Dungeness Light Station is located near the end of Dungeness Spit in a small inholding owned by the U.S. Coast Guard. The NRHP nomination includes the following information about the property:

> "The New Dungeness Light station was the first federal navigational aid constructed north of the Columbia River. Lighted in December, 1857 (just a few weeks before the light on Tatoosh Island), the station consists of the original lighthouse with tower and a nearby keepers' residence built in 1904. The Light station is situated at the tip of Dungeness Spit in the Strait of Juan de Fuca, and has served for nearly 140 years as a maritime beacon in an area plagued by strong storms, dense fog, and heavy commercial traffic. Although the tower was lowered in the early 20th century, the station retains excellent integrity and remains an enduring symbol of the historic lighthouses of Washington."

Determination of Eligibility: The light station was determined to be significant at the state level and nominated to the NRHP in 1993. It was listed the same year (#93001338). The property was determined eligible under Criterion A – it was associated with events that have made a significant contribution to the broad patterns of our history, in this case the area of significance was Maritime History and the period of significance was 1857-1942.

Status: The property continues to be listed on the NRHP. It is currently managed on a day-to-day basis by the New Dungeness Light Station Association, a nonprofit volunteer organization. In the event that the USCG declares the light station property excess to its needs, the Service will work with the USCG to bring the light station property into the Refuge System either through interagency cooperative management agreement or property transfer. The Service would then work with the New Dungeness Light Station Association to develop an agreement for the continued management and maintenance of the light station facilities.

Mellus Cabin: T31N R4W Section 27 Dungeness 7.5-minute USGS quad
The Mellus Cabin was recorded in 2006 (Speulda 2006). Based on a review of maps and an understanding of the military timeline, it appears that the cabin was likely built sometime in the early

1950s. Walter B. Mellus purchased the parcel in 1940 with no improvements during a period when the military presence may have limited his access to the area. He lived in the cabin along with a caretaker until his death in 1973, a year after the land had been sold to the U.S. Fish and Wildlife Service. Although the initial Service inventory documented two cabins and an outhouse on the parcel, when it was recorded in 2006 only the original 10 x 23-foot cabin remained. The cabin was remodeled prior to acquisition by the Service and was subsequently renovated in the 1980s to serve as temporary Refuge staff housing. A garage was added in 1992. The Cabin currently serves as quarters for a full-time volunteer Refuge caretaker.

Determination of Eligibility: It was determined that the Mellus Cabin does not meet NRHP eligibility criteria. The cabin was constructed after World War II and is not associated with any historic period, theme, or event. Mr. Mellus was not a prominent citizen in the area and does not appear in the historical record. The cabin's original appearance may have been rustic, but changes over the years destroyed the original characteristics. No archaeological materials were noted.

Status: Although slated for demolition since 2006, the cabin is still standing as of May 2013.

"Signal Station" Foundations and Debris: Graveyard Spit, Dungeness 7.5-minute USGS quad
The site consists of an assemblage of historic materials including cement foundations, pier blocks, septic tank, cistern, brick, tile, ceramic fragments, metal fragments, and some glass. Field notes taken in 2006 (Valentine 2006) indicate that a member of the local historical society referred to the location as a World War II era signal station. However, this fact has not been confirmed. The site has not been formally recorded or evaluated.

Dawley Unit Structures: T29N R3W S2 Sequim 7.5-minute USGS quad
Several structures constructed over 50 years ago are located on the Dawley Unit, including the main residence and multiple outbuildings (See Section 5.2, Refuge Facilities)

None of these structures have been formally recorded, nor have they been evaluated for historic significance, a process which must be accomplished prior to any proposed demolition or remodeling.

5.1.4 Current Knowledge of Local Cultural Resources and Archeological Sites Located Near Refuge Lands

Known Cultural Resources Occurring Off-refuge
A record search documented several additional cultural resources—both prehistoric and historic, sites and isolates—that have been recorded within a one-mile radius of the Refuge boundaries. While these sites do not fall under the jurisdiction of the Service, they provide a context for settlement and commerce in the vicinity of the Refuge. The closest sites are just east of the Refuge boundary—the "New Dungeness" townsite (45CA231) and the Tse'esqut Village (45CA239)—located at the base of Cline Spit. Both sites were noted by Smith in 1907 and relate to the ethnographic period (Smith 1907). Historic property inventories have been prepared for several houses located in Sequim that are greater than 50 years old.

5.1.5 Previous Archaeological Research

Three previous archaeological surveys of the Dungeness NWR contain information about the setting and potential for cultural resources within the Refuge. In 1907, Harlan L. Smith and company

documented numerous shell middens and burials in the vicinity of what is now Dungeness NWR. Smith's survey encompassed the whole of the Gulf of Georgia and Puget Sound (Jesup North Pacific Expedition directed by Franz Boas of the American Museum of Natural History). According to Smith in his acknowledgments, William H. Thacker conducted reconnaissance on Smith's behalf in the "San Juan group" during the summer of 1898. He continues, "In 1899 we examined the shell-heaps on Puget Sound, the Straits of Juan de Fuca as far west as New Dungeness" (Smith 1907). Site 45CA239 Tse'esqut Village, the ethnographically recorded site near New Dungeness Townsite is likely one of the sites described above.

In 1981, Robert Thomas and Hal Kennedy conducted an intensive surface survey of six sites proposed for development on the Dungeness NWR. Results of the investigations at these six locations were all negative, no cultural resources were identified (Kennedy 1981). Based on their research and review of other topographic areas similar to the bluff where they were surveying, Thomas and Kennedy prepared a list of categories of cultural resources that might be expected. These included isolated artifacts, burials, early archaeological sites (ca 60,000-8,000 years old), and ethnographically documented archaeological sites (Kennedy 1981).

They also noted that "Because soil conditions are related to glaciomarine and recessional outwash, buried archaeological sites would not be expected" (Kennedy 1981).

In 1988, Jeanne Welch and Dr. Richard Daugherty completed a survey and limited subsurface testing (augering) of the proposed enlargement of the parking lot at Dungeness NWR. No cultural resources were identified by this field effort.

Other archaeological investigations that have occurred at Dungeness NWR include survey for a vault toilet installation and environs (Raymond 1989, Valentine 1993), and the evaluation of the Mellus Cabin (Speulda 2006).

5.2 Refuge Facilities

The infrastructure and facilities discussed in this section include buildings, structures, roads, parking lots, trails, fences, signs, and utilities. Refer to Table 5-1 and Figure 5-1 for maps showing the locations of existing Refuge facilities.

5.2.1 Public Entrances and Access Points

The primary public entrance point for the Refuge is through the entrance station located adjacent to the public parking area at the north end of Voice of America Road within the Clallam County managed Dungeness Recreation Area. Visitors can also access the Refuge from the primitive trail entrance station located at the northern end of the County horse trail in the Dungeness Recreation Area. The Refuge bluff trail is accessible from five points along the public parking area and connects to the County bluff trail segment but does not provide direct access to Refuge beach areas.

Boaters may access tideland areas, which are open seasonally May 15 through September 30, through the Dungeness Harbor and Bay. The only boat access to dry land areas within the Refuge is located adjacent to the New Dungeness Light Station. The boat landing zone is designated by two yellow posts and is directly south of the lighthouse on the south side of Dungeness Spit. Reservations

are required to land and boaters are required to stay on the designated trail from the beach to the lighthouse as areas on either side are closed to the public to protect plants and wildlife.

5.2.2 Administrative Buildings and Other Structures

Dungeness Unit Buildings and Structures
The Washington Maritime National Wildlife Refuge Complex headquarters is located at 715 Holgerson Road in Sequim, Washington. Public access is located at the north end of Voice of America Road in the Dungeness Recreation Area. The headquarters consists of an administrative building (3,756 square feet), shop building (3,848 square feet), and an equipment storage building (2,220 square feet), all completed in 2009.

Additional buildings and structures include the Mellus Cabin (See Section 5.1.3) which is located in the forest on the bluff above the base of Dungeness Spit where the primitive trail joins the main trail and descends to the beach. Although the property was purchased by Mr. Mellus in 1940, the cabin (750 square feet) was not constructed until sometime in the early 1950s. The Mellus Cabin is currently used as a volunteer office and as the Refuge caretaker's residence. There is a septic system associated with the residence. Adjacent to the Mellus Cabin is an equipment storage garage built in 1992 (400 square feet) and a pump house built in 1973 which services a well drilled in the 1940s.

In 2011, the Service constructed a new entrance station in the "Northwest" timber frame style adjacent to the public parking area at the main trailhead. The station includes two structures, a fee station, and an interpretive kiosk with an attached structure containing three public trash/recycle cans. The facility includes four wood outdoor benches and a metal bicycle rack. A garbage storage structure located near the public restrooms was also constructed in a similar style and includes a dumpster and three public trash/recycle cans. There is a second smaller fee station constructed in 1987 located at the primitive trailhead.

There are two viewing decks totaling 1,300 square feet near the north end of the primitive and main trails adjacent to the Mellus Cabin with benches and telescopes overlooking the Dungeness Spit. The upper deck is wheelchair accessible. The Refuge leases a public restroom facility and drinking fountain (425 square feet) built in 1973 from Clallam County. It is located next to the public parking area, also leased from Clallam County, adjacent to the main Refuge entrance station and includes a 1,000 gallon twin vault septic system and drain field constructed around 2005 and located to the west of the building. However, that system is not able to handle the heavy use associated with the busiest visitor use days the Refuge experiences.

In 2011, the Service constructed an additional septic system for that facility on County property to increase capacity. A 2,000 gallon pump tank was added with a high capacity pump and aqua works controls. A much larger drain-field was added and includes ten 3 x 1 foot trenches, five measuring 60 feet in length and five measuring 70 feet in length. Pipe was installed in each trench which is designed to equally disperse effluent. The old system was left in place and a connecting valve was added to allow selection of the old or new system depending on needs.

Dungeness Unit – Other Infrastructure
Infrastructure at the Refuge Complex headquarters includes an on-site wastewater treatment/disposal system with two 1,000-gallon septic tanks, 250 linear feet of 4-inch diameter PVC effluent piping, and two gravel-less 60-foot long chamber drainfields; all installed in 2009. The domestic water

system is tied to the Dungeness Recreation Area's domestic water which is supplied by a community water company. It is comprised of 800 linear feet of 3-inch diameter PVC pipe, a 500-gallon storage tank, booster pump/controls, 1-inch diameter flowmeter, pressure sustaining valve, and 240 linear feet of 2-inch diameter PVC piping to the office building. The electrical infrastructure includes underground utilities (15 KV underground power cable in 2-inch PVC conduit (137 linear feet off-site and 643 linear feet on-site)); 75 KVA transformer; CT enclosure; 2 electric meters; and two 2-inch diameter conduits with underground power to the office, all installed in 2009.

Dawley Unit
There are 21 buildings, ponds and other substantial structures located on the Dawley Unit which is closed to all public access. In addition there is a 2,640 linear foot water distribution system to and from the large earthen impoundment pond south of Highway 101 constructed in 1964. Table 5-1 lists each structure including size, condition, and year constructed and/or deconstructed. Structure locations are identified by number on the associated map (Figure 5-1).

5.2.3 Fencing and Boundary Markers

Dungeness Unit Fences
Fencing on the Dungeness Unit falls into two general categories, split rail and plank rail. There is split rail and/or plank fencing surrounding most of the headquarters complex as well as delineating the Refuge property from the County recreation area. There is also plank rail fencing delineating the area which is closed to the public around the Mellus Cabin from the public trail. A few small fence sections also line both the main and primitive trails to discourage visitors from creating illegal "social" trail shortcuts.

Split Rail Fencing
In 2009, contractors installed 953 linear feet of split rail fencing on the southern and eastern boundary of the headquarters complex as part of the new headquarters construction. That fence includes an electronic security gate at the north end of Holgerson Road. Later in 2009, Refuge volunteers installed an additional 247 linear feet of split rail fencing in the staff parking area, around the new Complex office entrance, and at the entrance to the primitive trail. In 2011, 134 linear feet of split rail fence was added between the overflow parking area and the office path and behind the fee station.

Plank Rail Fencing
In 2011, contractors added 84 linear feet of heavy plank rail fencing between the office path and the main trail and an additional 30 linear feet between the entrance to the bluff trail and the parking space closest to the kiosk. This fence was very similar in style to the existing fence which fairly accurately delineates the boundary between the Refuge and the County Recreation Area. The primary difference is that the old fencing incorporated round creosote treated posts and the new fencing uses square untreated cedar posts. The old fence runs 1,389 linear feet from east of the garage building to the west end of the public parking lots and includes breaks or gaps for the primitive and main trail, the Refuge entrance station, the bluff trail entrance and four parking lot access points along the bluff trail.

The Mellus Cabin is separated from the main trail by 206 linear feet of plank rail fencing and there is 146 linear feet of fence separating the primitive trail from the main trail adjacent to the cabin. Three

additional sections of plank rail fence totaling 128 linear feet are located along the main trail and one measuring 33 linear feet is located in the forest near the middle section of the primitive trail.

Dawley Unit Fences
The Dawley Unit has 920 linear feet of chain link fencing, mostly north and east of the three "natural" ponds and around the stone shed. That fence includes two double gates (one unhinged) and one single gate. There is another double gate separating the Olympic Discovery Trail from the main residence driveway. An additional 306 linear feet of wire fencing stretching from the mobile home to the stone shed was installed by the Discovery Trail during construction.

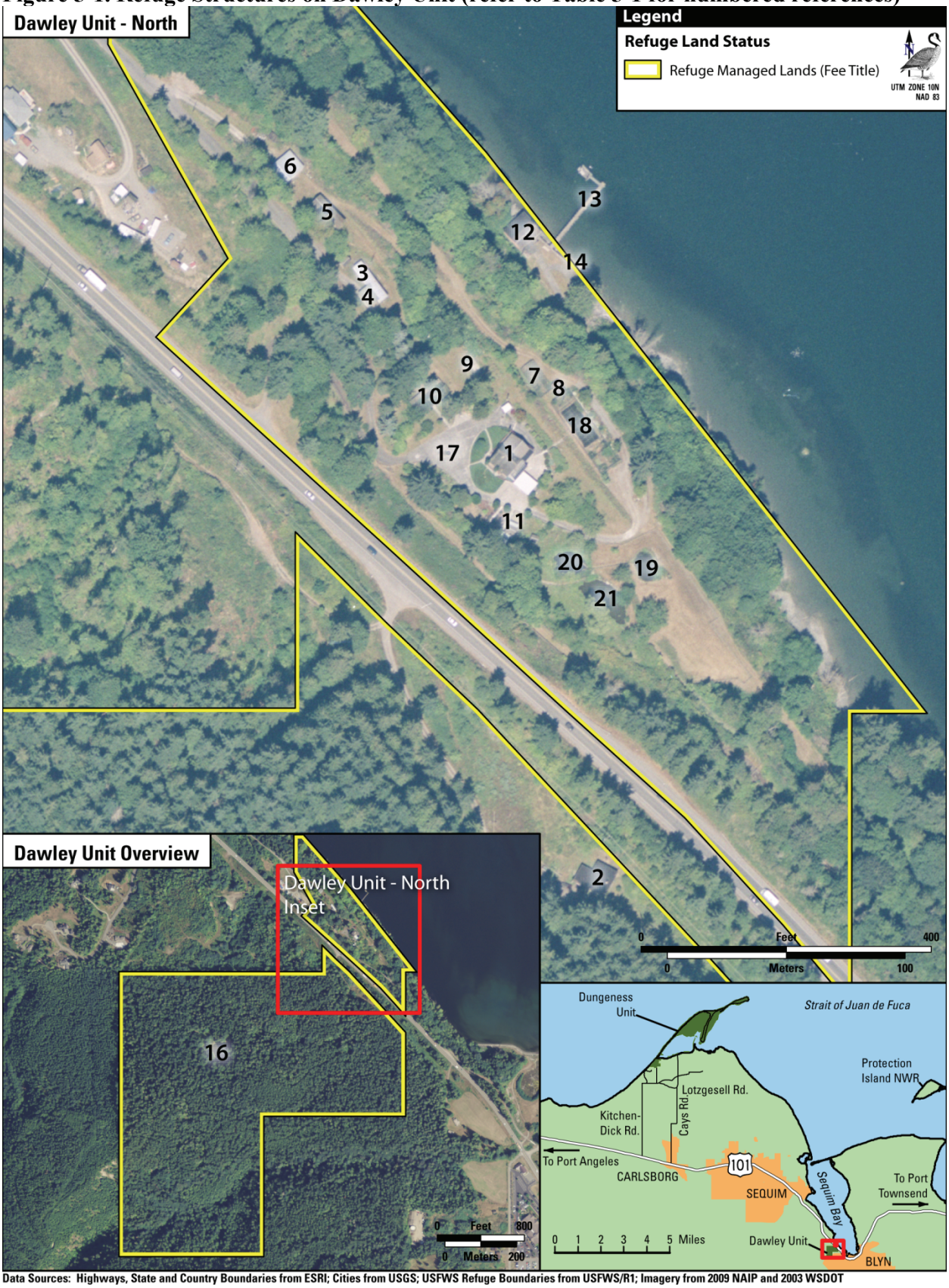
Saltwater Pilings
The Refuge currently maintains 13 plastic covered steel core pilings with regulatory signs demarcating the Refuge boundary in Dungeness Bay and Harbor.

Table 5-1. Refuge Structures on Dawley Unit (refer to Figure 5-1 for locations)

Structure		Size, sq. ft.	Septic syst.	Yr. Built	Condition	Removed	Tract
1	Main residence	4,393	yes	1935	Fair		North
2	Old rental house *	896	yes	1964	Poor		South
3	Mobile home *	808	yes	1974	Poor		North
4	& Small shed		no				
5	Large shed	720	no	1930	Poor		North
6	Metal garage	1,090	no	1990	Good		North
7	Aviary shed	990	no	1965	Foundation	2011	North
8	Small aviary	227	no	1963	Foundation	2011	North
9	Pentagon aviary	16	no	1975	Foundation	2011	North
10	Rectangle aviary	1,200	no	1975	Foundation	2011	North
11	Stone shed	288	no	1939	Fair		North
12	Beach house *	1,024	yes	1960	Poor		North
13	Wood dock *	59.44	-	1952	Fair		North
14	Concrete bulkhead *		-				
15	Pole barn *	Unknown	no	1964	Collapsed		South
16	Impoundment	Large	-	1964	Good		South
17	Brick "well"	Very small	-		Fair		North
18	Concrete pond	Small	-		Breached	2011	North
19	"Natural" pond 1	-	-				North
20	"Natural" pond 2	-	-				North
21	"Natural" pond 3	-	-				North

* The Service plans to evaluate the removal of structures 2, 3, 12, 13, 14, and 15 and decommission any associated septic systems. Note: Only the rental house removal may be associated with the Washington Department of Transportation's upcoming highway project.

Figure 5-1. Refuge Structures on Dawley Unit (refer to Table 5-1 for numbered references)



Data Sources: Highways, State and Country Boundaries from ESRI; Cities from USGS; USFWS Refuge Boundaries from USFWS/R1; Imagery from 2009 NAIP and 2003 WSDOT

The back sides of maps are blank to improve readability.

5.2.4 Roads and Trails

Dungeness Unit Roads
The Refuge Complex Headquarters compacted gravel access road located at the northern end of Holgerson Road is 490 feet long and was completed and chip sealed in 2009. It provides access to all three buildings at the headquarters and includes a staff parking area with room for approximately 7 vehicles. The parking area also includes a 12 x 36-foot concrete RV pad with water and electrical hook-ups and a sewage discharge connection.

Refuge visitors can park in one of two parking lots leased from Clallam County at the north end of Voice of America Road in the Dungeness Recreation Area. The main lot is chip sealed and contains 63 vehicle spaces including two Americans with Disabilities Act (ADA) compliant parking spaces. The "overflow" lot is a mixture of compact gravel and chip seal and contains spaces for 12 additional vehicles including one concrete paver ADA compliant disabled parking space. There is an emergency and maintenance beach access road and right of way through private property at the end of West Anderson Drive. That access includes a locked gate and is not available to the public.

Dawley Unit Roads
There is no public access to the Dawley Unit and no public roads. There is 1,164 linear feet of concrete roadway, 5,856 linear feet of gravel road, and 52,545 linear feet of dirt "skid" roads within the unit providing access to various locations.

Dungeness Unit Trails
Public access to the Refuge Complex headquarters from the Refuge entrance station and parking area is via a 404 linear feet concrete paver walkway which incorporates an ABA/ADA compliant parking space. The main trail connects the entrance station to the Dungeness Spit and is 2,115 linear feet. It is constructed of compacted gravel and was resurfaced and modified in 2011. The bluff trail is a dirt trail measuring 740 linear feet extending from the Refuge entrance station to the western end of the public parking area. The primitive trail is also a dirt trail measuring 3,110 linear feet and connects to the Dungeness Recreation Area horse trail on the south end and to the Refuge main trail on the north end. In 2009, the entrance to primitive trail was relocated approximately 30 feet east to align with the County horse trail and to facilitate the installation of the brick paver path connecting the Refuge Office with the entrance station. The old trail entrance was rehabilitated.

Although they are not maintained hiking trails, Refuge visitors can also hike on the beach on the Strait of Juan de Fuca side from the western Refuge boundary to the lighthouse compound. The Dungeness Harbor side of the Spit from the base to the ½ mile marker is open to public hiking from May 15 through September 30.

5.2.5 Signs

The Service maintains informational, interpretive, and regulatory signage in accordance with standard Service policy; however, due to the maritime nature of the Dungeness National Wildlife Refuge, a series of nonstandard "large format" signs have been utilized on shoreline areas. These heavy duty signs measure approximately 5 feet wide by 4.5 feet tall. Such signs are used in particularly sensitive habitat areas susceptible to disturbance by watercraft and warn boaters to remain 200 yards from shore where possible to protect wildlife. The size allows for text large enough to be clearly legible from a distance. See Appendix H for a complete sign inventory.

5.3 Public Use Overview

Upon establishment, all national wildlife refuges in the lower 48 states are closed to public use unless specifically designated as open. The Refuge Recreation Act of 1962 authorizes recreational uses of refuges only when such uses do not interfere with the refuge's primary purposes and when funds are available for development, operation, and maintenance of those uses. The National Wildlife Refuge System Administration Act of 1966 further stipulates that all uses of a refuge must be compatible with the purpose(s) for which the refuge was established.

Dungeness NWR offers visitors a limited variety of recreation opportunities. The Refuge includes areas that are open for public use year-round and areas that are open only seasonally, depending on the needs of Refuge wildlife. Some portions of the Refuge are closed to visitors year-round for the benefit of wildlife. The Dungeness NWR is divided into five public use zones. Table 5-2 provides a description of the zones as well as a summary of the areas open and closed to public uses and the types of uses that are allowed in each zone. Figure 2-3 also depicts the five public use zones. Under the management direction described within this CCP, public use activities on the Refuge will include:

- Fishing (saltwater)
- Shellfishing (clams and crabs)
- Wildlife observation
- Wildlife photography
- Hiking
- Boating (no wake allowed)
- Jogging
- Horseback riding (should alternative access be obtained per compatibility determination)
- Beach use (wading, other recreational beach uses)
- Environmental education
- Environmental interpretation

While there is no hunting allowed on the Refuge, there is waterfowl hunting taking place on adjacent lands and waters (See Section 5.8, Regional Recreational Opportunities). There is also some waterfowl hunting occurring illegally on Refuge waters (See Section 5.6.1, Illegal Refuge Uses).

The 1997 Final Environmental Assessment (EA) for the Management of Public Use for Dungeness National Wildlife Refuge established that personal water craft (jet skiing) and wind surfing are incompatible with Refuge purposes (USFWS 1997a). Hiking, wildlife observation and photography, boating, recreational fishing, jogging, beach use and horseback riding were determined to be compatible with the modifications outlined in the EA. Environmental education, tribal fishing, research, and permitted special uses were also found compatible.

In July 2006 the Service published its Appropriate Refuge Use Policy (603 FW 1). Under this policy refuge managers are directed to determine if a new or existing public use is an appropriate refuge use. If an existing use is not appropriate, the refuge manager is directed to modify the use to make it appropriate or terminate it, as expeditiously as practicable. In the Draft CCP/EA, the Service made preliminary findings and determinations regarding the appropriateness and compatibility of each use included in each alternative (USFWS 2012a). Appropriateness findings and compatibility determinations have been revised and finalized for each use included in the management direction. Appropriateness and compatibility are further discussed in Chapter 2 and Appendices A and B.

Table 5-2. Refuge Areas Open and Closed to the Public and Allowed Uses by Zone

Zone	Description	Open	Closed	Allowed Activities
Zone 1	West beach below the bluffs, west of Dungeness Spit	Year-round	N/A	Saltwater fishing, wildlife observation and photography, hiking, and recreational beach use (including jogging)
		Weekdays only: 4/1 to 9/30 Daily: 10/1 to 3/31	Weekends: 4/1 to 9/30 and Memorial Day, the Fourth of July, and Labor Day	Horseback riding (reservations required) should an alternative access route be developed
	Bluffs above the west beach	N/A	Year-round	N/A
Zone 2	First ½ mile of beach on Dungeness Spit facing the Strait of Juan de Fuca	Year-round	N/A	Saltwater fishing, wildlife observation and photography, hiking, and recreational beach use
	First ½ mile of beach on Dungeness Spit facing Dungeness Harbor	5/15 to 9/30 (foot access only)	10/1 to 5/14	Clamming/crabbing, wildlife observation and photography, and hiking
Zone 3	Dungeness Spit beach facing the Strait of Juan de Fuca from ½ mile (the end of Zone 2) to the New Dungeness Light Station	Year-round	N/A	Saltwater fishing, wildlife observation and photography, and hiking
Zone 4	Dungeness Spit beach facing Dungeness Harbor and Bay from ½ mile (the end of Zone 2) to the New Dungeness Light Station, the tip of Dungeness Spit, and Graveyard Spit, including a 100 yard buffer below the mean high-tide line	N/A	Year-round	N/A
Zone 5	Refuge waters and tidelands in Dungeness Harbor and Dungeness Bay beyond the Zone 4 100 yard buffer area	5/15 to 9/30 (boat access only)	10/1 to 5/14	Clamming/crabbing, wildlife observation and photography, and boating (no wake)

5.4 Wildlife-Dependent Public Uses

Wildlife-dependent public uses are voluntary, leisure time pursuits which require the presence of, or proximity to: fish, wildlife, or wildlands. Wildlife-dependent uses in the National Wildlife Refuge System generally refer to hunting, fishing, wildlife observation and photography, and environmental education and interpretation. With the exception of hunting, all of these uses occur at Dungeness NWR.

Some uses are not wildlife-dependent but do facilitate the pursuit of wildlife-dependent activities. Examples of nonwildlife-dependent uses occurring at Dungeness NWR that may facilitate fishing or wildlife observation and photography include hiking, boating, and recreational beach uses such as wading, picnicking, or sunbathing. These uses are described in Section 5.5, Other Refuge Uses.

5.4.1 Fishing and Shellfishing

A limited amount of hook-and-line saltwater fishing occurs on the Strait of Juan de Fuca side of Zones 1, 2, and 3. These three zones are open year-round to fishing activities (except the harbor side of Zone 2 is closed October 1 through May 14). Shellfishing occurs on the tidelands in Dungeness Harbor and Dungeness Bay in Zones 2 and 5. Both Zones 2 and 5 are open to shellfishing from May 15 through September 30. Visitors are allowed to access Zone 2 by foot only and Zone 5 by boat only. In Zone 5, shellfishing is restricted to beyond 100 yards from the mean high tide line. Shellfishing in the Refuge does not include oyster harvesting; all oysters in the area are privately owned. All Washington State fishing regulations apply to fishing and shellfishing activities in the Refuge. Use of the Refuge for fishing and shellfishing is limited because there are areas in the local vicinity that offer higher quality opportunities for these experiences. No developed facilities exist to support fishing or shellfishing.

5.4.2 Wildlife Observation and Photography

Wildlife observation and wildlife photography are the primary wildlife-dependent activities occurring on the Refuge. Visitors to Dungeness NWR can enjoy wildlife observation and photography opportunities in any of the areas open to public use. Wildlife observation and photography can occur year-round along the upland trails and the beach in Zone 1; along the Strait of Juan de Fuca in Zones 2 and 3; and seasonally in Zones 2 and 5. Access restrictions dictate that wildlife observation and photography can only occur via foot access in Zones 1, 2, and 3; or by boat in Zone 5. There are two observation decks with viewing scopes at Dungeness NWR. The upper deck is equipped with two viewing scopes and the lower deck with one. The observation decks are located approximately 3/8 mile from the parking area and can be reached via the main and primitive trails.

5.4.3 Environmental Education and Interpretation

The Refuge is a popular outdoor classroom for a variety of organizations, including school groups from elementary to university level. Instructors arrange for educational field trips to the Refuge and these groups often assist the Refuge with service projects. Projects include removing Styrofoam, plastics, and other debris from Refuge lands. The Refuge does not offer formal education programs but supports instructors who use the Refuge as a classroom.

There are a number of interpretive panels and other informational sources at the Refuge. Interpretive panels are located in the kiosk area near the parking lot and along the trail. Subjects include wildlife and habitat, human history, citizen science, and marine debris. Additional panels are planned for both overlooks. The Refuge also offers visitors an interpretive brochure, wildlife checklist, and various other publications. In addition, the Refuge takes advantage of volunteer subject matter experts to present interpretive programs about the Refuge's habitat resources and geomorphologic processes (i.e., spit formation).

The New Dungeness Light Station Association volunteers provide interpretive information to lighthouse visitors about the light station and its role in local maritime history. There is also a Refuge interpretive exhibit in the lighthouse. A map panel with Refuge regulations is located at the light station boat landing zone. Regulatory information signs are located off-Refuge at the Dungeness Landing County Park and Cline Spit Community Beach boat launches.

Graveyard Spit has been a designated Resource Natural Area (RNA) since 1990. Activities are limited to research, study, observation, monitoring, and education; and must be nondestructive and nonmanipulative; and must maintain the area in an unmodified condition. The natural processes must be allowed to predominate without human intervention. Public access to Graveyard Spit is not allowed; research arrangements and permits must be specifically granted by the Service.

5.5 Other Refuge Uses

In addition to wildlife-dependent public uses, refuges can sometimes offer experiences that are nonwildlife-dependent. Examples of nonwildlife-dependent uses include swimming or wading, horseback riding, jogging, and hiking or recreational boating purely for the sake of hiking or boating, respectively. The nonwildlife-dependent uses allowed and occurring at Dungeness NWR are described below.

5.5.1 Hiking

Some nonwildlife-dependent uses on the Refuge enable visitors to enjoy wildlife-dependent activities. For example, hiking allows visitors to engage in wildlife observation and photography. Hiking is also enjoyed simply for the sake of hiking as an experience. Hiking occurs along designated upland trails and on Refuge beaches. The main and primitive upland trails begin at the parking area and meander through the forest to an overlook on the bluff above Dungeness Spit. They join and continue down a steep hill to the spit, emerging from the forest at the interface of public use Zones 1 and 2. Hikers may choose to head west on the beach adjacent to the bluffs or east onto Dungeness Spit where they can continue another five miles to the New Dungeness Light Station.

5.5.2 Boating

Boating is another example of a nonwildlife-dependent activity that can support wildlife-dependent recreation as well as be enjoyed for the sake of the activity itself. Parts of the Refuge are only accessible by boat and, like hiking, recreational boating can allow visitors to engage in wildlife observation and photography in those areas. Recreational boating also affords visitors seasonal opportunities to engage in shellfishing on the Refuge tidelands in Dungeness Harbor and Dungeness Bay.

Boats can be used to access the New Dungeness Light Station. There is a designated boat landing zone south of the lighthouse that is open year-round; reservations are required. The reservation system allows Refuge staff to document visitation and limit the number of boat landings in order to minimize wildlife disturbances, if necessary. Boat landings are limited to lighthouse hours, 9 am to 5 pm. The narrow landing zone on the bay side of Dungeness Spit is the only area on the bay and harbor side of the spit in which boats are allowed to land within the 100-yard buffer zone. It is an unimproved section of beach with no facilities. Visitors must remain on the trail from the landing area to the lighthouse to minimize disturbance to wildlife.

Kayaks are a popular means for visiting the area. Several kayak outfitters offer guided tours to Dungeness NWR and the New Dungeness Light Station. Kayaks launch from Dungeness Landing or Cline Spit and may travel through Refuge waters seasonally to reach the landing zone at the lighthouse. While most of the tours occur in summer, some are also offered in the winter.

Although they are popular activities nearby, jet skiing and windsurfing are not allowed in the Refuge. All waters within the Refuge boundary are designated as no-wake zones. To protect wildlife, the Refuge has established a buffer that extends out 100 yards from the mean high tide line.

5.5.3 Horseback Riding

Under the management direction described within this CCP, horseback riding will be allowed with stipulations in Zone 1 (the beach area west of Dungeness Spit, below the bluffs) if a safe and legal alternate access route from the west or east can be obtained. If access is obtained from the east, horseback use of a Refuge-owned service road to the beach will also be allowed. Horseback riding will require advanced reservations through the Refuge Office. Riding will be permitted daily from October 1 through March 31 and on weekdays from April 1 through September 30, excluding Memorial Day, the Fourth of July, and Labor Day. The reservation system will be used to document visitation and avoid overcrowding. For more information see Chapter 2, and Appendices A and B.

5.5.4 Jogging

Under the management direction of this CCP, jogging is allowed in Zone 1 and on the bluff trail adjacent to the Refuge parking lot. Jogging is not allowed in Zones 2 and 3. Organized running events are not allowed. Groups are limited to 3 people or less to minimize wildlife disturbance and conflicts with other Refuge visitors. For more information see Chapter 2, and Appendices A and B.

5.5.5 Other Recreational Beach Use

Other recreational beach use includes wading, picnicking, sunbathing, and other passive, nonconsumptive uses not described above. These beach uses are allowed in Zones 1 and 2, along the beach facing the Strait of Juan de Fuca. These zones are the most accessible areas via the trail from the parking area.

In order to protect migrating birds and other wildlife from disturbance, jet skis, windsurfing, pets, bicycles, kites, Frisbees, boomerangs, and balls are not allowed on the Refuge. More information about illegal uses is provided in the next section.

5.6 Illegal Uses

5.6.1 Illegal Refuge Uses

The most frequent illegal uses occurring on the Refuge include nonpayment of the required entrance fee, and after hours and closed area trespass. Occurring less frequently are dog walking, bicycle riding, littering, climbing on closed bluffs, beach combing and collecting (including drift wood collection), and unauthorized boat landings and entry into closed waters. Additional incidental illegal uses include fishing (shellfish and finfish) out of season, water fowl hunting, camping, fires, graffiti and other vandalism. Nonwildlife-dependent recreational activities that disturb wildlife such as jogging in areas closed to that activity, kite flying, and ball sports occasionally occur on the Refuge.

Illegal uses persist partly due to limited law enforcement presence and a lack of public awareness of the sensitivity of Refuge wildlife to human disturbance. There is currently one dual-function Federal Wildlife Officer assigned to cover all six refuges within the Washington Maritime National Wildlife Refuge Complex. Refuge staff coordinates with other Federal officers/agents and works with the U.S. Coast Guard as well as State, county, and local law enforcement offices.

5.7 Refuge Visitation

5.7.1 Visitation

The Refuge is a popular regional destination. However, determining actual visitation is problematic due the Refuge's "honor" system where visitors are required to enter the number of people in their party on their fee payment envelope and because there is no mechanism in place to count Refuge boaters, except those that make reservations to land at the historic lighthouse. Some visitors simply do not fill out the required information and others illegally bypass the fee station altogether. As such, Refuge visitation is estimated by adding an additional 15% to the total visitor count attained from fee envelopes to account for people who do not comply with the registration requirements and for boaters who do not land at the lighthouse and those that fail to make the required reservation.

It is estimated that visitation in 2011 approached 76,000 people and may have actually been significantly higher. Construction of the new entrance station during spring and summer of 2011 may have negatively impacted visitation which has ranged in the past five years from relative lows of about 76,000 visitors in 2009 and 2011 to a high of about 80,300 in 2010. Between 2007 and 2011, Refuge visitation remained fairly steady (±5%) despite the onset of a severe economic recession suggesting the sluggish economy has not significantly impacted Refuge recreation trends. This may be due, in part, to the relatively low user fee of $3 per day or $12 annually per 4 adults. By comparison, many other popular recreation site user fees in the region are significantly higher (See Table 5-3, Regional Recreation Site User Fees). The local area is also considered to be a retirement community and many of the regular visitors possess lifetime "Senior" or "Golden Age" passes which cover Refuge entrance fees.

The Refuge usually experiences the highest visitation in the summer months from June through August. On average, this three month period accounts for nearly half of annual visitation. It is not unusual to have 600 or more visitors per day during the summer and very busy days may have over

900 people. The highest single day visitation on record was Sunday, September 4th, 2011, when 1,037 people were tallied entering the Refuge (USFWS 2012b).

In July 2011, visitor surveys were distributed to Refuge visitors as part of a National Science Foundation funded research project involving Colorado State University, the National Park Service, the USFWS, and the National Parks Conservation Association. Of the 150 respondents who filled out demographic information, 11% were ages 66 and up. The two largest age groups were from 46-55 (20%) and 56-65 (29%) (Davis et al. 2012). Demographic information for visitors to the nearby Olympic National Park (NP) provides additional insight into Refuge visitation. Based on a visitor study conducted at Olympic NP in July 2000, most of the visitor groups (64%) were family groups. Seventy-seven percent of the park's visitor groups were groups of two to four people (Van Ormer et al. 2001). Anecdotally, Dungeness NWR sees similar visitor group sizes and, particularly during the summer, a similar proportion of family groups.

While it is apparent that most visitors are seeking an outdoor recreation experience, it is difficult to quantify the number of visitors participating in each category. The most popular activities are hiking and wildlife and/or landscape viewing. Many people just want to see the Dungeness Spit and enjoy the panoramic views. Aside from the trails, the majority of visitors tend to congregate in the first ½ mile of the spit making it the busiest part of the Refuge's beach area.

Visitor logs maintained at the New Dungeness Light Station suggest that approximately 10% of Refuge visitors make the 11-mile round trip hike to see the historic lighthouse. Due to the difficulty of tracking visits by boat, it is unknown how many recreational boaters use Refuge waters. However, it is estimated that an average of 275 boats visit the lighthouse each year, most of those being kayaks. By far the majority of visitors, at least 99%, access the Refuge via the upland trails. Of those, more than 98% enter on the main trail, while only about 1% enter the Refuge via the primitive trail. In past years, horse riders typically accounted for less than 12% of primitive trail users or just over 1% of all trail users, and averaged 164 rider reservations annually between 2008 and 2010 (USFWS 2012b).

Education is also an important activity. The Refuge is used as an outdoor classroom for environmental education by regional schools and various organizations. Between 2007 and 2011, 117 educational use permits were issued for the Refuge covering 879 adults and 3,496 youths. On average, 23 permits covering 176 adults and 699 youths are issued annually. While specific curriculums vary, permits require that the course of study focus on the wildlife, plants, geology, marine environment, or history of Dungeness National Wildlife Refuge.

5.8 Regional Recreational Opportunities

Dungeness NWR is located on the North Olympic Peninsula which encompasses two counties, Jefferson and Clallam, and is bordered by the Pacific Ocean to the west, the Strait of Juan de Fuca to the north, Puget Sound to the east, and Olympic National Park and National Forest to the south. The area boasts an incredible array of bays, estuaries, lakes, rivers, waterfalls, glaciers, beaches, mountains, forests, wetlands, farmlands, and alpine meadows. It has a great diversity of natural habitats and nature based recreational opportunities. The North Olympic Peninsula is well known for its extensive hiking, biking, camping, boating, wildlife viewing, mountaineering, snow sports, hunting, fishing and diving opportunities. With so much land in public ownership, the recreational opportunities are quite extensive. The following abbreviated synopsis is intended to provide a general overview of regional recreation opportunities including those available in Clallam County and in the

general vicinity of the Refuge. Furthermore, the North Olympic Peninsula is only a short drive and a ferry ride away from additional recreational opportunities available in the San Juan Islands; Victoria, British Columbia; and Canada's Vancouver Island.

The Olympic Peninsula encompasses more than 6,500 square miles (Richards 1984) with the Olympic National Forest (NF) and Olympic National Park (NP) comprising nearly one-third of the land area (Turner et al. 1996). See Table 5-4, Land ownership on the Olympic Peninsula, Washington. Currently Olympic NF includes 633,677 acres, and Olympic NP includes 922,650 acres. Of the more than two million acres of forests in Clallam and Jefferson counties, more than 50% is federally owned (RC&DC 2009). Both public and private lands are generally held in large blocks, and the majority of the nonfederal lands are managed for timber production by the state of Washington's Department of Natural Resources (WDNR) and by large private corporations. Most of that land is open for recreation including hunting. Small private ownerships comprise only 21% of the Olympic Peninsula (Turner et al 1996).

Wilderness

The United States Congress designated the Olympic Wilderness in 1988 (Washington Park Wilderness Act of 1988, Public Law 100-668 (11/16/1988)). The area, managed by the National Park Service, now totals 876,669 acres and is Washington's largest Wilderness area. It is also one of the most diverse wilderness areas in the U.S. The heart of the Olympic Wilderness is made up of the rugged Olympic Mountains and some of the most pristine forests left south of the 49th Parallel. The temperate rainforest valleys of the west and south flanks of the mountains receive 140 to 180 inches of precipitation annually with Mt. Olympus (7,980 feet), the highest peak in the Olympic Mountains, receiving over 100 feet of snow annually (Wilderness.net 2012).

Mt. Olympus has the third largest glacial system in the conterminous U.S. next to Mt. Rainier and Mt. Baker, also in Washington State. The Olympic Wilderness also contains 48 miles of wilderness coast including beaches, rugged headlands, tide pools, sea stacks, and coastal rainforests. Just over 600 miles of trails lead into the interior of the park. Olympic is one of the most popular wilderness destinations in North America, with nearly 40,000 overnight wilderness visitors each year (Wilderness.net 2012).

Recreation on Washington Department of Natural Resources (WDNR) Lands

WDNR seeks to provide outdoor recreation opportunities to the public throughout Washington State. Recreation on WDNR-managed lands includes hiking, hunting, fishing, horseback riding, camping, off-road vehicle (ORV) driving, mountain biking, and boating. The agency provides trails and campgrounds in a primitive, natural setting. Most recreation on these lands takes place in the 2.2 million acres of forests that WDNR manages as state trust lands. WDNR manages 1,100 miles of trails, 143 recreation sites, and a wide variety of landscapes across the state (WDNR 2012).

WDNR's Olympic Region, which surrounds the Olympic Peninsula, offers a variety of quality recreation experiences. The region has 10 campgrounds, 4 designated multi-use trails with approximately 40 miles of trails for hiking, horseback riding, mountain biking, motorcycling, and ORVs or 4x4s, as well as numerous other trails for nonmotorized activities. The majority of the campgrounds have river or lake access for boating, fishing, and other water activities. The region is located near the Olympic National Park, Hoh Rain Forest, Olympic National Forest, Olympic Experimental State Forest, as well as the many coastal beaches in the region. The region encompasses approximately 371,000 acres of state forest, agriculture, urban and conservation lands (WDNR 2012). See Table 5-5 North Olympic Peninsula Parks and Recreation Areas.

Clallam County Parks
Clallam County manages parks in various parts of the County, primarily oriented around water. Recreation opportunities in the agency's twenty parks include camping, fishing, boating, hunting, hiking, horse riding, picnicking, scuba diving, and beachcombing. The 216-acre Dungeness Recreation Area borders the Refuge and offers picnic sites (including a group picnic area), year-round camping, hiking, biking, horseback riding, and other recreation opportunities. Pets on leash are allowed in the park (Clallam County Parks 2012a).

There are two other County Parks, Cline Spit and Dungeness Landing, adjacent to the Refuge. Both offer public restrooms, tidelands, and free boat launches. Cline Spit is approximately 2 acres in size and has a boat ramp for boats 17 feet long and smaller that provides access to inner Dungeness Bay. The park includes 240 linear feet of public tidelands. Dungeness Landing is 5.6 acres with 13 additional acres of tidelands along the outer Dungeness Bay. Park features include a covered birding platform, a high water boat launch, and spectacular views of the historic New Dungeness Light Station and the Refuge (Clallam County Parks 2012b). See Table 5-5 North Olympic Peninsula Parks and Recreation Areas.

Birding
From ocean beaches to the Olympic Mountains, the north Olympic Peninsula offers some of the best birding opportunities in the Pacific Northwest. Mild winters support large numbers of ocean birds, including waterfowl. Spring and fall are migration times and offer great diversity in species. Due to diverse habitat, from rainforest to tidelands, many species remain as summer residents (OPAS 2012). In addition to the Refuge, the following viewing sites are recommended by the local Audubon Chapter.

- Gardiner Beach, Diamond Point and Discovery Bay
- South Sequim Bay/Blyn and Jimmycomelately Creek
- John Wayne Marina
- Washington Harbor, Schmuck Road, and Port Williams/Marlyn Nelson County Park
- Dungeness Bay and 3 Crabs
- Dungeness Recreation Area
- Sequim's Railroad Bridge Park and Dungeness River Audubon Center
- Olympic National Forest: Upper waters of the Dungeness and Gray Wolf Rivers
- Olympic National Park and Hurricane Ridge
- Ediz Hook and Port Angeles Harbor
- Elwha River Estuary
- Salt Creek County Park
- Neah Bay and Cape Flattery

Wildlife Viewing
Exceptional opportunities to view the region's rich wildlife abound. One of the newest is the Whale Trail, a network of marine mammal viewing sites in the Pacific Northwest (Figure 5-2). The Whale Trail is being developed by a core team of partners including NOAA Fisheries, the Washington Department of Fish and Wildlife, People for Puget Sound, the Seattle Aquarium, the Olympic Coast National Marine Sanctuary, the Whale Museum, and Coast Watch Society. Thus far it includes 8 sites on the Olympic Peninsula, 32 sites in total located in city, county, and state parks; Tribal lands; and the Washington State Ferries (Whale Trail 2012).

Figure 5-2. One of Four Whale Trail Signs along Highway 112 on the Olympic Peninsula Photo Credit: USFWS

Olympic Coast National Marine Sanctuary (OCNMS or Sanctuary)
The Sanctuary includes 2,408 square nautical miles of marine waters off the rugged Olympic Peninsula coastline. The Sanctuary extends 25 to 50 miles seaward, covering much of the continental shelf and several major submarine canyons. The Sanctuary protects a productive upwelling zone that is home to marine mammals and seabirds. Along its shores are thriving kelp and intertidal communities teeming with fishes and other sea life. Twenty nine species of marine mammals reside in, or migrate through the Sanctuary. Gray whales, sea otters, harbor seals, and Steller's and California sea lions can be spotted from land at many locations along the coast at some time during the year. Other whales including humpback whales can be seen from boats as they feed miles offshore. The Sanctuary receives more than three million visitors annually, many attracted by Olympic National Park and other natural and cultural amenities (NOAA 2012a). The Sanctuary surrounds all the islands comprising Flattery Rocks, Quillayute Needles, and Copalis NWRs.

Waterfowl Hunting
While there is no hunting allowed in the Refuge, there are public and private recreational hunting opportunities nearby. On October 16, 2010, the Washington Department of Fish and Wildlife (WDFW) opened a new public waterfowl hunting area on the Lower Dungeness Unit west of the mouth of the Dungeness River off of East Anderson Road near Sequim. The 140 acre unit is open for waterfowl hunting on Wednesdays, Saturdays, and Sundays throughout the hunting season under a three-year agreement with Dungeness Farms Inc. As part of that agreement WDFW granted exclusive public access to Dungeness Farms to a parcel off Three Crabs Road (WDFW 2010). In addition, WDFW allows waterfowl hunting on State owned waters adjacent to the Refuge.

Western Washington Pheasant Release Program
The major goal of the pheasant program in western Washington is to provide an upland bird hunting opportunity. The program also encourages participation from young and older-aged hunters. Because the cool, wet climate of western Washington combined with the lack of grain farming limits naturally sustained pheasant populations, 30,000 to 40,000 pheasants are released each year on about 25

release sites. The only release site in Clallam County is the Dungeness Recreation Area (DRA) which currently allows pheasant hunting between the first weekend in October and November 30 on Saturdays, Sundays, and holidays (WDFW 2012b). The DRA also allows waterfowl hunting Saturdays, Sundays, and holidays throughout the waterfowl season. However, after completion of Clallam County's Master Plan for DRA, the hunting program has been determined to no longer be a compatible activity and will likely be phased out after 2013 (Clallam County Parks 2008).

Public Hunting on Private Lands

Since about 50% of Washington is in private ownership, many public hunting opportunities rely on landowners opening their lands. In Washington, hunters must obtain landowner permission to hunt on private land. Since 1948, WDFW has worked with private landowners across the state to provide public access through a negotiated agreement. Landowners participating in a WDFW cooperative agreement retain liability protection provided under state law (RCW 4.24.210). Landowners receive technical services, materials for posting (signs and posts), and in some cases monetary compensation. During the 2010-2011 hunting season, there was one Private Lands Program cooperator in Clallam County providing 216 acres of hunting area (WDFW 2012a).

Horse Riding

Low rainfall and mild winters in the Dungeness Valley make the area ideal for year-round equestrian activities and there are several popular places to ride horses near the Refuge. The Dungeness Recreation Area provides equestrian trails which are open daily except Saturdays, Sundays and holidays during the hunting season. Clallam County also offers equestrian trails at Robin Hill Farm County Park. The Park features 195 acres of wetlands, thick forests, and large grassy meadows. There are approximately 2.5 miles of horseback riding trails through forests and rolling grasslands. Riders can also access the Olympic Discovery Trail from the Park.

The Olympic Discovery Trail provides approximately 53 miles of hiking and biking trails in the lowlands between the Olympic Mountains and the Strait of Juan de Fuca. The trail will eventually span 126.2 miles from Port Townsend to the Pacific Ocean. Many parts of the trail have a horse track alongside; it may be a wide, dirt or packed gravel shoulder or a separated path. Between Sequim and Port Angeles horses are allowed from the west side of the Dungeness River Bridge to east side of the Morse Creek Bridge, although there is not an adequate horse track from Lake Farm Road to Morse Creek. Horse trailer parking and unloading is available at Robin Hill Farm County Park (PTC 2012).

Table 5-3. Regional Recreation Site User Fees

Site/Agency		Daily Fee	7 Day Fee	Annual Fee	# of Visitors Covered
Dungeness NWR		$3		$12	4 adults or immediate family
Clallam County Parks		Free *			
Jefferson County Parks		Free *			
Sequim/Port Angeles Parks		Free			
WDFW		$10 ($11.50**)		$30 ($35**) ***	Occupants of Private Vehicle
WDNR		$10 ($11.50**)		$30 ($35**)	Occupants of Private Vehicle
WA State Parks		$10 ($11.50**)		$30 ($35**)	Occupants of Private Vehicle
Olympic NF		$5		$30	Occupants of Private Vehicle
Olympic NP	Vehicle		$15	$30	Occupants of Private Vehicle
	Individual		$5	$30	Per Person
Makah Recreation				$10	Occupants of Private Vehicle

Site/Agency	Daily Fee	7 Day Fee	Annual Fee	# of Visitors Covered
Permit				
Olympic Game Farm	$11/$12			Per Person

* Fees charged for camping
** Price including dealer and transaction fees
*** Hunters, fishers, and trappers get a Vehicle Access Pass as part of their annual license fee, excluding annual shellfish license.

Table 5-4. Land Ownership on the Olympic Peninsula, Washington

Ownership	Mi^2	Km^2	%
Private	4,664	7,506	45
National Park Service	2,262	3,640	22
U.S. Forest Service	1,578	2,540	15
Washington State	1,267	2,039	12
Tribal	608	978	1
County	28	45	<1
U.S. Department of Defense	10	16	<1
U.S. Fish and Wildlife Service	1	2	<1
Bureau of Land Management	1	1	<1

Source: Ratti et al. 1999.

Table 5-5. North Olympic Peninsula Parks and Recreation Areas

Ownership	Size
Federal	
Olympic National Park	922,650 acres
Olympic National Forest	633,677 acres
Dungeness National Wildlife Refuge	772.5 acres, > 50% open to the public permanently or seasonally
WDNR Recreation Areas in Clallam County	
Bear Creek Campground	
Foothills ORV Trailhead and Trails	
Little River Trailhead and Trails	
Lyre River Campground	
Murdock Beach Access	
Sadie Creek Trailhead, Vista & Trail	
Striped Peak Vista, Trailhead and Trail	
WDNR Recreation Areas in Jefferson County	
Copper Mine Bottom Campground	
Cottonwood Campground	
Hoh Oxbow Campground	
Minnie Peterson Campground	
South Fork Hoh Campground	
Upper Clearwater Campground	
Willoughby Creek Day Use Area	
Yahoo Lake Campground	
WA Department of Fish and Wildlife Lands	
Bell Creek Unit	89 acres
Chimacum Unit	109 acres

Ownership	Size
Elwha Unit	62 acres
Lower Dungeness Unit	148 acres + 73 acres of easement
Morse Creek Unit	133 acres
Snow Creek-Salmon Creek Unit	156 acres
South Sequim Bay Unit	22 acres
Tarboo Unit	Not available
WA State Parks	
Anderson Lake SP	480 acres
Bogachiel SP	123 acres
Damon Point SP (WDNR Owned)	61 acres
Dosewallips SP	425 acres
Fort Flagler SP	784 acres
Fort Worden SP & Conference Center	433 acres
Grayland Beach SP	412 acres
Griffiths-Priday Ocean SP	364 acres
Mystery Bay SP	10 acres
Ocean City SP	170 acres
Old Fort Townsend SP	367 acres
Pacific Beach	10 acres
Pillar Point SP	4.3 acres
Sequim Bay SP	92 acres
Shine Tidelands SP	13 acres
Triton Cove SP	29 acres
Clallam County Parks	
Camp David Jr.	9.5 acres
Clallam Bay Spit Community Beach CP	33 acres
Cline Spit CP	2 acres
Dungeness Landing CP	5.6 acres + 13 acres of tidelands
Dungeness Recreation Area	216 acres
Freshwater Bay CP	21.07 acres
Jessie Cook Scriven CP	5 acres
Lake Pleasant Community Beach	< 2 acres
Mary Lukes Wheeler CP	10 acres
Panorama Vista (WDNR Owned)	3 miles of tidelands
Port Williams (Marlyn Nelson CP)	1 acre
Quillayute River CP	13 acres
Robin Hill Farm CP	195 acres
Salt Creek Recreation Area	196 acres
Three Waters CP	8.5 acres
Verne Samuelson Trail CP	1.5 mile trail
Olympic Discovery Trail	120 miles planned

5.9 Regional Recreation Rates and Trends

5.9.1 Outdoor Recreation Participation Rates Statewide

The Washington State Recreation and Conservation Office (RCO), formerly the Interagency Committee for Outdoor Recreation (IAC), advises the State on matters of outdoor recreation. The RCO conducts inventories of outdoor recreation sites and opportunities, conducts studies of recreational participation and preferences, and periodically releases documents related to overall state outdoor recreation. The most recent release is the 2006 Outdoor Recreation Survey (formerly, the State Comprehensive Outdoor Recreation Planning Report – SCORP Report).

The report identified 15 major categories of outdoor recreation, subdivided into 114 activity types or settings. Of these 15 major categories, walking/hiking is the number one activity with 74% of Washington residents participating in some type or setting of walking and/or hiking. Nature activity is the third most popular recreation, with 54% of residents enjoying some form of this activity. The report indicated observing/photographing nature and wildlife has a participation rate of 29% and that visiting interpretive centers has a participation rate of 15% among statewide residents (See Table 5-6, Major activity group participation in 2006).

The most frequently occurring recreational activities in 2006 included walking without a pet (3.5 million times), observing or photographing wildlife or nature (3.1 million times), walking with a pet (2.7 million times), jogging or running (2.3 million times), and playground recreation (2.2 million times). The most frequently mentioned activities that Washingtonians wanted to do more of in the 12 months following the survey interview included sightseeing (46.9%), picnicking or cooking outdoors (39.4%), hiking (33.5%), tent camping with a car or motorcycle (33.4%), and swimming or wading at a beach (28.4%) (RCO 2007).

Table 5-6. Major Activity Group Participation in 2006

Ranking of Major Activity Areas Activity Area	Population %
Walking/Hiking	73.8
Team/Individual Sports, Physical Activity	69.2
Nature Activity	53.9
Picnicking	46.8
Indoor Community Facility Activity	45.1
Water Activity	36.0
Sightseeing	35.4
Bicycle Riding	30.9
Off-road Vehicle Riding	17.9
Snow/Ice Activity	17.5
Camping	17.1
Fishing	15.2
Hunting/Shooting	7.3
Equestrian Activity	4.3
Air Activity	4.0

Source: RCO 2007.

5.9.2 Forecast for Regional Recreation Demand and Key Recreation Needs

Overall, outdoor recreation in most categories continues to increase at high growth rates. In their 2003 report, the IAC projected future participation in 13 of 14 major outdoor recreation use categories over periods of 10 and 20 years. Nine of these activities were projected to experience double digit growth (IAC 2003). These most recent estimates of recreation trends were based on the National Survey on Recreation and the Environment Projections for the Pacific Region (NSRE), which includes Washington State. The IAC adjusted the NRSE projections as necessary based on age group participation, estimates of resource and facility availability, user group organization and representation, land use and land designations, and "other factors," including the economy and social factors. Table 5-7, Projected Participation Increases for Selected Outdoor Recreation Activities, shows the percent change expected for Washington State by activity as reported by IAC.

In an earlier assessment conducted by the IAC, trails and environmental education were identified as the two highest outdoor recreation needs in the state (IAC 1995). In their subsequent report in 2002, the IAC encouraged USFWS to find the resources with which to ensure that regulatory processes are as efficient as possible while protecting important natural resources, and to consider their findings in the development and implementation of management plans (IAC 2003). Many outdoor activities generally permitted on refuges are expected to show increases of 20 to 40 percent over the next 20 years. The exception is hunting, in which participation is expected to fall at about that same rate. This CCP considers the recommendations of the IAC and specifically addresses the increasing need for environmental education and maintaining access to trails.

Hiking/Walking
On average in 2006, of the various walking and hiking activities, Washington residents expressed the greatest interest in doing more hiking (34.2%) in the next 12 months. Of all age groups, parents of children under 10 expressed the highest level of interest in the child doing more walking and hiking in general (33.8%). Females showed higher levels of interest than males in doing more walking with pets (18.5%) or without pets (32.5%). Males were more likely than females to want to do more climbing or mountaineering (9.8%). Washingtonians 50 and older were the most likely to express an interest in doing more walking without a pet (30.4% of those 50 to 64 and 34.6% of those 65 or older) (RCO 2007).

Wildlife Observation and Photography
Washington State offers some of the most fantastic and unique opportunities to view and photograph wildlife in the U.S. In particular, the north Olympic Peninsula offers endless opportunities to experience wildlife including rare seabirds such as tufted puffins, rhinoceros auklets, and black oystercatchers. The region's rich waters are home to large numbers of marine mammals, including seals, porpoises, and whales, as well as a myriad of other creatures. It is estimated that nearly 40 percent of Washington residents participated in nature and wildlife observation and photography in 2006 (RCO 2007), although the actual percentage may be well over that (IAC 2003).

The RCO's 2006 Outdoor Recreation Survey reported such activity occurred more than 35 million times that year (RCO 2007). Participation in nature related activities is growing in popularity in Washington and is expected to increase significantly in coming years (IAC 2003). On average in 2006, just over a quarter of Washington residents wanted to do more observation or photography of wildlife or nature in the next 12 months (25.8%). Females wanted to visit nature or interpretive centers more and at higher rates than males. Parents of children under 10 indicated their children

would like to do more visiting of nature or interpretive centers, gathering or collecting things in nature settings, and nature activities in general at rates higher than older residents indicated for themselves (RCO 2007).

Sightseeing
On average in 2006, 47.7% Washington residents wanted to do more sightseeing in general in the next 12 months. Females expressed this desire more frequently (51.2%) than did males (44.1%). Residents 50 to 64 years old wanted to do more sightseeing (in general) at a significantly higher rate (35.0%) than did those under 20 (18%). More than one quarter of Washingtonians (27.3%) mentioned wanting to do more of a specific type of sightseeing (RCO 2007).

Fishing
Whether due to the perception, or actual declines in available fish, data showed a steady decline in the sale of state fishing licenses in the 10 years prior to the release of the Assessment of Outdoor Recreation in 2003 (IAC 2003). However, in 2006, about the same number of Washington residents wanted to do more fishing from a bank, dock, or jetty in the next 12 months (18.7%) as wanted to do more fishing from a private boat (18.5%). With the exceptions of fishing for shellfish and fishing from a bank, dock, or jetty, males showed greater levels of interest in doing more fishing than females. Compared to other regions, residents in the San Juan Islands and the Peninsulas (Olympic and Kitsap) showed the greatest interest in doing more fishing for shellfish (28.1% and 20.4%, respectively) (RCO 2007). Future participation in fishing will depend to a large degree on the success of habitat preservation and restoration efforts now underway statewide (IAC 2003).

Hunting
Hunting is overwhelmingly practiced by men with about 6 percent of state residents participating in peak season prior to the RCO's 2008 report. License sales appear to be steady, but are shrinking as a percent of population. Consistent with national trends, increased participation is highly unlikely as the state's population continues a general rural-to-urban migration (RCO 2008). Despite the trend, in 2006, Washington residents expressed interest in doing more firearms activity of any type (11.2%) and for more hunting and shooting in general (9.9%) in the next 12 months. Males were more likely than females to express an interest in doing more of all hunting or shooting activities (RCO 2007).

Equestrian Activity (horse riding)
On average in 2006, nearly one quarter of Washington residents wanted to do more horseback riding in general in the next 12 months (23.8%). This interest was more prevalent among females (27.1 %) than among males (20.4%). It was also more prevalent among children under 10 (30.7%) and tweens and teens (33.2%) than among older Washingtonians (50-64: 18.7 %, 65+: 7.7%) (RCO 2007).

Table 5-7. Projected Participation Increases for Selected Outdoor Recreation Activities

Activity	Estimated Change, 10 years (2003-2013)	Estimated Change, 20 Years (2003-2023)
Walking	23%	34%
Hiking	10%	20%
Nature Activities (photography, wildlife observation, gathering and collecting, gardening, and visiting interpretive centers)	23%	37%
Fishing	-5%	-10%
Hunting / Shooting	-15%	-21%

Activity	Estimated Change, 10 years (2003-2013)	Estimated Change, 20 Years (2003-2023)
Sightseeing (includes driving for pleasure)	10%	20%
Camping – developed (RV style)	10%	20%
Canoeing/kayaking	21%	30%
Motor Boating	10%	No Estimate
Equestrian	5%	8%
Nonpool swimming	19%	29%

Source: IAC 2003.

5.10 Socioeconomics

5.10.1 Population and Area Economy

Dungeness NWR is located in Clallam County on the northern coast of the Olympic Peninsula in the state of Washington. The nearest city is Sequim, which has a population of 6,273 (U.S. Census Bureau 2012). Table 5-8 shows the population and area economy. The county population increased (11 percent) from 2000 to 2010, compared with a 14 percent increase for Washington and a 10 percent increase for the United States as a whole. County employment increased by 11 percent from 2000 to 2010, compared to a smaller employment increase in Washington (8 percent) and the United States (5 percent). Per capita income in Clallam County increased by 16 percent between 2000 and 2010, while Washington and the United States both increased by 4 percent.

Table 5-8. Dungeness NWR: Summary of Area Economy, 2010

	Population*		Employment*		Per Capita Income*	
	2010	Percent change 2000-2010	2010	Percent change 2000-2010	2010	Percent change 2000-2010
Clallam County	71.5	11%	35.4	11%	$37,614	16%
Washington	6,743.0	14%	3,793.6	8%	$43,933	4%
United States	309,330.2	10%	173,767.4	5%	$41,198	4%

Source: USDC 2012.
* Population and Employment in thousands; Per Capita Income in 2011 dollars.

The largest industry sectors for Clallam County are ranked below by employment (Table 5-9). The largest employer is the State and local government, followed by food services and drinking places.

Table 5-9. Industry Summary for Clallam County

Industry	Employment	Output	Employment Income*
State and Local Government	6,595	$372,059	$328,490
Food Services and Drinking Places	1,943	$102,033	$32,448
Health Practitioner Offices	1,021	$96,458	$37,634
Retail Stores - General Merchandise	862	$64,504	$29,199
Real Estate	862	$101,261	$6,424
Nonresidential Construction	807	$115,562	$26,454
Retail Stores - Food and Beverage	801	$61,328	$24,672

Industry	Employment	Output	Employment Income*
Nursing	799	$31,168	$21,344
Commercial Logging	770	$187,995	$18,734
Civic, Social, Professional, and Similar Organizations	661	$27,812	$11,817

Source: Implan 2008.
* Dollars in thousands.

5.10.2 Local Community

The Dungeness NWR is located approximately 6 miles northwest of Sequim, WA (pronounced "squim"). The area is famous throughout the Pacific Northwest for its low rainfall and sunny skies. Known as "Sunny Sequim" or "the Blue Hole," Sequim and the surrounding Dungeness Valley lie in the rainshadow of the Olympic Mountains, and boast an average annual rainfall of less than 17 inches. In recent years the Dungeness Valley's consistently sunny weather, unusual for Western Washington, has drawn many new residents from across the U.S. that want to enjoy the benefits of a more temperate climate, less crowded landscape, and a welcoming community. The Sequim area has become an attractive retirement community, with the average age in Sequim rising to the near 60s during the past 20 years (MySequim 2012). Despite recent declines in job growth, -0.59 % from October 2010 to September 2011 and a comparatively high unemployment rate of 11.6% (Sperling's 2011), Sequim continues to be an attractive place to retire and the fastest growing community in Clallam County (CLR 2010) ensuring an increasing demand for outdoor recreational opportunities.

5.10.3 Refuge Impact on the Local Economy

Visitors to Dungeness NWR spend money on food, lodging, equipment, transportation, and other expenses, which creates jobs within the local economy. Additionally, Refuge budget expenditures, including those provided through the Refuge Revenue Sharing Act, also result in economic impacts to the local community. The effects on the local economy associated with consumer expenditures on Refuge-related recreation and effects associated with Refuge budget expenditures are explored in detail in Chapter 6 of the Draft CCP/EA (USFWS 2012a).

Appendices A-M

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Appendix A. Appropriate Use Findings

A.1 Introduction

The Appropriate Refuge Uses Policy (603 FW 1 (2006)) outlines the process that the Service uses to determine when general public uses on refuges may be considered. Priority public uses previously defined as wildlife-dependent uses (hunting, fishing, wildlife observation and photography and environmental education and interpretation) under the National Wildlife Refuge System Improvement Act of 1997 are generally exempt from appropriate use review. Other exempt uses include situations where the Service does not have adequate jurisdiction to control the activity and refuge management activities. In essence, the appropriate use policy provides refuge managers with a consistent procedure to first screen and then document decisions concerning a non-priority public use. When a use is determined to be appropriate, a refuge manager must then decide if the use is compatible before allowing it on a refuge. For purposes of this CCP an "appropriate use" must meet at least one of the following three conditions.

- The use is a wildlife-dependent recreational use as identified in the Refuge Improvement Act.
- The use involves the take of fish and wildlife under state regulations.
- The use has been found to be appropriate as specified in section 1.11 of the policy and documented on FWS Form 3-2319.

During the CCP process, the refuge manager reviewed all existing and proposed refuge uses for Dungeness National Wildlife Refuge that is associated with the Preferred Alternative (Alternative B). Documentation of appropriateness findings for wildlife-dependent uses is not included in this Appendix because wildlife-dependent uses are appropriate by definition. They are, however, evaluated for compatibility in Appendix B, Compatibility Determination. All other refuge uses were evaluated using the criteria described in policy and listed on FWS Form 3-2319. The table below shows the uses evaluated and appropriateness findings made by the refuge manager. Additional documentation is included in this Appendix for each use identified in the table.

Table A-1. Summary of Appropriate Use Findings

Refuge Use	Appropriate	Page
Research, Scientific Collecting, and Survey Activities	Yes	A-2
Boating	Yes	A-5
Horseback Riding	Yes	A-8
Vehicle Access to New Dungeness Light Station	Yes	A-11
Jogging/ Running	Yes	A-14

Finding of Appropriateness of a Refuge Use

Refuge Name: Dungeness National Wildlife Refuge

Use: Research, Scientific Collecting, and Survey Activities

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use, or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___ No _X_

When the refuge manager finds the use **appropriate** based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ Appropriate__X___

Acting Refuge Manager: Loren Soll Date: 04/19/2013

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor ~~must sign~~ concurrence.

Refuge Supervisor: _____ Date: 4/23/13

A compatibility determination is required before the use may be allowed.

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Finding of Appropriateness of a Refuge Use

Supplement to FWS Form 3-2319

Research, Scientific Collecting, and Surveys

Further Explanation of Answers Provided for the Decision Criteria:

Project: Conducting research on refuge lands and waters

Summary: The Refuge receives requests to conduct scientific research on refuge lands and waters. Research applicants must submit a proposal that would outline: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on refuge wildlife and/or habitat, including disturbance (short- and long-term), injury, or mortality; (5) personnel required; (6) costs to the Refuge, if any; and (7) end products expected (i.e., reports, publications). Research proposals would be reviewed by refuge staff, the Regional Office Branch of Refuge Biology, and others as appropriate prior to the Refuge issuing a special use permit (SUP). Projects will not be open-ended, and at a minimum, will be reviewed annually.

For each of the findings listed on FWS Form 3-2319, a justification has been provided below:

(a) Do we have jurisdiction over the use?
Some or all of the proposed activities would take place within refuge boundaries. The Refuge has jurisdiction over those research projects that are sited within refuge boundaries.

(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?
Any proposed research activities would comply with all applicable laws and regulations and any restrictions or qualifications that are required to comply with laws and regulations would be specified in the SUP.

(c) Is the use consistent with applicable executive orders and Department and Service policies?
Through the review of individual projects, the Refuge would ensure that they are consistent with applicable policies, especially the Research on Service Lands Policy (803 FW 1).

(d) Is the use consistent with public safety?
Through individual project review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project's SUP.

(e) Is the use consistent with goals and objectives in an approved management plan or other document?
Research activities are approved in instances where they can provide meaningful data that may contribute to refuge management and public appreciation of natural resources.

(f) Is the use manageable within available budget and staff?
The Refuge receives fewer than two requests per year for this activity, and it is manageable with available budget and staff.

(g) Will this be manageable in the future within existing resources?
The proposed activity at current levels would be manageable in the future with the existing resources.

(h) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

The proposed use is beneficial to the Refuge's natural and cultural resources because the types of research projects approved are those that have the distinct likelihood of helping achieve refuge purposes by providing information useful for the management of trust resources and contributing to the public's understanding and appreciation of natural and/or cultural resources.

(i) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description) compatible, wildlife-dependent recreation into the future?

The Refuge will ensure that the research activities do not impair existing or future wildlife-dependent recreational use of the Refuge during individual project review, prior to issuing the SUP for the project.

Finding of Appropriateness of a Refuge Use

Refuge Name: Dungeness National Wildlife Refuge

Use: Boating

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use, or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___ No _X_

When the refuge manager finds the use **appropriate** based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ Appropriate__X___

Acting Refuge Manager: Loren Soll Date: 04/19/2013

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: Date: 4/23/13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
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Finding of Appropriateness of a Refuge Use

Supplement to FWS Form 3-2319

Boating (electric and wind driven; human powered; and motorized)

Further Explanation of Answers Provided for the Decision Criteria:

Project: Boating

Summary: Boating occurs in refuge waters primarily in support of fishing and wildlife observation. Boats are allowed in refuge waters from May 15 to September 30. The remainder of the year these waters are closed to all use to protect migrating and wintering species of wildlife. Boaters must operate at a no wake speed and stay 100 yards below mean high tide line thus providing a buffer to wildlife using the shoreline.

For the findings listed on FWS Form 3-2319, a justification has been provided below

(a) Do we have jurisdiction over the use?
An October 20, 1994 memorandum from the Assistant Solicitor, Branch of Fish and Wildlife to the Director, U.S. Fish and Wildlife Service (Service) concludes "… that the Service has statutory authority under the National Wildlife Refuge Administration Act (Administration Act) to regulate activities that occur on water bodies 'within' refuge units. The Service, in terms of its refuge administration regulations, has effectively defined this authority to apply to areas the United States holds in fee or to the extent of the interest held by the United States." The Solicitor also noted that "… other legislative authorities allow the Service to regulate activities on waters that are not 'within' refuge units but those authorities can be exercised only by regulations that are issued to protect migratory birds, to protect refuges that were acquired pursuant to the Migratory Bird Conservation Act, or to protect species listed under the Endangered Species Act or protected by the Marine Mammal Protection Act."

Federal authority to regulate activities on state owned tidelands was reiterated in an August 7, 2003 memorandum to Refuge Chief, Fish and Wildlife Service, Region 1 from the Office of the Solicitor, Pacific Northwest Region concerning airboat use at Willapa National Wildlife Refuge.

(e) Is the use consistent with goals and objectives in an approved management plan or other document?
Boating, in support of recreational fishing and wildlife observation, supports Goals 5 and 6 in the Dungeness NWR CCP.

(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
Boating was modified with the 1997 Environmental Assessment "Management of Public Use for Dungeness National Wildlife Refuge" (USFWS 1997).

i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

Boating on refuge waters takes place primarily in support of fishing, wildlife observation and as a means of access to the New Dungeness Light Station. The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation, photography, hunting, fishing, and environmental education as priority public uses on national wildlife refuges. Boating on the Refuge enhances visitor opportunities to participate in a number of these activities. The Service strives to provide visitor uses supporting these activities when compatible with the purpose(s) and goals of the Refuge and the mission of the National Wildlife Refuge System (System).

(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?
Based upon the biological impacts presented in the CCP/Environmental Assessment, it is determined that providing boating opportunities at Dungeness NWR will not materially interfere with or detract from the purposes for which the Refuge was established. By limiting areas open to boats, limiting the seasons of use, and complying with stipulations identified in the Compatibility Determination, impacts affiliated with boat use can be lessened. Monitoring of this activity and its impacts will allow the refuge staff to modify programs if needed to ensure this use remains at an acceptable level.

Literature Cited

USFWS (U.S. Fish and Wildlife Service). 1997. Management of public use for Dungeness National Wildlife Refuge – final environmental assessment. U.S. Department of Interior, Fish and Wildlife Service. Sequim, WA. 53 pp. On file at the Washington Maritime National Wildlife Refuge Complex Headquarters. Sequim, Washington.

Finding of Appropriateness of a Refuge Use

Refuge Name: Dungeness National Wildlife Refuge

Use: Horseback Riding

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use, or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___ No _X_

When the refuge manager finds the use **appropriate** based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ Appropriate___ X ____

Acting Refuge Manager: Loren Soll Date: 04/19/2013

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: Date: 4/23/13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Finding of Appropriateness of a Refuge Use

Supplement to FWS Form 3-2319

Horseback Riding

Further Explanation of Answers Provided for the Decision Criteria:

Project: Horseback riding

Summary: Horseback riding will be allowed on designated areas of Dungeness NWR year-round if a safe and legal alternate access can be obtained from the east or the west. The activity will be restricted to the beach west of where the main trail joins the beach (west beach, Zone 1, approximately 0.5 mile). If a safe and legal access route onto the Refuge is obtained from the east, then horseback use of the administrative road from the eastern Refuge boundary to where the main trail joins the beach will also be allowed. Horseback riding will be permitted daily October 1 through March 31 and weekdays April 1 through September 30, by reservation only through the Refuge Office. No horseback riding on Memorial Day, the Fourth of July, and Labor Day. Depending on demand, numbers may be limited to prevent overcrowding and ensure public safety.

For the findings listed on FWS Form 3-2319, a justification has been provided below

(d) Is the use consistent with public safety?
A serious accident between an equestrian and a pedestrian on a shared section of the main trail in May 2012 resulted in the Refuge being closed to horseback use due to safety concerns. The Service has determined that if safe and legal alternative access becomes available from the east or the west then this activity could take place on the west beach (Zone 1). Measures to ensure public safety and reduce conflicts with other users are listed in the stipulations necessary to ensure compatibility (Appendix B).

(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
Horseback riding was modified with the 1997 Environmental Assessment "Management of Public Use for Dungeness National Wildlife Refuge" (USFWS 1997). A serious accident between an equestrian and a pedestrian on a shared section of the main trail in May 2012 has necessitated this further modification. The Service has determined that if safe and legal alternative access becomes available from the east or the west then this activity could take place on the west beach (Zone 1).

(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?
Facilitating this use on the Refuge will increase visitor knowledge and appreciation of fish and wildlife resources. This enhanced understanding will foster increased public stewardship of natural resources and support for the Service's management actions in achieving the refuge purposes and the mission of the National Wildlife Refuge System.

(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

This use conducted with stipulations to ensure compatibility can be accommodated while minimizing impacts on existing wildlife-dependent recreational uses. The Refuge will monitor this use and its impacts to other refuge users and may further modify stipulations necessary for compatibility if needed.

Literature Cited

USFWS (U.S. Fish and Wildlife Service). 1997. Management of public use for Dungeness National Wildlife Refuge – final environmental assessment. U.S. Department of Interior, Fish and Wildlife Service. Sequim, WA. 53 pp. On file at the Washington Maritime National Wildlife Refuge Complex Headquarters. Sequim, Washington.

Finding of Appropriateness of a Refuge Use

Refuge Name: Dungeness National Wildlife Refuge

Use: Vehicle Access through Refuge by New Dungeness Light Station Association to New Dungeness Light Station

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use, or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___ No _X_

When the refuge manager finds the use **appropriate** based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ Appropriate__X___

Acting Refuge Manager: Loren Soll Date: 04/19/2013

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: Date: 4/23/13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Finding of Appropriateness of a Refuge Use

Supplement to FWS Form 3-2319

Transport - Vehicle Access to New Dungeness Light Station

Further Explanation of Answers Provided for the Decision Criteria

Project: Vehicle Access to New Dungeness Light Station

Summary: The U. S. Coast Guard (USCG) withdrew its last keeper from the automated New Dungeness Light Station in March of 1994. Before the Station was unmanned, the USCG accessed the Station by boat, helicopter, and vehicles driven on the beach. The New Dungeness Light Station Association (NDLSA) obtained a renewable license with the USCG to care for the Station in 1994 and have accessed the Station via vehicle under a refuge Special Use Permit since that time. Vehicle use is restricted to volunteer Light Station keeper exchange and for maintenance purposes. Keepers are rotated in and out of the Light Station once a week coinciding with a low tide event either on a Friday or Saturday. During the summer months these exchanges occur during the day while during the winter they occur at night. Maintenance trips are less frequent but average a couple per month. It is the intent of the U. S. Fish and Wildlife Service to acquire the Light Station from the USCG when it is excessed and to enter into an agreement with the NDLSA similar to the one they have with the USCG.

For the findings listed on FWS Form 3-2319, a justification has been provided below.

(d) Is the use consistent with public safety?
The NDLSA access the refuge beach via Anderson Road so there are no vehicles on refuge trails. Once on the beach (Strait of Juan de Fuca side) they travel no more than 10 to 15 miles per hour and have a low volume horn that they sound if nearing a visitor on the beach so as to not startle them. This mode of transport for keeper exchange and maintenance needs is far safer than using a boat due to the weather and sea conditions that can occur in the Strait of Juan de Fuca.

(e) Is the use consistent with goals and objectives in an approved management plan or other document?
The Refuge has identified in the CCP the intent to acquire the Light Station property from the USCG when it is excessed and then to enter into an agreement with the NDLSA to care, maintain and interpret the facilities.

(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
This activity has been ongoing since 1994 although neither a compatibility or an appropriateness determination were ever prepared.

(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?
Allowing safe access to the NDLSA to care for, maintain, and interpret the New Dungeness Light Station will contribute to the public's understanding and appreciation of this significant cultural resource.

(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

This use conducted with stipulations to ensure compatibility and under a guiding document (Special Use Permit or Memorandum of Agreement/Understanding) can be accommodated while minimizing impacts on existing wildlife-dependent recreational uses.

Finding of Appropriateness of a Refuge Use

Refuge Name: Dungeness National Wildlife Refuge

Use: Jogging /Running

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use, or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___ No _X_

When the refuge manager finds the use **appropriate** based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ Appropriate__ X ___

Acting Refuge Manager: _____ Date: 04/19/2013

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: _____ Date: 4/23/13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Finding of Appropriateness of a Refuge Use

Supplement to FWS Form 3-2319

Jogging/Running

Further Explanation of Answers Provided for the Decision Criteria:

Project: Jogging/running

Summary: Jogging/running will be allowed only on the trail adjacent to the refuge parking lot (parking lot trail, approximately 0.2 mile) and along the west beach from the end of the upland forested trail to the western boundary of the Refuge (west beach, Zone 1, approximately 0.5 mile).

For the findings listed on FWS Form 3-2319, a justification has been provided below:

(e) Is the use consistent with the goals and objectives in an approved management plan or other document?
The use is consistent within the stipulations identified in the Compatibility Determination (Appendix B), restricted to the parking lot trail and west beach. There is a potential for this activity to disturb wildlife, however these two areas receive very little use by wildlife and those that are present appear to be accustomed to a high degree of disturbance associated with the trailhead and parking lot.

(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
Jogging/running was restricted in the 1997 EA – "Management of Public Use for Dungeness National Wildlife Refuge" to the main and primitive (formerly equestrian) trail and on the beach in Zones 1 and 2, although some "illegal" use occurs in Zone 3 (USFWS 1997). Upon revisiting this use in compliance with the Appropriate Refuge Uses Policy that was not in effect when the EA was finalized, jogging/running will be allowed only on the trail adjacent to the refuge parking lot and along the west beach (Zone 1).

(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?
Although jogging is not a wildlife-dependent use and is primarily athletic in nature, it is likely that some joggers observe and enjoy wildlife while on the Refuge.

(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1 for description), compatible, wildlife-dependent recreation into the future?
Compatible wildlife-dependent activities such as wildlife watching, photography, and environmental education may be negatively affected because of the expected responses by wildlife to the fast moving activity associated with jogging. When wildlife react by moving away from jogging activity or alter behavior by hiding they will be less likely to be observed (Bennett and Zuelke 1999). Further, user groups of shared-use paths often have conflicting needs. Moore (1994) concluded that trail conflicts can occur among different user groups, among users within the same user group, and as a result of factors not related to trail user activities at all. Conflict has been found to be related to activity style, focus of trip, expectations, attitudes toward and perceptions of the environment, level

of tolerance for others, and different norms held by different users. This loss of expectation of a quality wildlife-dependent experience could result in avoidance of some refuge trails by wildlife watchers and photographers who encounter joggers using the same trail.

There is a potential to interfere with wildlife-dependent uses; however, the parking lot trail and west beach both receive very little use by wildlife and those that are present appear to be accustomed to a high degree of disturbance associated with the trailhead and parking lot. As a result, conflicts between joggers and wildlife-dependent public use are expected to be minimal because visitors do not necessarily expect to encounter wildlife in these areas. Measures to reduce potential conflicts between user groups would include limiting group size to 3 individuals on the parking lot trail, and providing information at the parking lots, refuge headquarters and in the refuge tear sheet that clearly indicates permitted uses of each area.

Literature Cited

Bennett, K.A. and E. Zuelke. 1999. The effects of recreation on birds: a literature review. Delaware Natural Heritage Program. Smyrna, DE.

Moore, R.L. 1994. Conflicts on multiple-use trails: synthesis of the literature and state of the practice. Federal Highway Administration Report No. FHWA-PD-94-031. Report Date: August 1994. Federal Highway Administration. Washington, D.C. 68 pp.

USFWS (U.S. Fish and Wildlife Service). 1997. Management of public use for Dungeness National Wildlife Refuge – final environmental assessment. U.S. Department of Interior, Fish and Wildlife Service. Sequim, WA. 53 pp. On file at the Washington Maritime National Wildlife Refuge Complex Headquarters. Sequim, Washington.

Appendix B. Compatibility Determinations

B.1 Introduction

The compatibility determinations (CDs) developed during the comprehensive conservation plan (CCP) planning process evaluate uses projected to occur under Alternative B, the preferred alternative, in the Draft CCP/Environmental Assessment (EA) for the Dungeness National Wildlife Refuge (NWR or Refuge) (USFWS 2012a), which was carried forward as the management direction for the Refuge in this CCP. The evaluation of funds needed for management and implementation of each use is described in Appendix C, Implementation. Chapter 6 of the Draft CCP/EA also contained an analysis of the impacts of refuge uses to wildlife and habitats. That document is incorporated through reference into this set of CDs.

B.1.1 Uses Evaluated At This Time

The following section includes full CDs for all refuge uses that are required to be evaluated at this time. According to Service policy, compatibility determinations are to be completed for all uses proposed under a CCP that have been determined to be appropriate. Existing wildlife-dependent recreational uses must also be reevaluated and new CDs prepared during development of a CCP. According to the Service's compatibility policy, uses other than wildlife-dependent recreational uses are not explicitly required to be reevaluated in concert with preparation of a CCP, unless conditions of the use have changed or unless significant new information relative to the use and its effects have become available or the existing CDs are more than 10 years old. However, the Service planning policy recommends preparing CDs for all individual uses, specific use programs, or groups of related uses associated with the proposed action. Accordingly, the following CDs are included in this document for public review.

Table B-1. Summary of Compatibility Determinations

Refuge Use	Compatible	Page
Environmental Education, Wildlife Observation, Photography, Interpretation	Yes	B-4
Research, scientific collecting, and surveys	Yes	B-11
Recreational fishing	Yes	B-25
Tribal fishery	Yes	B-31
Boating	Yes	B-37
Vehicle access to New Dungeness Light Station	Yes	B-43
Horseback riding	Yes	B-48
Jogging	Yes	B-55

B.1.2 Compatibility–Legal and Historical Context

Compatibility is a tool refuge managers use to ensure that recreational and other uses do not interfere with wildlife conservation, the primary focus of national wildlife refuges. Compatibility is not new to the Refuge System and dates back to 1918, as a concept. As policy, it has been used since 1962. The Refuge Recreation Act of 1962 directed the Secretary of the Interior to allow only those public uses of refuge lands that were "compatible with the primary purposes for which the area was established."

Legally, national wildlife refuges are closed to all public uses until officially opened through a compatibility determination. Regulations require that adequate funds be available for administration and protection of refuges before opening them to any public uses. However, wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, environmental education, and interpretation) are to receive enhanced consideration and cannot be rejected simply for lack of funding resources unless the refuge has made a concerted effort to seek out funds from all potential partners. Once found compatible, wildlife-dependent recreational uses are deemed the priority public uses at the refuge. If a proposed use is found not compatible, the refuge manager is legally precluded from approving it. Economic uses that are conducted by or authorized by the refuge also require compatibility determinations.

Under compatibility policy, uses are defined as recreational, economic/commercial, or management use of a refuge by the public or a non-Refuge System entity. Uses generally providing an economic return (even if conducted for the purposes of habitat management) are also subject to compatibility determinations. The Service does not prepare compatibility determinations for uses when the Service does not have jurisdiction. For example, the Service may have limited jurisdiction over refuge areas where property rights are vested by others; where legally binding agreements exist; or where there are treaty rights held by tribes. In addition, aircraft overflights, emergency actions, some activities on navigable waters, and activities by other Federal agencies on "overlay refuges" are exempt from the compatibility review process.

New compatibility regulations, required by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), were adopted by the Service in October, 2000 (http://refuges.fws.gov/policymakers/nwrpolicies.html). The regulations require that a use must be compatible with both the mission of the System and the purposes of the individual refuge. This standard helps to ensure consistency in application across the Refuge System. The Act also requires that compatibility determinations be in writing and that the public have an opportunity to comment on most use evaluations.

The Refuge System mission emphasizes that the needs of fish, wildlife, and plants must be of primary consideration. The Improvement Act defined a compatible use as one that "in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the Refuge." Sound professional judgment is defined under the Improvement Act as "a finding, determination, or decision, that is consistent with principles of sound fish and wildlife management and administration, available science and resources." Compatibility for priority wildlife-dependent uses may depend on the level or extent of a use.

Court interpretations of the compatibility standard have found that compatibility is a biological standard and cannot be used to balance or weigh economic, political, or recreational interests against the primary purpose of the refuge (Defenders of Wildlife v. Andrus [Ruby Lake Refuge]).

The Service recognizes that compatibility determinations are complex. For this reason, refuge managers are required to consider "principles of sound fish and wildlife management" and "best available science" in making these determinations (House of Representatives Report 105-106). Evaluations of the existing uses on the Dungeness National Wildlife Refuge are based on the professional judgment of refuge and planning personnel including observations of refuge uses and reviews of appropriate scientific literature.

In July 2006, the Service published its Appropriate Refuge Uses Policy (603 FW 1). Under this policy, most proposed uses must also undergo a review prior to compatibility. Uses excepted from the policy include priority wildlife-dependent recreational uses, and uses under reserved rights – see policy for more detail. Appropriate use findings for Dungeness NWR are included in Appendix A.

B.2 References

Defenders of Wildlife v. Andrus (Ruby Lake Refuge I). 11 Envtl. Rptr. Case 2098 (D.D.C. 1978), p. 873.

House of Representatives Report 105-106 (on NWRSIA) - http://refuges.fws.gov/policyMakers/mandates/HR1420/part1.html

Compatibility regulations, adopted by the Service in October, 2000: (http://Refuges.fws.gov/policymakers/nwrpolicies.html)

Compatibility Determination

Use: Environmental Education, Wildlife Observation, Photography, and Interpretation

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j) as amended
- Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4)
- Endangered Species Act of 1973

Refuge Purpose(s):
The purposes for the Dungeness NWR have been identified in historic legal documentation establishing and adding refuge lands. The Refuge was originally established to preserve important habitat for native birds with refuge purposes specified as follows:

> "…as a refuge, preserve, and breeding ground for native birds." (Executive Order 2123 dated 20 January 1915.
>
> "... suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." (16 U.S.C. 460k-1)
>
> "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
>
> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)
>
> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

National Wildlife Refuge System Mission:

> "The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

Description of Use:

In the National Wildlife Refuge System Improvement Act of 1997, the United States Congress declared wildlife observation and photography, and environmental education and interpretation as four of six priority wildlife-dependent public uses of the NWRS. These four uses are non-consumptive, wildlife-dependent public uses with similar elements and are considered together in this compatibility determination (CD).

Existing wildlife-dependent public uses include wildlife observation, photography, interpretation, and environmental education. Dungeness NWR is open to public use year-round during daylight hours. Existing public use facilities that are involved in these uses include an orientation kiosk with interpretive panels; an entrance fee kiosk; a 3,300 foot main hiking trail with interpretive panels; a 1,800 foot primitive hiking (former equestrian) trail with associated entrance fee kiosk; two observation decks (upper and lower) at the confluence of the main and primitive trails; and a parking lot and public restroom leased from Clallam County. Visitors engage in wildlife observation and photography while walking the self-guided forest trails and open areas of Dungeness Spit (approximately 5 miles of beach), sitting on observation benches along the main trail and at the observation decks. "Dungeness Spit," as it is known to the local public, provides an opportunity for the public to enjoy the marine portion of the Refuge. Visitors use select portions of the beach for walking, picnicking, and wading in the course of observing seabirds, shorebirds, bald eagles, and occasional marine mammals. By allowing visitors to access only certain areas of the beach and water and monitoring visitor behavior, adverse effects associated with refuge visitation can be minimized. Complex staff, the Friends of Dungeness NWR, and refuge volunteers provide environmental education programs on site to local schools on a request basis. Interpretation is provided of the wildlife resources and habitat via interpretation panels at the orientation kiosk, along the main trail, and during on-site events by refuge friends, volunteers, and staff.

Availability of Resources:

Base funding is available to cover staff costs and sufficient funds are available to manage the activity at current levels but not at the level described under the management direction of the CCP. The following funding/annual costs will be required to administer and manage wildlife observation, photography, interpretation, and environmental education activities as designed under the CCP.

Category	One-time Expenses	Recurring Expenses
Special equipment, facilities, or equipment(signs, brochures, EE material)	$23,000	
Monitoring and Administration		$15,000
Maintenance		$22,000
Law Enforcement		$18,000
Totals	**$23,000**	**$55,000**

Anticipated Impacts of the Use(s):
The presence of people observing or photographing wildlife at Dungeness NWR has the potential to cause disturbance to wildlife such as nesting and loafing species and harbor seal pups left on the beach. Human activities on the forest trails and on the beach may result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects or varying levels of behavioral modification (Smith and Hunt 1995). Various studies have shown that the severity of the effects depends upon the distance to the disturbance and its duration, frequency, predictability, and visibility to wildlife (Knight and Cole 1995). The variables found to have the greatest influence on wildlife behavior are (a) the distance from the animal to the disturbance and (b) the duration of the disturbance. Animals also show greater flight response to humans moving unpredictably than to humans following a distinct path (Gabrielsen and Smith 1995). These wildlife disturbance considerations were folded into the design of the interpretive trail, which helps keep people on a path to reduce off-trail walking, and assists in keeping human activities away from bluff edges.

Of the wildlife-dependent public uses evaluated, wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop to casually view species, wildlife photographers are more likely to approach wildlife (Klein 1993) to get that perfect photograph. Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other compounding factors include the potential for photographers to remain close to wildlife for extended periods of time in an attempt to habituate the wildlife subject to their presence (Dobb 1998) and the tendency of casual photographers, with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails. This usually results in increased disturbance to wildlife and habitat, including trampling of plants. The establishment of seasonal and permanent areas closed to the public on Dungeness and Graveyard spits and the requirement that visitors remain on forest trails restricts the general visitor and photographers' accessibility to areas where their actions would cause wildlife disturbance or trample sensitive vegetation.

Impacts from the wildlife-dependent public uses of wildlife observation and photography are contained effectively and mitigated within the overall design of the 1997 Environmental Assessment "Management of Public Use for Dungeness National Wildlife Refuge" (USFWS 1997) by providing clearly defined zones where and seasons when these activities can take place, and requiring that visitors restrict their use to those seasons and areas. This strategy will continue to be implemented under the CCP. The Complex is aware that some visitors disregard signs requiring visitors to stay within the designated public use areas (Area Closed signs). Such unauthorized use creates the potential for greater disturbance to wildlife.

The other two wildlife-dependent public use programs – interpretation and environmental education – use the existing public facilities, including the kiosk area, trail, interpretive panels, and wildlife observation accommodations (upper and lower observation decks). Impacts from these uses will not be additive with regard to impacts from wildlife observation and photography.

Public Review and Comment:
This compatibility determination was submitted for 90-day public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:
The requirements laid out in the preferred alternative of the Environmental Assessment – "Management of Public Use for Dungeness National Wildlife Refuge" (USFWS 1997) are adopted as stipulations to ensure compatibility and include:

User stipulations:

- Graveyard Spit and the tip of Dungeness Spit are closed to public access
- In Zone 1 – Beach in front of bluffs - Hiking, wildlife observation, and wildlife photography permitted year-round
- In Zone 2 – Base of Dungeness Spit out to ½ mile - Hiking, wildlife observation, wildlife photography and incidental beach uses (picnicking and wading) permitted on the Strait of Juan de Fuca side year-round and on the Dungeness Harbor side from May 15 to September 30. From October 1 to May 14, the Harbor side of Zone 2 is closed to all access.
- In Zone 3 – Strait side of Dungeness Spit from ½ mile to New Dungeness Light Station – Hiking, wildlife observation, and wildlife photography permitted on the Strait side year-round.
- In Zone 4 – Dungeness Spit from lighthouse to end of spit, the Harbor and Bay sides of Dungeness Spit, and all of Graveyard Spit including a 100-yard buffer zone below the mean high tide line - closed to public access year-round. Where the refuge boundary does not accommodate a 100 yard buffer, the buffer is slightly narrower. Boats are permitted to land year-round between the hours of 9 AM and 5 PM, by reservation only through the Complex office (as deemed necessary by the Refuge) in the designated 100 yard zone of beach next to the light station compound on the Bay side of Dungeness Spit. Visitors are allowed to walk through Zone 4 in a designated area to get to and from the landing site to the lighthouse.
- In Zone 5 – Refuge waters and tidelands on the Harbor and Bay sides of Dungeness and Graveyard spits outside of the 100 yard buffer zone - wildlife observation and photography by use of a boat permitted from May 15 through September 30. From October 1 to May 14 this zone is closed to all public access.

Management actions taken to reduce disturbance to harbor seals pupping in areas open to public use will include:

- As soon as a new pup is found, the immediate area where the pup is located will be closed and marked with cones.
- A volunteer will be stationed at the site whenever possible to prevent disturbance and to educate visitors.
- Brochures, signs, and visitor contacts will be used to educate the public about unnecessary pup disturbance and human intervention.

The response of wildlife to these modifications in public use activities will be monitored and evaluated to measure the effectiveness of the program in meeting refuge purposes. Based on monitoring data, public use regulations could become more restrictive in the future.

Justification:
Wildlife observation, photography, and environmental education and interpretation are priority public uses of the NWRS. Providing opportunities for these activities will contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of Dungeness NWR. Wildlife observation, photography, and interpretation will provide an excellent forum for allowing public access and increasing understanding of refuge resources. The educational possibilities provided by these opportunities will outweigh any anticipated negative impacts associated with implementation of the program. The stipulations outlined above, as well as the best management practices identified, will minimize potential impacts relative to wildlife/human interactions.

Although all of these activities can result in disturbance to wildlife, disturbance will be limited in time and space. There is more than an adequate amount of undisturbed habitat available to the majority of refuge wildlife for escape and cover.

It is anticipated that wildlife populations will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened from wildlife observation, photography, and environmental education and interpretation activities. The relatively limited number of individuals expected to be adversely affected due to allowing these uses will not cause wildlife populations to materially decline, the physiological condition and production of refuge wildlife species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted.

Thus, allowing interpretation, environmental education, wildlife observation, and photography to occur with stipulations outlined above will not materially detract or interfere with achieving Dungeness NWR purposes or the NWRS mission, and in some instances may benefit refuge purposes. For example, an educated public is one less likely to damage natural and cultural resources and is more likely to be supportive of funding for national wildlife refuges and other public land.

Mandatory Re-Evaluation Date:

__X__ Mandatory 15-year reevaluation date (for wildlife-dependent public uses)

_____ Mandatory 10-year reevaluation date (for all uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References:

Dobb, E. 1998. Reality check: the debate behind the lens. Audubon 100(1):44-51, 98-99.

Gabrielsen, G.W. and E.N. Smith. 1995. Physiological responses of wildlife to disturbance. Pages 95-107 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Washington, D.C.: Island Press.

Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. Wildlife Society Bulletin 21:31-39.

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Morton, J.M. 1995. Management of human disturbance and its effects on waterfowl. Pages F59- F86 in: W.R. Whitman, T. Strange, L. Widjeskog, R. Whittemore, P. Kehoe, and L. Roberts, eds. Waterfowl habitat restoration, enhancement and management in the Atlantic flyway. 3rd edition. Dover, DE: Environmental Management Committee, Atlantic Flyway Council Technical Section, and the Delaware Division of Fish and Wildlife.

Smith, L. and J.D. Hunt. 1995. Nature tourism: impacts and management. Pages 203-219 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Washington, D.C.: Island Press.

USFWS. 1997. Management of public use for Dungeness National Wildlife Refuge – final environmental assessment. U.S. Department of Interior, Fish and Wildlife Service. Sequim, WA. 53 pp. On file at the Washington Maritime National Wildlife Refuge Complex Headquarters. Sequim, Washington.

Refuge Determination:

Prepared by: Loren Doll (Signature) 04/19/2013 (Date)

Acting Refuge Manager/ Project Leader Approval: Loren Doll (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: [signature] (Signature) 4/23/13 (Date)

Regional Chief, National Wildlife Refuge System: Ed E. West (Signature) 4-23-13 (Date)

Compatibility Determination

Use: Research, Scientific Collecting, and Surveys

Research: Planned, organized, and systematic investigation of a scientific nature.
Scientific collecting: Gathering of refuge natural resources or cultural artifacts for scientific purposes.
Surveys: Scientific inventory or monitoring.

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j) as amended
- Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4)
- Endangered Species Act of 1973

Refuge Purpose(s):
The purposes for the Dungeness NWR have been identified in historic legal documentation establishing and adding refuge lands. The Refuge was originally established to preserve important habitat for native birds with refuge purposes specified as follows:

> "…as a refuge, preserve, and breeding ground for native birds." (Executive Order 2123 dated 20 January 1915.
>
> "... suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." (16 U.S.C. 460k-1)
>
> "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
>
> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)
>
> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

National Wildlife Refuge System Mission:

> "The mission of the [National Wildlife Refuge] System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

Description of Use(s):

The refuge staff receives periodic requests from non-Service entities (e.g., universities, state or territorial agencies, other Federal agencies, nongovernmental organizations) to conduct research, scientific collecting, and surveys on refuge lands. These project requests can involve a wide range of natural and cultural resources as well as public-use management issues including basic absence/presence surveys, collection of new species for identification, habitat use and life-history requirements for specific species/species groups, practical methods for habitat restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, identification and analyses of paleontological specimens, wilderness character, modeling of wildlife populations, bioprospecting, and assessing response of habitat/wildlife to disturbance from public uses. Projects may be species-specific, refuge-specific, or evaluate the relative contribution of the refuge lands to larger landscapes (e.g., ecoregion, region, flyway, national, international) issues and trends.

The Service's Research and Management Studies (4 RM 6) and Appropriate Refuge Uses (603 FW 1.10D(4)) policies indicate priority for scientific investigatory studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitat as well as their natural diversity. Projects that contribute to refuge-specific needs for resource and/or wilderness management goals and objectives, where applicable, will be given a higher priority over other requests.

Availability of Resources:

Refuge staff responsibilities for projects by non-Service entities will be primarily be limited to the following: review of proposals, prepare SUP(s) and other compliance documents (e.g., Section 7 of the Endangered Species Act of 1973, Section 106 of the National Historic Preservation Act), and monitor project implementation to ensure that impacts and conflicts remain within acceptable levels (compatibility) over time. Additional administrative support, logistical and operational support may also be provided depending on each specific request. Estimated costs for one-time (e.g., prepare SUP) and annually re-occurring tasks by refuge staff and other Service employees will be determined for each project. Sufficient funding in the general operating budget of the Refuge must be available to cover expenses for these projects. The terms and conditions for funding and staff support necessary to administer each project on the Refuge will be clearly stated in the SUP(s).

The Refuge has the following staffing and funding to administratively support and monitor research that is currently taking place on refuge lands (see table below). Any substantial increase in the number of projects will create a need for additional resources to oversee the administration and monitoring of the investigators and their projects. Any substantial additional costs above those

itemized below may result in finding a project not compatible unless expenses are offset by the investigator(s), sponsoring agency, or organization.

Category and Itemization	One-time ($)	Annual ($/yr)
Administration and management		$1,000
Maintenance		$500
Monitoring		$1,750
Special equipment, facilities, or improvement		
Totals		**$3,250**

Itemized costs in the previous table are current estimates calculated using **30% of the base cost for a GS-11 Refuge Biologist and a 3% cost of a GS-11 Refuge Manager**.

Anticipated Impacts of the Use(s):
Use of the Refuge to conduct research, scientific collecting, and surveys will generally provide information that will benefit fish, wildlife, plants, and their habitats. Scientific findings gained through these projects provide important information regarding life-history needs of species and species groups as well as identify or refine management actions to achieve resource management objectives in refuge management plans (especially CCPs). Reducing uncertainty regarding wildlife and habitat responses to refuge management actions in order to achieve desired outcomes reflected in resource management objectives is essential for adaptive management in accordance with 522 DM 1.

If project methods impact or conflict with refuge-specific resources, priority wildlife-dependent public uses, other high-priority research, wilderness, and refuge habitat and wildlife management programs, then it must be clearly demonstrated that its scientific findings will contribute to resource management and that the project cannot be conducted off refuge lands for the project to be compatible. The investigator(s) must identify methods/strategies in advance required to minimize or eliminate the potential impact(s) and conflict(s). If unacceptable impacts cannot be avoided, then the project will not be compatible. Projects that represent public or private economic use of the natural resources of any national wildlife refuge (e.g., bioprospecting), in accordance with 16 U.S.C. 715s, must contribute to the achievement of the national wildlife refuge purposes or the National Wildlife Refuge System mission to be compatible (50 C.F.R. 29.1).

Impacts will be project- and site-specific, and they will vary depending upon nature and scope of the field work. Data collection techniques will generally have minimal animal mortality or disturbance, habitat destruction, no introduction of contaminants, or no introduction of non-indigenous species. In contrast, projects involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection will have short-term impacts. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) will be collected for identification and/or experimentation and statistical analysis. Where possible, researchers will coordinate and share collections to reduce sampling needed for multiple projects. For example, if one investigator collects fish for a diet study and another research examines otoliths, then it may be possible to accomplish sampling for both projects with one collection effort.

Investigator(s) obtaining required State or Territorial, and Federal collecting permits will also ensure minimal impacts to fish, wildlife, plants, and their habitats. If, even after incorporating the above strategies, projects would result in long-term or cumulative effects, projects would not be compatible. A Section 7 consultation under the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884, as

amended Public Law 93-205) will be required for activities that may affect a federally listed species and/or critical habitat. Only projects that have no effect or will result in not likely to adversely affect determinations will be considered compatible.

Spread of invasive plants and/or pathogens is possible from ground disturbance and/or transportation of project equipment and personnel, but it will be minimized or eliminated by requiring proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary. If after all practical measures are taken and unacceptable spread of invasive species is anticipated to occur, then the project will be found not compatible without a restoration or mitigation plan.

There also could be localized and temporary effects from vegetation trampling, collecting of soil and plant samples, or trapping and handling of wildlife. Impacts may also occur from infrastructure necessary to support a projects (e.g., permanent transects or plot markers, exclosure devices, monitoring equipment, solar panels to power unattended monitoring equipment). Some level of disturbance is expected with these projects, especially if investigator(s) enter areas closed to the public and collect samples or handle wildlife. However, wildlife disturbance (including altered behavior) will usually be localized and temporary in nature. Where long-term or cumulative unacceptable effects cannot be avoided, the project will not be found compatible.

At least 6 months before initiation of field work (unless an exception is made by prior approval of the refuge manager), project investigator(s) must submit a detailed proposal using the format provided in Attachment 1. Project proposals will be reviewed by refuge staff and others, as needed, to assess the potential impacts (short-term, long-term, and cumulative) relative to benefits of the investigation to refuge management issues and understanding of natural systems. This assessment will form the primary basis for allowing or denying a specific project. Projects which result in unacceptable refuge impacts will not be found compatible. If allowed and found compatible after approval, all projects also will be assessed during implementation to ensure impacts and conflicts remain within acceptable levels.

If the proposal is approved, then the refuge manager will issue a SUP(s) with required stipulations (terms and conditions) of the project to avoid and/or minimize potential impacts to refuge resources as well as conflicts with other public-use activities and refuge field management operations. After approval, projects also are monitored during implementation to ensure impacts and conflicts remain within acceptable levels based upon documented stipulations.

The combination of stipulations identified above and conditions included in any SUP(s) will ensure that proposed projects contribute to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the Refuge. As a result, these projects will help fulfill refuge purpose(s); contribute to the Mission of the NWRS; and maintain the biological integrity, diversity, and environmental health of the Refuge.

Projects which are not covered by the CCP (objectives under Goal 4 [Gather scientific information (surveys, research, and assessments) to support adaptive management decisions under objectives for Goals 1-3.]) will require additional NEPA documentation.

Public Review and Comment:
This compatibility determination was submitted for 90-day public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR.

Determination: (check one below)

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:
Each project will require a SUP. Annual or other short-term SUPs are preferred; however, some permits will be a longer period, if needed, to allow completion of the project. All SUPs will have a definite termination date in accordance with 5 RM 17.11. Renewals will be subject to refuge manager review and approval based timely submission of and content in progress reports, compliance with SUP stipulations, and required permits.

- Projects will adhere to scientifically defensible protocols for data collection, where available and applicable.
- Investigators must possess appropriate and comply with conditions of State or Territorial and Federal permits for their projects.
- If unacceptable impacts to natural resources or conflicts arise or are documented by the refuge staff, then the refuge manager can suspend, modify conditions of, or terminate an on-going project already permitted by SUP(s) on the Refuge.
- Progress reports are required at least annually for multiple-year projects. The minimum required elements for a progress report will be provided to investigator(s) (see Attachment 2).
- Final reports are due one year after completion of the project unless negotiated otherwise with the refuge manager.
- Continuation of existing projects will require approval by the Refuge Manager.
- The refuge staff will be given the opportunity to review draft manuscript(s) from the project before being submitted to a scientific journal(s) for consideration of publication.
- The refuge staff will be provided with copies (reprints) of all publications resulting from a refuge project.
- The refuge staff will be provided with copies of raw data (preferably electronic database format) at the conclusion of the project.
- Upon completion of the project or annually, all equipment and markers (unless required for long-term projects), must be removed and sites must restored to the refuge manager's satisfaction. Conditions for clean-up and removal of equipment and physical markers will be stipulated in the SUP(s).
- All samples collected on refuge lands are the property of the Service even while in the possession of the investigator(s). Any future work with previously collected samples not clearly identified in the project proposal will require submission of a subsequent proposal for review and approval. In addition, a new SUP will be required for additional project work. For samples or specimens to be stored at other facilities (e.g., museums), a memorandum of understand will be necessary (see Attachment 3).
- Sampling equipment as well as investigator(s) clothing and vehicles (e.g., ATV, boats) will be thoroughly cleaned (free of dirt and plant material) before being allowed for use refuge lands to prevent the introduction and/or spread of pests.
- The NWRS, specific refuge, names of refuge staff and other Service personnel that supported or contributed to the project will be appropriately cited and acknowledged in all written and oral presentations resulting from projects on refuge lands.
- At any time, refuge staff may accompany investigator(s) in the field.

- Investigator(s) and support staff will follow all refuge-specific regulations that specify access and travel on the Refuge.

Justification:
Research, scientific collecting, and surveys on refuge lands are inherently valuable to the Service because they will expand scientific information available for resource management decisions. In addition, only projects which directly or indirectly contribute to the enhancement, protection, use, preservation, and management of refuge wildlife populations and their habitats generally will be authorized on refuge lands. In many cases, if it were not for the refuge staff providing access to refuge lands and waters along with some support, the project would never occur and less scientific information would be available to the Service to aid in managing and conserving the refuge resources. By allowing the use to occur under the stipulations described above, it is anticipated that wildlife species which could be disturbed during the use will find sufficient food resources and resting places so their abundance and use will not be measurably lessened on the Refuge. Additionally, it is anticipated that monitoring, as needed, will prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats. As a result, these projects will not materially interfere with or detract from fulfilling refuge purpose(s); contributing to the Mission of the NWRS; and maintaining the biological integrity, diversity, and environmental health of the Refuge.

Mandatory Re-evaluation Date: (provide month and year for "allowed" uses only)

_____ Mandatory 15-year re-evaluation date (wildlife-dependent public uses)

__X__ Mandatory 10-year re-evaluation date (uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

Refuge Determination:

Prepared by: Loren Lobl (Signature) 04/19/2013 (Date)

Acting Refuge Manager/ Project Leader Approval: Loren Lobl (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: (Signature) 4/23/13 (Date)

Regional Chief, National Wildlife Refuge System: Ted D. Wet (Signature) 4-23-13 (Date)

Attachment 1

FORMAT FOR PROPOSALS TO CONDUCT RESEARCH OR LONG-TERM MONITORING ON NATIONAL WILDLIFE REFUGES

A Special Use Permit (SUP) is required to conduct research and/or long-term monitoring on refuge lands. To receive a SUP, a detailed project proposal using the following format must be submitted to the refuge manager approximately 6 months prior to the start of the project.

Title:

Principal Investigator(s):
Provide the name(s) and affiliation(s) of all principal investigator(s) that will be responsible for implementation of the research and/or long-term monitoring described in the proposal. In addition, provide a brief description or attach vitae of expertise for principal investigator(s) germane to work described in the proposal.

Background and Justification:
In a narrative format, describe the following as applicable:

- *The resource management issue (e.g., decline in Pisonia rainforest) and/or knowledge gap regarding ecological function that currently exists with any available background information.*
- *Benefit of project findings (e.g., management implications) to resources associated with the Refuge.*
- *Potential consequences if the conservation issue and/or knowledge gap regarding ecological function is not addressed.*

Objectives:
Provide detailed objective(s) for the proposed project.

Methods and Materials:
Provide a detailed description of the methods and materials associated with field and laboratory work (if applicable) to be conducted for the project. Methods should include the following:

- *study area(s)*
- *number of samples;*
- *sampling dates and locations*
- *sampling techniques*
- *data analyses including **statistical methods** and **significance levels**.*

Previously published methods should be cited without explanation; whereas, new or modified techniques should be described in detail. Include number of personnel as well as all facilities and equipment (e.g., vehicles, boats, structures, markers) required to collect samples/data. Provide a clear description of the relationships among study objectives, field methods, and statistical analyses.

Permits:
Identify all State or Territorial and Federal permits required if applicable.

Potential Impacts to Refuge Resources:
Describe potential impacts to threatened or endangered species as well as other refuge plants, wildlife, and fish species that could result from the implementation of project activities on the Refuge. Consider the cumulative impacts associated with this project.

Animal Welfare Plan:
If appropriate, attach a copy of the Institutional Animal Care and Use review and/or animal welfare plans that are required by the principle investigator's affiliation.

Partnerships and Funding Sources:
List other participating institutions, agencies, organizations, or individuals as well as the nature and magnitude of their cooperative involvement (e.g., funding, equipment, personnel).

Project Schedule:
Provide estimated initiation and completion dates for field sampling, laboratory work, data analyses, and report/manuscript preparation. If the project is divided into phases to be accomplished separately provide separate initiation and completion dates for each phase.

Reports and Raw Data:
Establish a schedule for annual progress and final reports; include adequate time for peer review of the final report/manuscript. Draft reports/manuscripts should be submitted to the refuge manager for review prior to submission for consideration of publication. At the conclusion of a research study (manuscripts accepted for publication), an electronic copy of the data (e.g., GIS vegetation layers, animal species composition and numbers, genetics) should be provided to the refuge manager. For long-term monitoring projects, the Service also requires raw data for management and planning purposes for the Refuge.

Publications:
Describe the ultimate disposition of study results as publications in scientific journals, presentation at professional symposiums, or final reports.

Disposition of Samples:
If the project entails the collection of biotic and/or abiotic (e.g., sediment) samples, then describe their storage. Although the samples may be in the possession of scientists for the purposes of conducting the project in accordance with the SUP, the Service retains ownership of all samples collected on refuge lands. If the samples will be used for subsequent research activities that are not described within the original proposal, a new proposal must be submitted to the refuge manager to obtain a SUP before initiation of the follow-up project. After conclusion of the research activities, consult with the refuge manager regarding the final disposition of the samples. If specimens will be curated at a museum, then prepare a MOU using the format provided in Attachment 3.

Attachment 2

ANNUAL PROGRESS REPORTS FOR REFUGE RESEARCH AND LONG-TERM MONITORING PROJECTS

Study title:

Fiscal year:

Progress:
In a narrative format, summarize the work that was completed on the study including the number and types of samples collected and/or data analyses.

Important findings:
In narrative format, generally describe any conclusions and/or management recommendations that may be drawn from the work completed to date.

Describe problems encountered:
In narrative format, describe any problems that were encountered during the year and their effects upon the study.

Proposed resolution to problems:
For each problem encountered, describe the actions that have been taken to remediate it.

Preparer:

Date prepared:

Attachment 3

MEMORANDUM OF UNDERSTANDING
FOR CURATORIAL SERVICES
BETWEEN THE
(Name of the Federal agency)
AND THE
(Name of the Repository)

This Memorandum of Understanding is entered into this (**day**) day of (**month and year**), between the United States of America, acting by and through the (**name of the Federal agency**), hereinafter called the Depositor, and the (**name of the Repository**), hereinafter called the Repository, in the State/Territory of (**name of the State/Territory**).

The Parties do witnesseth that

WHEREAS, the Depositor has the responsibility under Federal law to preserve for future use certain collections of paleontological specimens and/or biological samples as well as associated records, herein called the Collection, listed in Attachment A which is attached hereto and made a part hereof, and is desirous of obtaining curatorial services; and

WHEREAS, the Repository is desirous of obtaining, housing and maintaining the Collection, and recognizes the benefits which will accrue to it, the public and scientific interests by housing and maintaining the Collection for study and other educational purposes; and

WHEREAS, the Parties hereto recognize the Federal Government's continued ownership and control over the Collection and any other U.S. Government-owned personal property, listed in Attachment B which is attached hereto and made a part hereof, provided to the Repository, and the Federal Government's responsibility to ensure that the Collection is suitably managed and preserved for the public good; and

WHEREAS, the Parties hereto recognize the mutual benefits to be derived by having the Collection suitably housed and maintained by the Repository;

NOW THEREFORE, the Parties do mutually agree as follows:

1. The Repository shall:

    a. Provide for the professional care and management of the Collection from the (**names of the resources**) sites, assigned (**list site numbers**) site numbers. The collections were recovered in connection with the (**name of the Federal or federally-authorized project**) project, located in (**name of the nearest city or town**), (**name of the county, if applicable**) county, in the State/Territory of (**name of the State/Territory**)-

    b. Assign as the Curator, the Collections Manager and the Conservator having responsibility for the work under this Memorandum, persons who are qualified museum professionals and whose expertise is appropriate to the nature and content of the Collection.

c. Begin all work on or about (**month, date and year**) and continue for a period of (**number of years**) years or until sooner terminated or revoked in accordance with the terms set forth herein.

d. Provide and maintain a repository facility having requisite equipment, space and adequate safeguards for the physical security and controlled environment for the Collection and any other U.S. Government-owned personal property in the possession of the Repository.

e. Not in any way adversely alter or deface any of the Collection except as may be absolutely necessary in the course of stabilization, conservation, scientific study, analysis and research. Any activity that will involve the intentional destruction of any of the Collection must be approved in advance and in writing by the Depositor.

f. Annually inspect the facilities, the Collection and any other U.S. Government-owned personal property. Every (**number of years**) years inventory the Collection and any other U.S. Government-owned personal property. Perform only those conservation treatments as are absolutely necessary to ensure the physical stability and integrity of the Collection, and report the results of all inventories, inspections and treatments to the Depositor.

g. Within five (5) days of discovery, report all instances of and circumstances surrounding loss of, deterioration and damage to, or destruction of the Collection and any other U.S. Government-owned personal property to the Depositor, and those actions taken to stabilize the Collection and to correct any deficiencies in the physical plant or operating procedures that may have contributed to the loss, deterioration, damage or destruction. Any actions that will involve the repair and restoration of any of the Collection and any other U.S. Government-owned personal property must be approved in advance and in writing by the Depositor.

h. Review and approve or deny requests for access to or short-term loan of the Collection (or a part thereof) for scientific and educational uses. In addition, refer requests for consumptive uses of the Collection (or a part thereof) to the Depositor for approval or denial.

i. Not mortgage, pledge, assign, repatriate, transfer, exchange, give, sublet, discard or part with possession of any of the Collection or any other U.S. Government-owned personal property in any manner to any third party either directly or indirectly without the prior written permission of the Depositor, and redirect any such request to the Depositor for response. In addition, not take any action whereby any of the Collection or any other U.S. Government-owned personal property shall or may be encumbered, seized, taken in execution, sold, attached, lost, stolen, destroyed or damaged.

2. The Depositor shall:

a. On or about (month, date and year), deliver or cause to be delivered to the Repository the Collection, as described in Attachment A, and any other U.S. Government-owned personal property, as described in Attachment B.

b. Assign as the Depositor's Representative having full authority with regard to this Memorandum, a person who meets pertinent professional qualifications.

c. Every (number of years) years, jointly with the Repository's designated representative, have the Depositor's Representative inspect and inventory the Collection and any other U.S. Government-owned personal property, and inspect the repository facility.

d. Review and approve or deny requests for consumptively using the Collection (or a part thereof).

3. Removal of all or any portion of the Collection from the premises of the Repository for scientific or educational purposes; any conditions for handling, packaging and transporting the Collection; and other conditions that may be specified by the Repository to prevent breakage, deterioration and contamination.

4. The Collection or portions thereof may be exhibited, photographed or otherwise reproduced and studied in accordance with the terms and conditions stipulated in Attachment C to this Memorandum. All exhibits, reproductions and studies shall credit the Depositor, and read as follows: "Courtesy of the (**name of the Federal agency**)." The Repository agrees to provide the Depositor with copies of any resulting publications.

5. The Repository shall maintain complete and accurate records of the Collection and any other U.S. Government-owned personal property, including information on the study, use, loan and location of said Collection which has been removed from the premises of the Repository.

6. Upon execution by both parties, this Memorandum of Understanding shall be effective on this (**day**) day of (**month and year**), and shall remain in effect for **(number of years**) years, at which time it will be reviewed, revised, as necessary, and reaffirmed or terminated. This Memorandum may be revised or extended by mutual consent of both parties, or by issuance of a written amendment signed and dated by both parties. Either party may terminate this Memorandum by providing 90 days written notice. Upon termination, the Repository shall return such Collection and any other U.S. Government-owned personal property to the destination directed by the Depositor and in such manner to preclude breakage, loss, deterioration and contamination during handling, packaging and shipping, and in accordance with other conditions specified in writing by the Depositor. If the Repository terminates, or is in default of, this Memorandum, the Repository shall fund the packaging and transportation costs. If the Depositor terminates this Memorandum, the Depositor shall fund the packaging and transportation costs.

7. Title to the Collection being cared for and maintained under this Memorandum lies with the Federal Government.

IN WITNESS WHEREOF, the Parties hereto have executed this Memorandum.

Signed: (signature of the Federal Agency Official) Date: (date)

Signed: (signature of the Repository Official) Date: (date)

Attachment 3A: Inventory of the Collection

Attachment 3B: Inventory of any other U.S. Government-owned Personal Property

Attachment 3C: Terms and Conditions Required by the Depositor

Compatibility Determination

Use: Fishing, General and Other

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j) as amended
- Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4)
- Endangered Species Act of 1973

Refuge Purpose(s):
The purposes for the Dungeness NWR have been identified in historic legal documentation establishing and adding refuge lands. The Refuge was originally established to preserve important habitat for native birds with refuge purposes specified as follows:

> "…as a refuge, preserve, and breeding ground for native birds." (Executive Order 2123 dated 20 January 1915.
>
> "... suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." (16 U.S.C. 460k-1)
>
> "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
>
> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)
>
> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

National Wildlife Refuge System Mission:

> "The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

Description of Use(s):

Two types of fishing occur at Dungeness National Wildlife Refuge; fin fish (salmon species primarily) and shell fish (mollusks and Dungeness crab). The Refuge has jurisdiction over the land base including shorelines to mean high water and the second class tidelands under a perpetual easement from the State of Washington and the waters associated with those tidelands. Anglers accessing the fishing opportunities on the Refuge do so by fishing from the shoreline or from boats. Finfishing from the shoreline occurs on the Strait of Juan de Fuca side of Dungeness Spit from the western boundary east to the New Dungeness Light Station (Zones 1, 2 and 3) and from boats in refuge waters associated with the Refuge's second class tidelands on the Dungeness Harbor and Bay sides of Dungeness Spit outside a 100 yard buffer zone below Mean High Tide (Zone 5). Shellfishing occurs on the Dungeness Harbor side from the base of Dungeness Spit out to ½ mile (Zone 2)—foot access only—and on the Refuge's second-class tidelands and waters associated with these tidelands on the Dungeness Harbor and Bay sides of Dungeness Spit outside a 100 yard buffer zone below Mean High Tide (Zone 5) – boat access only. Public uses of Zones 2 and 5 are restricted to May 15 to September 30. All fishing is conducted in accordance with State regulations.

This compatibility determination (CD) reassesses and re-evaluates recreational fishing from all shorelines and Dungeness Harbor and Bay areas within the refuge boundary. Under this use fishing will be allowed consistent with State regulations. Specific species/numbers to be taken and open periods will be set by the Washington Department of Fish and Wildlife to match adjacent areas open to fishing, however seasonal closures of Refuge Zones 2 and 5 will continue.

Recreational fishing (a wildlife-dependent activity) has been identified in the National Wildlife Refuge System Administration Act, as amended, as a priority public use, provided it is compatible with the purpose for which the Refuge was established.

Availability of Resources

The recreational fishing program will not require any new infrastructure or personnel. Administration of a fishing program will require coordination with the State of Washington and require monitoring and some law enforcement patrols; however refuge staff is in place and capable of conducting these additional duties.

Category	One Time Expenses	Recurring Expenses
Monitoring/Law Enforcement		$4,000
Signage/Brochures	$3,000	$500
Maintenance		$1,500
Totals	**$3,000**	**$6,000**

Anticipated Impacts of the Use(s):

As a solitary and stationary activity, fishing tends to be less disturbing to wildlife than hunting or motorized boating (Tuite et al. 1983). It is well recognized that fishing can give many people a

deeper appreciation of fish and wildlife and a better understanding of the importance of conserving habitat, which has ultimately contributed to the Refuge System mission. A goal of Dungeness National Wildlife Refuge is to provide opportunities for wildlife-dependent recreation. Fishing is one of the six priority public uses in the National Wildlife Refuge System. Of key concern, then, is to manage the activity to keep any potential adverse impacts within acceptable limits.

Any angler activities on the Refuge are and will remain consistent with State guidelines. Related impacts for fish stocks associated with recreational fishing in the Strait of Juan de Fuca adjacent to the Refuge and Dungeness Harbor and Bay, are estimated annually and taken into consideration by the State of Washington in the development of annual fishing agreements and associated regulations. Because fishing regulations are established to provide a sustainable fish resource, impacts to fish populations from recreational fishing activity are expected to be minor.

Additional disturbance will be caused to birds and other wildlife using the open waters and where fishing will occur. Fishing activities may influence the composition of bird communities, as well as abundance, and productivity of waterbirds (Bell and Austin 1985, Bouffard 1982, Cooke 1987, Edwards and Bell 1985, Tydeman 1977). Anglers often fish in shallow, sheltered bays and creeks that birds prefer, negatively impacting distribution and abundance of waterfowl, grebes, and coots (Cooke 1987). Increases in anglers and associated shoreline activity discouraged waterfowl using otherwise suitable habitat (Jahn and Hunt 1964). Anglers influenced the numbers, behavior, and diurnal distribution of avian scavengers present at sites in Washington, when compared to non-fishing days (Knight et al. 1991). Shoreline activities, such as human noise, can cause some birds to flush and go elsewhere.

Boating associated with fishing can alter bird distribution, reduce use of particular habitats or entire areas by waterfowl and other water-birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). Boating close to shore may disturb harbor seals hauled out on the beach. Impacts of motorized boating can occur even at low densities, given their noise, speed, and ability to cover extensive areas in a short amount of time. (See Boating Compatibility Determination.)

Despite the potential impacts that fishing and supporting activities (boating) can have on wildlife, impacts to wildlife from allowing fishing are expected to be minor for the following reasons. The 100 yard buffer from the mean high tide on the Harbor and Bay side of Dungeness and Graveyard spits coupled with the requirement for boats to have no wake will minimize disturbance to any nesting seabirds or shorebirds and resting or pupping harbor or elephant seals. The majority of waterfowl use on the Refuge occurs in the fall, winter and spring months, with some birds arriving as early as September and October. Because the majority of the fishing activity occurs in the summer and fall (through mid-October), disturbance to waterfowl species is reduced by annual closing refuge waters to all use from October 1 to May 14.

Public Review and Comment:
This compatibility determination was submitted for 90-day public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:
The requirements laid out in the preferred alternative of the 1997 Environmental Assessment – "Management of Public Use for Dungeness National Wildlife Refuge" (USFWS 1997) are adopted as stipulations to ensure compatibility and include:

User stipulations:

- Graveyard Spit and the tip of Dungeness Spit are closed to public access
- In Zone 1 – Beach in front of bluffs –Fin fishing permitted year-round
- In Zone 2 – Base of Dungeness Spit out to ½ mile – Fin fishing permitted on the Strait of Juan de Fuca side year-round. Fin fishing and shell fishing permitted on the Dungeness Harbor side from May 15 to September 30 – foot access only. From October 1 to May 14, the Harbor side of Zone 2 is closed to all access.
- In Zone 3 – Strait side of Dungeness Spit from ½ mile to New Dungeness Light Station – Fin fishing permitted year-round.
- In Zone 4 – Dungeness Spit from lighthouse to end of spit, the Harbor and Bay sides of Dungeness Spit, and all of Graveyard Spit including a 100-yard buffer zone below the mean high tide line - closed to public access year-round. Where the refuge boundary does not accommodate a 100 yard buffer, the buffer is slightly narrower.
- In Zone 5 – Refuge waters and tidelands on the Harbor and Bay sides of Dungeness and Graveyard spits outside of the 100 yard buffer zone – fin fishing and shell fishing permitted from May 15 through September 30 – boat access only. From October 1 to May 14 this zone is closed to all public access.

The response of wildlife to these modifications in public use activities will be monitored and evaluated to measure the effectiveness of the program in meeting refuge purposes. Based on monitoring data, public use regulations could become more restrictive in the future.

Justification:
Recreational fishing is one of the six priority public uses of the National Wildlife Refuge System. Providing a quality fishing program contributes to achieving one of the Refuge's goals. Despite the potential impacts that fishing and supporting activities (boating) can have on wildlife, impacts to wildlife from allowing fishing are expected to be minor for the following reasons. The 100 yard buffer from the mean high tide on the Harbor and Bay side of Dungeness and Graveyard spits coupled with the requirement for boats to have no wake will minimize disturbance to any nesting seabirds or shorebirds and resting or pupping harbor or elephant seals. The majority of waterfowl use on the Refuge occurs in the fall, winter and spring months, with some birds arriving as early as September and October. Because the majority of the fishing activity occurs in the summer and fall (through mid-October), disturbance to waterfowl species is reduced by annual closing refuge waters to all use from October 1 to May 14.

Mandatory Re-Evaluation Date:

__X__ Mandatory 15-year reevaluation date (for wildlife-dependent public uses)

_____ Mandatory 10-year reevaluation date (for all uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References:

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Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Technical Bulletin No. 33. Wisconsin Conservation Department. Madison, WI. 212 pp.

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Tydeman, C.F. 1977. The importance of the close fishing season to breeding bird communities. Journal of Environmental Management 5:289-296.

Refuge Determination:

Prepared by: _____ (Signature) 04/19/2013 (Date)

Acting Refuge Manager/ Project Leader Approval: _____ (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: _____ (Signature) 4/23/13 (Date)

Regional Chief, National Wildlife Refuge System: _____ (Signature) 4-23-13 (Date)

Compatibility Determination

Use: Fishing, Other, Tribal

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j) as amended
- Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4)
- Endangered Species Act of 1973

Refuge Purpose(s):
The purposes for the Dungeness NWR have been identified in historic legal documentation establishing and adding refuge lands. The Refuge was originally established to preserve important habitat for native birds with refuge purposes specified as follows:

> "…as a refuge, preserve, and breeding ground for native birds." (Executive Order 2123 dated 20 January 1915.
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> "... suitable for-(1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." (16 U.S.C. 460k-1)
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>
> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)
>
> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

National Wildlife Refuge System Mission:

"The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

Description of Use:

The S'Klallam and Skokomish Tribes were signatories to the Point-No-Point Treaty with the U.S. Government in 1855. The S'Klallam tribe today consists of the Jamestown S'Klallam, Lower Elwha Klallam, and Port Gamble S'Klallam. In accordance with the Treaty, the Tribes retained the right to fish "at their usual and accustomed places." The Tribes, in exercising their Treaty rights, fish in Dungeness Harbor and Bay by set nets or other traditional methods, or by modern or improved fishing techniques. The U.S. Fish and Wildlife Service recognizes that the Treaty fishing rights include access to National Wildlife Refuge System lands. This is a treaty right against land owned by the United States. Access to the Refuge is only open to Tribal members involved in fishing. In 1983, the USFWS and the three S'Klallam Tribes signed a Letter of Agreement for Management of the Tribal Fishery on Dungeness National Wildlife Refuge. The Letter of Agreement contained 8 principles of agreement to promote mutual understanding and cooperation between the USFWS and the Tribes of the Point-No-Point Treaty and to provide for orderly conduct of the fishery on Dungeness NWR. These principles of agreement are reflected in the stipulations necessary to ensure compatibility.

Availability of Resources:

The recreational fishing program will not require any new infrastructure or personnel. Administration of the Tribal fishing program will require coordination with the Point-No-Point Treaty Tribes and require monitoring and some law enforcement patrols; however refuge staff is in place and capable of conducting these duties.

Category	One Time Expenses	Recurring Expenses
Administration- Coordination with tribes		$1,500
Monitoring/Law Enforcement		$2,500
Totals		**$4,000**

Anticipated Impacts of the Use(s):

Any Tribal angler activities on the Refuge are and will remain consistent with Tribal guidelines. Related impacts for fish stocks associated with Tribal fishing in Dungeness Harbor and Bay are estimated annually and taken into consideration by the State of Washington and Tribes as co-managers of the fishery in the development of annual fishing agreements and associated regulations. Because fishing regulations are established to provide a sustainable fish resource, impacts to fish populations from Tribal fishing activity are expected to be minor.

Additional disturbance will be caused to birds and other wildlife using the open waters and where fishing will occur. Fishing activities may influence the composition of bird communities, as well as abundance, and productivity of waterbirds (Bell and Austin 1985, Bouffard 1982, Cooke 1987, Edwards and Bell 1985, Tydeman 1977). Anglers often fish in shallow, sheltered bays and creeks that birds prefer, negatively impacting distribution and abundance of waterfowl, grebes, and coots

(Cooke 1987). Increases in anglers and associated shoreline activity discouraged waterfowl using otherwise suitable habitat (Jahn and Hunt 1964). Anglers influenced the numbers, behavior, and diurnal distribution of avian scavengers present at sites in Washington, when compared to non-fishing days (Knight et al. 1991). Shoreline activities, such as human noise, can cause some birds to flush and go elsewhere. Tribal members currently may set fires for camping and curing fish and construct temporary shelters as has been done traditionally. These activities reduce drift wood habitat on the spit and may result in a wildfire.

Boating associated with fishing can alter bird distribution, reduce use of particular habitats or entire areas by waterfowl and other water-birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). Boating close to shore may disturb harbor seals hauled out on the beach. Impacts of motorized boating can occur even at low densities, given their noise, speed, and ability to cover extensive areas in a short amount of time. (See Boating Compatibility Determination.)

There will be impacts to refuge resources from Tribal fishing. Under the 1983 Letter of Agreement for Management of the Tribal Fishery on Dungeness NWR, Tribal members are allowed access to refuge closed areas in exercising their Treaty Rights. Tribal members can camp, collect drift wood and build fires. These activities result in wildlife displacement, reduce drift wood habitat on the spit and may result in a wildfire. Boating in support of the Tribal fishery can take place in waters closed to public use after September 30th if the fishery continues beyond that date. Wildlife species using these closed areas can be disturbed. In addition avian and marine mammal species may become entangled in Tribal nets and be injured or die.

Despite the potential impacts that Tribal fishing and supporting activities (boating) can have on wildlife, impacts to wildlife from allowing fishing are expected to be minor for the following reasons. In most years, relatively few individuals participate in this fishery. The use is limited in time usually beginning in mid- September and finishing in late October before we get large numbers of wintering birds and there is plenty of adjacent sanctuary for disturbed wildlife to escape to. An additional steelhead fishery occurs from December through February but has resulted in very limited participation and occurs mostly outside of refuge waters in the vicinity of Cline Spit. Tribal members must maintain visual contact with their nets and not leave them unattended which reduces the incidence of bycatch of avian and marine mammal species. Fires are not to be left unattended thus reducing the likelihood of a wildfire event.

Public Review and Comment:
This compatibility determination was submitted for 90-day public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:
The principles of agreement as laid out in the 1983 Letter of Agreement for Management of the Tribal Fishery on Dungeness National Wildlife Refuge are adopted as stipulations to ensure compatibility and include:

1. During the prescribed fishing seasons, established by the Tribes and the Washington Department of Fish and Wildlife, the Tribes (Lower Elwha Klallam, Jamestown S'Klallam and Port Gamble S'Klallam) of the Point-No-Point Treaty (PNPT) may conduct their fishery in Dungeness Harbor and Bay in compliance with tribal and applicable state regulations
2. Access by tribal members and fish buyers to the refuge areas, which are the usual and accustomed fishing grounds and stations of the Tribes (Lower Elwha Klallam, Jamestown S'Klallam and Port Gamble S'Klallam), is limited to boat and foot.
3. Leaving equipment (boats, nets, etc.) on the refuge lands is discouraged. The owner assumes all risks associated with unattended equipment
4. The Tribes (Lower Elwha Klallam, Jamestown S'Klallam and Port Gamble S'Klallam) of the PNPT may set fires for camping and curing fish and construct temporary shelters as has been done traditionally. Fires should not be left unattended. Camp sites should be totally removed and fire pits extinguished and covered with sand at the conclusion of the fishing season.
5. The USFWS prohibits pets and littering while on refuge lands
6. The Tribal Enforcement Division will be responsible for ensuring compliance with the above principles and with Tribal fishery regulations and will respond to complaints from USFWS personnel for reasons of non-compliance.
7. The Tribes will notify the USFWS of opening and closing dates of the fishing seasons on Dungeness NWR.
8. The USFWS agrees to discourage visitors to the Dungeness NWR from vandalizing fishing gear or otherwise disturbing Indian fishing activities on refuge lands.

The Letter of Agreement is 29 years old and the Refuge will contact the Tribes concerning updating the document. In particular the Refuge will work to modify conditions 3 and 4. Should these two principles be changed then the CD (stipulations necessary to ensure compatibility) will be modified to reflect same.

Justification:
The USFWS recognizes the Point-No-Point Treaty Tribes retained the right to fish "at their usual and accustomed places" and that Dungeness NWR is one of those places. Although there may be some wildlife and habitat disturbance associated with this activity, the USFWS will continue to work with the Tribes to minimize these effects. Although Tribal fishing and associated boating can result in disturbance to wildlife, disturbance is expected to be intermittent and limited in time and space. There are more than adequate amounts of undisturbed habitat available to the majority of wildlife for escape and cover.

It is anticipated that wildlife populations will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened from Tribal fishing activities. The relatively limited number of individual animals and plants expected to be adversely affected due to fishing will not cause wildlife populations to materially decline, the physiological condition and production of affected species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing Tribal fishing to occur with stipulations (1983 Letter of Agreement for Management of the Tribal Fishery on Dungeness National Wildlife Refuge) will not materially detract from or interfere with the purposes for which the Refuge was established or the Refuge System mission.

Mandatory Re-Evaluation Date:

_____ Mandatory 15-year re-evaluation date (wildlife-dependent public uses)

__X__ Mandatory 10-year re-evaluation date (uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References:

Bell, D.V. and L.W. Austin. 1985. The game-fishing season and its effects on overwintering wildfowl. Biological Conservation 33:65-80.

Bouffard, S.H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Transactions of the Forty-Seventh North American Wildlife and Natural Resources Conference 47:553-556.

Cooke, A.S. 1987. Disturbance by anglers of birds at Grafam Water. ITE Symposium 19:15-22.

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Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Technical Bulletin No. 33. Wisconsin Conservation Department. Madison, WI. 212 pp.

Knight, R.L. and D.N. Cole. 1995. Factors that influence wildlife responses to recreationists. Pages 71-79 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Washington, D.C.: Island Press

Knight, R.L., D.P. Anderson, and N.Y. Marr. 1991. Responses of an avian scavenging guild to anglers. Biological Conservation 56:195-205.

Tydeman, C.F. 1977. The importance of the close fishing season to breeding bird communities. Journal of Environmental Management 5:289-296.

Refuge Determination:

Prepared by: _____ (Signature) 04/19/2013 (Date)

Acting Refuge Manager/ Project Leader Approval: _____ (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: _____ (Signature) 4/23/13 (Date)

Regional Chief, National Wildlife Refuge System: _____ (Signature) 4-23-13 (Date)

Compatibility Determination

Use: Boating (Motorized and Non-motorized)

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j) as amended
- Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4)
- Endangered Species Act of 1973

Refuge Purpose(s):
The purposes for the Dungeness NWR have been identified in historic legal documentation establishing and adding refuge lands. The Refuge was originally established to preserve important habitat for native birds with refuge purposes specified as follows:

> "…as a refuge, preserve, and breeding ground for native birds." (Executive Order 2123 dated 20 January 1915.
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> "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
>
> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)
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> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

National Wildlife Refuge System Mission:

> "The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

Description of Use:

Boating use addressed in this compatibility determination is for motorized and non-motorized boats, including kayaks and canoes in refuge waters associated with the Refuge's second class tidelands. Although boating is not a wildlife-dependent public use, it does facilitate other wildlife-dependent uses such as fishing, wildlife observation, and photography. Boating at Dungeness NWR primarily supports fishing (shell fish and fin fish), although wildlife observation and photography are also conducted from these platforms. Access to the New Dungeness Light Station via boat is permitted through a reservation system (See Environmental Education, Wildlife Observation, Photography, and Interpretation Compatibility Determination). Currently boating on refuge waters is limited to May 15 through September 30. Personal watercrafts, wind surfing and para-surfing/sailing are not permitted on refuge waters.

Availability of Resources:

The following funding/annual cost will be required to administer and manage boating activities as described above:

Category	One Time Expense	Recurring Expense
Administration (Reservation system for lighthouse landings)		$1,000
Monitoring		$4,000
Signage/Outreach	$3,500	$500
Totals	**$3,500**	**$5,500**

The Refuge has sufficient staff and funding to allow the use.

Anticipated Impacts of the Use(s):

Dungeness NWR provides crucial foraging and resting habitat for wintering migratory birds, including waterfowl, shorebirds, seabirds, and other waterbirds. Recreational boating affects their use of refuge and other Dungeness Harbor and Bay waters. Boating activity, both motorized and non-motorized, can alter distribution, reduce use of particular habitats or entire areas by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). More sensitive species may find it difficult to secure adequate food or loafing sites as their preferred habitat becomes fragmented and recreation-related disturbances increase (Skagen et al. 1991, Pfister et al. 1992). During migration and wintering, Pacific brant can be considered obligate feeders on eelgrass. Because of this, the eelgrass beds associated with the Refuge's second-class tidelands are important brant feeding areas.

Another species that could be impacted is the harbor seal. Harbor seals haulout and bear their pups on Dungeness Harbor and Bay tideflats and beaches. Harbor seals are afforded protection under the Marine Mammal Protection Act of 1972.

Canoes and kayaks can cause significant disturbance effects based on their ability to penetrate into shallower areas (Speight 1973, Knight and Cole 1995). Canoes or slow-moving boats have been observed to disturb great blue herons (Vos et al. 1985). Huffman (1999) found that non-motorized boats within 30 meters (98 feet) of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Huffman 1999, DeLong 2002).

The overall effects to wildlife will not be significant because refuge waters are closed to all use during the migration and winter season and there is a requirement to maintain a closed area 100 yard buffer zone below the mean high tide line during periods when these waters are open to public use.

Impacts from boating are contained effectively and mitigated within the overall design of the 1997 Environmental Assessment "Management of Public Use for Dungeness National Wildlife Refuge" (USFWS 1997) by providing clearly defined zones where and seasons when these activities can take place, and requiring that visitors restrict their use to those seasons and areas. This strategy will continue to be implemented under the CCP. The Complex is aware that some visitors disregard signs requiring visitors to stay within the designated public use areas (Area Closed signs). Such unauthorized use creates the potential for greater disturbance to wildlife

Public Review and Comment:
This compatibility determination was submitted for 90-day public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:
The requirements laid out in the preferred alternative of the Environmental Assessment – "Management of Public Use for Dungeness National Wildlife Refuge" (USFWS 1997) are adopted as stipulations to ensure compatibility and include:

- In Zone 4 – Dungeness Spit from lighthouse to end of spit, the Harbor and Bay sides of Dungeness Spit, and all of Graveyard Spit including a 100-yard buffer zone below the mean high tide line - closed to public access year-round. Where the refuge boundary does not accommodate a 100 yard buffer, the buffer is slightly narrower.
- In Zone 5 – Refuge waters and tidelands on the Harbor and Bay sides of Dungeness Spit outside the 100 yard buffer – motorized and non-motorized boats (kayaks, small sailboats, canoes, rowboats, etc.) allowed access to the areas west and east of Graveyard Spit in Zone 5, from October 1 to May 14.
- From October 1 to May 14 this zone is closed to all public access.
- Zone 5 is a no wake zone for power boats.
- Boats are permitted to land year-round between the hours of 9 AM and 5 PM, by reservation only through the Complex office (as deemed necessary by the Refuge), in the designated 100 yard zone of beach next to the light station compound on the Bay side of Dungeness Spit.

Number of landings is limited to no more than 20 per day. Visitors are allowed to walk through Zone 4 in a designated area to get to and from the landing site to the lighthouse.

The response of wildlife to these modifications in public use activities will be monitored and evaluated to measure the effectiveness of the program in meeting refuge purposes. Based on monitoring data, public use regulations could become more restrictive in the future.

Justification:
Boating itself is not considered wildlife-dependent recreation, but many wildlife-dependent recreational activities (fishing, waterfowl hunting, environmental education, interpretation, and wildlife observation/photography) are associated with boating. Providing opportunities for wildlife-dependent priority public uses will contribute toward fulfilling provisions under the National Wildlife Refuge System Administration Act as amended in 1997. Although boating has a potential to impact wildlife, implementing the prescribed measures listed in the Stipulations section will minimize these impacts. It is anticipated that closing refuge waters to boating during the migration and winter time periods will provide secure feeding and resting places for brant, waterfowl and shorebirds. The 100 yard buffer on the Dungeness Harbor and Bay side of Dungeness and Graveyard spits will minimize the potential for disturbance to nesting black oystercatchers and harbor seals.

Thus, it is anticipated that birds will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened, the physiological condition and production of waterfowl and other waterbirds will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall status will not be impaired. Thus, allowing boating under the stipulations described above will not materially detract from or interfere with the purposes for which the Refuge was established or the Refuge System mission. The Refuge will also implement a monitoring program to help assess disturbance effects on wildlife and habitat. Improved outreach and educational information for refuge visitors involved in activities associated with boating will also help to reduce the impacts associated with boating activities.

Mandatory Re-Evaluation Date:

_____ Mandatory 15-year re-evaluation date (wildlife-dependent public uses)

__X__ Mandatory 10-year re-evaluation date (uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References:

DeLong, A. 2002. Managing visitor use and disturbance of waterbirds. a literature review of impacts and mitigation measures. Appendix L in: Stillwater National Wildlife Refuge Complex final

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Vos, D.K., R.A. Ryder, and W.D. Graul. 1985. Response of breeding great blue herons to human disturbance in north central Colorado. Colonial Waterbirds 8:13-22.

Refuge Determination:

Prepared by: Loren Lobl (Signature) 04/19/2013 (Date)

Acting Refuge Manager/ Project Leader Approval: Loren Lobl (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: (Signature) 4/23/13 (Date)

Regional Chief, National Wildlife Refuge System: Ed D. Wit (Signature) 4-23-13 (Date)

Compatibility Determination

Use: Transport - Vehicle Access to New Dungeness Light Station

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
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In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

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> "The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

Description of Use:

The U.S. Coast Guard (USCG) withdrew its last keeper from the automated New Dungeness Light Station (Station) in March of 1994. It planned to board up the buildings and maintain the equipment with regular inspections, a move necessitated by budget reductions and made possible by automation. Other unattended light stations have experienced damage by vandals and general deterioration. The New Dungeness Light Station Association (NDLSA) organized in early 1994 with the mission of protecting and preserving the Station. With help from the U.S. Lighthouse Society it obtained a renewable license from the USCG to care for the Station

Since September 3, 1994, NDLSA has continuously staffed the Station with volunteer keepers who serve in one-week shifts. Keepers, along with their supplies and personal effects, are taken to the Station in a NDLSA vehicle at low tide each week. In addition, vehicles are used to transport work parties when maintenance needs dictate, usually a couple of times a month. During the summer months these exchanges occur during the day while during the winter they occur at night. Volunteer keepers clean and repair buildings, maintain the grounds, and conduct tours for refuge visitors arriving by foot or by water in kayaks or small boats. Typically about 5,000 visitors sign the guest book at the Station every year.

Vehicle access coincides with low tide events. Two vehicles make the trip to ensure that if one vehicle breaks down then the other can move people and equipment and the stranded vehicle to a safe area. NDLSA vehicle drivers undergo training and are instructed on what to do if approaching walking refuge visitors and the maximum speed allowed on the Refuge.

Availability of Resources

Administration of this use will not require any new infrastructure or personnel but will require coordination with the NDLSA and some increased monitoring by refuge staff.

Category	One Time Expenses	Recurring Expenses
Administration - Coordination with NDLSA		$500
Monitoring		$1,200
Totals		**$1,700**

Anticipated Impacts of the Use(s):

The extent of impacts from vehicle use of the beach varies by season. During the daylight summer months, seal pups on the beach may be trampled and resting shorebirds and gulls displaced. Compatible wildlife-dependent activities such as wildlife watching, photography, and environmental education may be negatively affected because of the expected responses by wildlife to vehicles approaching or passing by. When wildlife react by moving away from or alter behavior by hiding, they are less likely to be observed (Bennett and Zuelke 1999).

User groups of shared-use paths often have conflicting needs. Moore (1994) concluded that trail conflicts can occur among different user groups, among users within the same user group, and as a result of factors not related to trail user activities at all. Conflict has been found to related to activity style, focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users. This loss of expectation of a quality wildlife-dependent experience could result in avoidance of refuge beach by wildlife watchers and photographers who encounter vehicles using the same beach.

During the winter season when vehicle use on the beach occurs at night to coincide with winter low tide events, impacts to refuge wildlife resources will be minimized but will include resting shorebird and gull displacement. Impacts to marine mammals will be minimal and might affect molting elephant seals. Impacts to refuge visitors will be negligible as the Refuge is open only during daylight hours.

Public Review and Comment:
This compatibility determination was submitted for 90-day public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

- Levels of use and impacts associated with the use will be monitored to ensure that the use remained compatible. Monitoring will evaluate impacts of the use upon, among others, refuge management activities; fish, wildlife, plants, and their habitats; biological integrity, diversity, and environmental health; and wildlife-dependent public uses. If monitoring reveals that levels of use or associated impacts exceed those envisioned in the compatibility determination, the use might be re-evaluated and modified to ensure it remains compatible or terminated if found not compatible.
- Vehicle speed while on the Refuge will not exceed 15 MPH
- Vehicles will be equipped with “beepers” and give an audible warning before passing visitors on the beach
- Vehicles will come to a complete stop when approaching children and wait until safe to pass.
- The Refuge will contact NDLSA when seal pups or molting seals are on the beach to inform them of their presence and location.
- Vehicle use is restricted to keeper exchange, major maintenance needs, and emergency evacuation of keepers or NDLSA work party members.
- NDLSA drivers will receive training on safe operation of motor vehicles on the Refuge and on sandy, rocky surfaces.
- Any accidental spillage of petroleum products (gas, oil) resulting from operation of vehicles by the NDLSA will be immediately reported to the refuge manager. Clean-up operations will be conducted immediately, or as soon as it can be safely accomplished, and be the responsibility of the NDLSA.

Justification:
The New Dungeness Light Station is a cultural resource located at the northeast end of Dungeness Spit. The 35 acres presently owned by the USCG is an inholding on Dungeness NWR. The Refuge has identified in the Dungeness NWR CCP its intent to acquire the area when excessed by the USCG and to enter into a formal agreement with the New Dungeness Light Station Association to care, maintain, and interpret the Station. The safe movement of people and supplies necessary to maintain and interpret the Station is best accomplished by allowing vehicle access via the beach at low tides. Weather patterns in the Strait of Juan de Fuca often result in strong westerly winds and subsequent rough water making access by boat unpredictable and hazardous. As described above, disturbance and other impacts to wildlife and refuge visitors from allowing the use will be negligible. Thus allowing the NDLSA to use vehicles on the beach under a Special Use Permit or Memorandum of Understanding/Agreement and with stipulations as listed above will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the Refuge was established.

Mandatory Re-Evaluation Date:

_____ Mandatory 15-year re-evaluation date (wildlife-dependent public uses)

__X__ Mandatory 10-year re-evaluation date (uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References:

Bennett, K.A. and E. Zuelke. 1999. The effects of recreation on birds: a literature review. Delaware Natural Heritage Program. Smyrna, DE.

Moore, R.L. 1994. Conflicts on multiple-use trails: synthesis of the literature and state of the practice. Federal Highway Administration Report No. FHWA-PD-94-031. Report Date: August 1994. Federal Highway Administration. Washington, D.C. 68 pp.

Refuge Determination:

Prepared by: _____ (Signature) 04/19/2013 (Date)

Acting Refuge Manager/
Project Leader Approval: _____ (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: _____ (Signature) 4/23/13 (Date)

Regional Chief,
National Wildlife
Refuge System: _____ (Signature) 4-23-13 (Date)

Compatibility Determination

Use: Horseback Riding

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j) as amended
- Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4)
- Endangered Species Act of 1973

Refuge Purpose(s):
The purposes for the Dungeness NWR have been identified in historic legal documentation establishing and adding refuge lands. The Refuge was originally established to preserve important habitat for native birds with refuge purposes specified as follows:

> "…as a refuge, preserve, and breeding ground for native birds." (Executive Order 2123 dated 20 January 1915.
>
> "... suitable for-(1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." (16 U.S.C. 460k-1)
>
> "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
>
> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)
>
> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

National Wildlife Refuge System Mission:

"The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

Description of Use:

While not one of the six wildlife-dependent public uses listed or identified in the National Wildlife Refuge System Administration Act, as amended (1997), horseback riding on the Dungeness NWR can facilitate wildlife observation, but is not necessary to achieve it. The Service will allow horseback use on the beach west of the point where the main trail meets Dungeness Spit (Zone 1) if a safe and legal alternate access route can be obtained from the west or from the east. If an alternate route is obtained from the east then horseback use of the administrative road from the gate separating the Refuge from the private landowner to the east to the beach will also be allowed.

Availability of Resources

Costs to provide for horseback riding, including operation of a reservation system, signing, required trail maintenance, and monitoring will be moderate. If access from the east is obtained in the future then a new entrance/fee area will need to be developed including signage and a fee collection point. Monitoring costs will be covered with other public use activities. Base funding is available to cover staff costs.

Category	One Time Expenses	Recurring Expenses
Administration and management (operation of reservation system)		$1,000
Maintenance (trail and signs)	$3,000	$1,000
Monitoring		$1,200
Special equipment, facilities, or improvements (mounting blocks, signs, development of new access entry station if access is obtained from the east at a future date)	$4,500	
Totals	**$7,500**	**$3,200**

Anticipated Impacts of the Use(s):

Impacts related to horseback riding can range from exotic plant seed dispersal (Beck 1993, Hammitt and Cole 1987) in horse coats and manures, soil compaction and erosion (Bainbridge 1974, Hammitt and Cole 1987, Hendee et al. 1990), stream sedimentation (Wilson and Seney 1994), trail widening (Whittaker 1978), vegetation trampling (Nagy and Scotter 1974, Weaver and Dale 1978, Whittaker 1978), aesthetic concerns relative to horse manure (Lee 1975), and direct wildlife disturbance (Owen 1973), to direct and indirect conflicts with other recreationists.

Impacts to Wildlife and Habitat:

Possible biological impacts of horseback riding include disturbance to wildlife and habitat. Wildlife can be affected through the sight and sound of recreationists (Boyle and Samson 1985). Some of the effects of disturbance to wildlife from recreational activities include changes in foraging behavior; reduction of productivity; abandonment or alteration of breeding territories; alteration of animal

distribution; alteration of flight behavior; energy depletion; and disruption of nest and brood rearing attentiveness (Klein 1989, Knight and Skagen 1988).

Wildlife disturbance relative to horseback riding has been poorly studied, with most references using other activities such as hiking and cross-country skiing to infer horseback riding impacts. Only one study identified disturbance tolerance of waterfowl to horseback riders and found that horseback riders could approach geese up to a distance of 150 feet. This is compared to suggested hiking trail distances of 250 feet (Miller et al. 1998) and boat buffers ranging from 250 to 900 feet (depending on type of boat, whether motorized, and species impacted; Burger et al. 1999). The 150-foot approach distance offered by Owen (1973) is consistent with observations suggesting that horseback wildlife observers can approach wildlife at closer distances than through other forms of travel. However, any form of approach is expected to cause some disturbance, which will vary according to the species affected and the type, level, frequency, and duration of disturbance, as well as the habitat type and time of day or year that it occurs.

In addition to direct impacts to wildlife, habitat can be affected through vegetation trampling, soil compaction and erosion (Cole 1983, Cole 1990). Impacts from vegetation trampling can lower species richness, decrease ground cover and density of plant species, increase species diversity through an increase in weedy annuals, and induce changes in species composition (Bonanno 1992, Bright 1986, Grabherr 1983).

Exotic plant establishment is further facilitated by increased soil disturbance, as many exotic plants gain a competitive advantage in highly disturbed sites; hoof action tends to dig up and puncture the soil surface (McQuaid-Cook 1978). This can also increase the spread of previously established exotics by providing loose, disturbed soil for germination and spreading reproductive plant structures.

Refuge-specific Impacts

A primary concern in allowing any public use on Dungeness NWR is to maintain adverse impacts within acceptable limits. Potential impacts of horseback riding include conflicts between user groups, exotic plant establishment, and wildlife disturbance. Conflicts with non-equestrian users may occur as some users are not comfortable around horses and may even perceive them as dangerous. Noxious weeds could be spread into upland habitat from horse droppings. Horseback riding on Dungeness NWR has the potential of impacting marine mammal, shorebird, and other migratory bird populations feeding and resting on the beach during certain times of the year. The extent of impacts from horseback riding on the west beach (Zone 1) varies by season. During the summer months, seal pups on the beach and bluff nesting guillemots may be disturbed. Throughout the year, shorebirds and gulls may be disturbed and displaced.

Due to the potential for horseback riding to adversely affect refuge resources and other refuge visitors, a variety of stipulations will be enacted to minimize impacts. The stipulations pertaining to timing, space, pace of use, and waste removal also will ensure proper control of the uses and provide management flexibility should detrimental impacts develop. Disturbances to wildlife and habitat will be minimized by limiting horseback riding to the beach west of Dungeness Spit (Zone 1).

Overall, disturbances on the beach to the west of where the main trail meets the beach are expected to result in minor impacts to resident wildlife and other refuge users, due to the low volume and seasons of use.

Public Review and Comment:
In the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR, the Service proposed to discontinue allowing horseback riding due to safety concerns. The Service received numerous comments and suggestions over the course of our 90-day public review and comment period in response to our proposal to discontinue horseback riding, the results of which are this revised proposal for horseback riding and compatibility determination.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

- Zone 1- (west beach) – Horseback riding will be permitted by reservation only through the Complex office and riders will be required to obtain an entrance permit.
- Additional permits may be required in the future if the reservation system is not sufficient.
- Depending on demand, the number of parties per day may be limited to prevent overcrowding and ensure public safety.
- Party size will be limited to no more than 4 horses to reduce potential conflicts with pedestrians.
- Horses must walk (no trotting, cantering or galloping) while on refuge areas open to horse use.
- Pedestrians have the right of way.
- If access is gained from the east, equestrians would be required to remove manure from the service road.
- Horseback riding daily October 1 through March 31 and weekdays April 1 through September 30. No horseback riding on Memorial Day, the Fourth of July, or Labor Day.
- The response of wildlife and visitors to this public use activity will be monitored and evaluated to measure the effectiveness of the program in meeting refuge purposes. If monitoring reveals that levels of use or associated impacts exceeds those envisioned in the compatibility determination, the use will be re-evaluated and modified to ensure it remains compatible or terminated if found not compatible.

Justification:
Facilitating this use on the Refuge will increase visitor knowledge and appreciation of fish and wildlife resources. This enhanced understanding will foster increased public stewardship of natural resources and support for the Service's management actions in achieving the refuge purposes and the mission of the National Wildlife Refuge System.

Allowing use on only the west beach (Zone 1) should reduce conflicts between user groups as this area historically sees limited public use. Although horseback riding can result in disturbance to wildlife, disturbance is expected to be intermittent, short-term and limited in time and space. There is more than an adequate amount of undisturbed habitat available to the majority of wildlife for escape and cover. The relatively limited number of individuals expected to be adversely affected by horseback riding will not cause wildlife populations to materially decline, the physiological condition and production of wildlife species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus,

allowing horseback riding under the stipulations will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the Refuge was established.

Mandatory Re-Evaluation Date:

_____ Mandatory 15-year re-evaluation date (wildlife-dependent public uses)

__X__ Mandatory 10-year re-evaluation date (uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

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Beck, K.G. 1993. How do weeds affect us all. Proceedings of the Eighth Grazing Lands Forum. Washington, District of Columbia. December 2, 1993, pages 5-13.

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Burger, J., B. Harrington, J. Rodgers, and H. Smith. 1999. Minimum recommended set-back (RS) distances for various disturbances approaching directly towards waterbirds to prevent flushing.

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Hammitt, W.E., and D.N. Cole. 1987. Wildland Recreation: Ecology and Management. John Wiley and Sons, New York, New York. 341 pages.

Hendee, J.C., G.H. Stankey, and R.C. Lucas. 1990. Wilderness Management. North American Press, Golden, Colorado.

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Knight, R.L., and S.K. Skagen. 1988. Effects of recreational disturbance on birds ofprey: A review. Pages 355-359 in Proceedings ofthe Southwest Raptor Management Symposium Workshop. National Wildlife Federation, Washington, District of Columbia.

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Refuge Determination:

Prepared by: _____ (Signature) 04/19/2013 (Date)

Acting Refuge Manager/ Project Leader Approval: _____ (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: _____ (Signature) 4/23/13 (Date)

Regional Chief, National Wildlife Refuge System: _____ (Signature) 4-23-13 (Date)

Compatibility Determination

Use: Jogging

Refuge Name: Dungeness National Wildlife Refuge

County and State: Clallam County, Washington

Establishing and Acquisition Authorities:

- Executive Order 2123, Dungeness Spit Reservation for Protection of Native Birds, signed 20 January 1915
- Tidelands of the second class were conveyed to the United State of America, U.S. Fish and Wildlife Service, from the State of Washington through a permanent easement on May 29, 1943, (Deed No. 18251 App. No. 10585), under the authority described in Section 152, Chapter 255, State of Washington Laws of 1927.
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j) as amended
- Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4)
- Endangered Species Act of 1973

Refuge Purpose(s):
The purposes for the Dungeness NWR have been identified in historic legal documentation establishing and adding refuge lands. The Refuge was originally established to preserve important habitat for native birds with refuge purposes specified as follows:

> "…as a refuge, preserve, and breeding ground for native birds." (Executive Order 2123 dated 20 January 1915.
>
> "... suitable for-(1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." (16 U.S.C. 460k-1)
>
> "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
>
> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)
>
> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

In accordance with 601 FW 1, all lands acquired since the original establishment of the Refuge retain these purposes.

National Wildlife Refuge System Mission:

> "The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

Description of Use:

While not one of the six wildlife-dependent public uses listed or identified in the National Wildlife Refuge System Administration Act, as amended (1997), jogging is an existing use on the Dungeness NWR. Jogging will be limited to the trail adjacent to the refuge parking lot (parking lot trail, approximately 0.2 mile) and along the west beach from the end of the upland forested trail to the western boundary of the Refuge (west beach, Zone 1, approximately 0.5 mile). The parking lot trail connects the bluff and horse trails within Dungeness County Park. Organized running groups and special events such as practice meets will be prohibited. Groups will be limited to 3 people or less on the parking lot trail due to the confined nature of the trail. Restrictions on this activity will be clearly posted at the refuge kiosk adjacent to the parking lot and in the refuge brochure and website.

Jogging occurs year-round on the Refuge with the majority of use observed from spring through fall. Although jogging is primarily athletic in nature, it is likely that some joggers observe and enjoy wildlife while on the Refuge. Anecdotal evidence indicates that total use by joggers in appropriate areas is minor. However, refuge staff, volunteers and visitors have observed jogging in sections of the Refuge in which this use is not allowed due to disturbance of wildlife and conflicts with refuge visitors.

Availability of Resources

Costs to administer jogging, including signage, required trail maintenance, enforcement of regulations, and the monitoring of public use and biological impacts will be moderate. The direct costs for trail and sign maintenance associated with this activity will be minimal as costs will be covered along with other public use activities. Base funding is available to cover staff costs and sufficient funds and staff are available to manage the activity.

Category	One Time Expenses	Recurring Expenses
Maintenance (trail and signs)	$2,000	$750
Monitoring		$1,200
Totals	**$2,000**	**$1,950**

Anticipated Impacts of the Use(s):

Impacts to Wildlife (Disturbance):

Immediate responses by wildlife to recreational activity can range from behavioral changes including nest abandonment or change in food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995). The long-term effects are more difficult to assess but may include altered behavior, vigor, productivity or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions. Knight and Cole (1991) found that wildlife responses to human disturbance include avoidance, habituation, and attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the habitat type, time of day, time of year, weather; the animal's access to food

and cover, energy demands, and reproductive status (Knight and Cole 1991, Gabrielsen and Smith 1995).

Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of birds to human activities includes departure from site (Owens 1977, Burger 1981, Korschgen et al. 1985, Henson and Grant 1991, Klein 1993, Taylor and Knight 2003), use of suboptimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

The locations and timing of recreational activities impact species in different ways. Miller et al. (1998) found that nesting success was lower near recreational trails where human activity is common, than at greater distances from the trails. A number of species have shown greater reactions when pedestrian use occurred off trail (Miller et al. 1998, Taylor and Knight 2003). In regard to waterfowl, Klein (1989) found migratory dabbling ducks to be the most sensitive to disturbance, and migrant ducks to be more sensitive when they first arrived in the late fall, than later in winter. Burger (1981) found that migratory shorebirds showed the most sign of disturbance by flushing out of the area entirely, while resident gulls were least disturbed and were only temporarily displaced. For songbirds, Gutzwiller et al. (1997) found that singing behavior of some species was altered by low levels of human intrusion.

Jogging can impact normal wildlife behavioral activities, including feeding, reproductive, and social behavior. Studies have shown that waterfowl and shorebirds are sensitive to jogging activity (Burger 1981, Burger 1986). Rapid movement by joggers is more disturbing to wildlife, than slower moving hikers (Bennett and Zuelke 1999, Burger 1981). Movement away from or at an oblique angle to wildlife is less disturbing than a direct approach (Knight and Cole 1991).

The impacts of jogging, as conducted on Dungeness NWR, have not been studied in detail. However, jogging can impact marine mammal, passerine, shorebird, waterfowl and other migratory bird populations feeding and resting on the beach, bluff, or near trails. The extent of impacts from jogging to refuge wildlife would vary by season. For example, during the summer months seal pups on the beach may be disturbed and resting shorebirds and gulls displaced.

Potential Conflicts between User Groups: Moore (1994) concluded that trail conflicts can occur among different user groups, among users within the same user group, and as a result of factors not related to trail user activities at all. Conflict has been found to be related to activity style, focus of trip, expectations, attitudes toward and perceptions of the environment, level of tolerance for others, and different norms held by different users. Compatible wildlife-dependent activities such as wildlife watching, photography, and environmental education, may be negatively affected because of the expected responses by wildlife to joggers approaching or passing by. When wildlife react by moving away from or alter behavior by hiding, they are less likely to be observed (Bennett and Zuelke 1999). This loss of an anticipated quality wildlife-dependent experience could result in avoidance of the Refuge by wildlife watchers and photographers who encounter joggers using the same areas.

Impacts of jogging have been reported from refuge staff, volunteers and visitors including wildlife disturbance on the forested trail and beach as well as conflicts between user groups. The number of encounters that create conflict is unknown. Measures to reduce potential conflicts between other user groups will include providing information at the refuge kiosk adjacent to the parking lots and in the refuge brochure and website that clearly indicates permitted uses and rules of conduct.

Overall Impact to Dungeness NWR: The studies cited above show that public use activities can and do disturb wildlife. Based on the circumstances described in the scientific literature as well as reports from staff, volunteers and visitors, similar effects are occurring on Dungeness NWR. A primary concern in allowing any public use on Dungeness NWR is to maintain adverse impacts within acceptable limits. Korschgen and Dahlgren (1992) and Fox and Madison (1997) state the importance of disturbance-free food reserves and areas as a management alternative to minimize human disturbances. The Refuge has several areas which are removed from human activity and support high use by aquatic birds and marine mammals including Graveyard Spit and the tip of Dungeness Spit.

We will allow jogging only on the trail adjacent to the parking lot and the west beach since these areas receive less overall wildlife use compared with other sections of the Refuge and conflicts with other visitors, primarily engaged in wildlife-dependent activities, will be limited. Therefore, we anticipate the impacts on wildlife and wildlife-dependent public use from jogging in these areas to be minor.

Jogging will not be allowed on the forested trails leading down to the beach because the higher speed of joggers, combined with short sight distances on confined wooded trails, creates unsafe conditions for both joggers and other refuge visitors (e.g., families with baby strollers, people with limited agility and mobility). Special running events and team training will not be allowed since group size has been found to increase wildlife response to disturbance (Geist et al. 2005, Yosef 2000) and group events can cause conflicts with other visitors on confined wooded trails. Restricting group size to a maximum of 3 and educating the public on the effects of recreation on wildlife and habitat will further reduce impacts to wildlife and reduce conflicts with other refuge visitors.

Enforcement of regulations and imposed fines may also minimize visitor disturbance to wildlife (Knight and Gutzwiller 1995). If a pattern of violation is demonstrated which results in jogging becoming a non-compatible activity (i.e. wildlife disturbance or impacts on wildlife-dependent public use) this use will be reevaluated and may be eliminated.

Public Review and Comment:
In the Draft Comprehensive Conservation Plan and Environmental Assessment for Dungeness NWR, the Service proposed to discontinue allowing jogging on the Refuge due to wildlife disturbance concerns. The Service received numerous comments and suggestions over the course of our 90-day review and comment period in response to our proposal to discontinue jogging, the results of which are this revised proposal for jogging and compatibility determination.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

- Jogging will only be allowed on the trail adjacent to the parking lot and west beach (Zone 1). This activity will not be allowed on any other part of the Refuge.
- Use is restricted to daylight hours only.

- Organized running groups and running events will be prohibited. Groups will be limited to three people or less along the parking lot trail.
- Compliance, levels of use, and impacts associated with the use will be monitored to ensure that it remains compatible. Monitoring will evaluate impacts of the use upon fish, wildlife, plants, habitats, and wildlife-dependent public uses.
- If monitoring reveals that levels of use or associated impacts exceed those envisioned in the compatibility determination, the use will be re-evaluated and modified to ensure it remains compatible or terminated if found not compatible.

Justification:
Although jogging is not a wildlife-dependent public use of the Refuge, as defined by statute (16 U.S.C. 668dd et seq.), it is likely that some joggers observe and enjoy wildlife while on the Refuge. Occasional use of the west beach and parking lot trail is expected to have negligible impacts on wildlife or wildlife-dependent public uses. Potential for wildlife disturbance is minimal given the low level of use by wildlife and refuge visitors in these areas. In addition, conflicts between joggers and wildlife-dependent public uses are expected to be low due to the low use of the west beach and parking lot trail by wildlife and subsequent low expectations of visitors to encounter wildlife in these areas.

It is anticipated that wildlife populations will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened from allowing jogging on the west beach and parking lot trail. The relatively limited number of individuals expected to be adversely affected due to jogging will not cause wildlife populations to materially decline; the physiological condition and production of wildlife species will not be impaired; their behavior and normal activity patterns will not be altered dramatically; and their overall welfare will not be negatively impacted. Allowing jogging on specified areas of the Refuge where conflicts with other refuge visitors would be limited will allow joggers to experience the Refuge safely. Thus, allowing jogging to occur with stipulations will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System mission.

Mandatory Re-Evaluation Date:

_____ Mandatory 15-year re-evaluation date (wildlife-dependent public uses)

__X__ Mandatory 10-year re-evaluation date (uses other than wildlife-dependent public uses)

NEPA Compliance for Refuge Use Decision: (check one below)

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X__ Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

References:

Belanger, L., and Bedard J. 1990. Energetic cost of man-induced disturbance to staging snow geese. Journal of Wildlife Management 54(1), 36-41.

Bennett, K.A. and E. Zuelke. 1999. The effects of recreation on birds: a literature review. Delaware Natural Heritage Program. Smyrna, DE.

Boyle, S.A. and Samson, F.B. 1985. Effects of non-consumptive recreation on wildlife: A review. Wildlife Society Bulletin 13 (2) 110-116.

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Refuge Determination:

Prepared by: _____ (Signature) 04/19/2013 (Date)

Acting Refuge Manager/ Project Leader Approval: _____ (Signature) 04/19/2013 (Date)

Concurrence:

Refuge Supervisor: _____ (Signature) 4/23/13 (Date)

Regional Chief, National Wildlife Refuge System: _____ (Signature) 4-23-13 (Date)

Appendix C. Implementation

C.1 Introduction

Implementation of the comprehensive conservation plan (CCP) will require increased funding, which will be sought from a variety of sources including Congressional allocations and public and private partnerships and grants. There are no guarantees that additional federal funds will be made available to implement any of these projects. Other sources of funds will need to be obtained, both public and private. Activities and projects identified will be implemented as funds become available.

The CCP identifies several projects to be implemented over the next fifteen years. Most of these projects are included in the Refuge Operational Needs System (RONS - new staff), or Service Asset Maintenance and Management System (SAMMS - deferred maintenance projects) which are used to request funding from Congress. Visitor Facility and Enhancement (VFE) projects considered for funding must be requested through the Branch of Visitor Services. Currently, a large backlog of maintenance needs exists for Dungeness NWR. In 2008, the deferred maintenance backlog for Dungeness NWR was $1,156,000, with more projects needing to be added. An attempt at reducing this backlog needs to be addressed and is included here in the analysis of funding needs. Prioritized staffing needs identified in the RONS will be necessary to implement the CCP to meet refuge goals and objectives and legal mandates. The SAMMS database documents and tracks repairs, replacements, and maintenance of facilities and equipment. Smaller projects will be implemented as funding allows, and funding will be sought for these projects through a variety of sources.

Annual revenue sharing payments, associated with Dungeness NWR in Clallam County will continue. The total payment made in 2010 was $7,967 for 213 acres of refuge lands. In addition Dungeness NWR leases from Clallam County the public restroom and parking lots located adjacent to the main trail entrance for $1,800 a year.

Monitoring activities will be conducted on a percentage of all new and existing projects and activities to document wildlife populations and changes across time, habitat conditions, and responses to management practices. Actual monitoring and evaluation procedures will be detailed in step-down management plans. General monitoring activities are discussed in Chapter 2 under Goal 4, which addresses the collection of scientific information (inventories, monitoring, feasibility studies, assessments, and research) to support adaptive management decisions on Dungeness NWR.

C.2 Step-Down Plans

The Comprehensive Conservation Plan is one of several necessary plans used by managers, biologists, and staff for refuge management. The CCP provides guidance in the form of goals, objectives, and strategies for several refuge program areas but may lack some of the specifics needed for implementation. Step-down management plans will be developed for individual program areas within approximately 5 years after CCP completion. All step-down plans require appropriate NEPA compliance and implementation may require additional county, state and federal permits. Project-specific plans, with appropriate NEPA compliance, may be prepared outside of these step-down plans. Step-down plans for the Refuge follow in Table C-1.

Table C-1. Dungeness NWR Step-down Management Plans

Step-Down Management Plan	Status (Date Completed and/or Date to be Prepared/Updated)
Habitat Management Plan (HMP)	CCP meets requirement for HMP
Forest Management Plan	Prepare by 2018
Integrated Pest Management Plan	Prepared concurrently with CCP, Appendix G
Fire Management Plan	Complex-wide plan in draft concurrent with CCP
Visitor Services Plan	Initiate planning after completion of CCP
Inventory and Monitoring Plan	Initiate planning after completion of CCP

C.3 Costs to Implement CCP

The following sections detail both one-time and recurring costs for various projects as described within the CCP. One-time costs reflect the initial costs associated with a project, whether it is purchase of equipment, contracting services, construction, a research project, or other activity. Recurring costs reflect the future operational and maintenance costs associated with the project. The following tables primarily document projects with a physically visible, trackable "on-the-ground" component, such as facilities, habitat restoration, research, and monitoring and surveys. The scope and costs for "administrative" activities such as the development and implementation of cooperative documents (e.g., memorandum of understanding, agreements), reporting, and establishment of partnerships are difficult to estimate in advance and thus are not accounted for in the tables below.

C.3.1 One-time costs

One-time costs are project costs that have a start-up cost associated with them, such as purchasing a new vehicle for wildlife and habitat monitoring, or designing, constructing and installing an interpretive sign. Some cost estimates are for projects that can be completed in three years or less. One-time costs can include the cost of temporary or term salary associated with a short-term project. Salary for existing and new positions, and operational costs, are reflected in operational (or recurring) costs.

Funds for one-time costs will be sought through increases in refuge base funding, special project funds, and grants. Projects listed below in Table C-2 show one-time start-up and implementation costs, such as those associated with building and facility needs including removal of old buildings, replacement of buildings, public use facilities, road/trail improvements, and new signs. One-time costs are also associated with projects such as habitat restoration, invasive plant and animal control, and research. In many cases, new research projects, because of their relatively high initial establishment cost, are considered one-time projects and include costs of contracting services or hiring a temporary staff position for the short-term project. Some project costs are taken from RONS or SAMMS proposals; others are not yet in any project database and their costs have been estimated, particularly if the scope of the project is unknown at this time due to lack of baseline data.

Table C-2. One-Time Costs (in thousands) for Research and Assessments; Inventories, Surveys, and Monitoring, Habitat Management and Restoration, Facilities and Public Use-Related Actions

Project Description	Priority	Type	Current Management	Future Management	Potential Fund Source
Research					
Study the value of salt marsh habitat in Graveyard Spit as a nursery area for crab and salmon	Low	Study	0	5	1260 funds, grants, partnerships
Study driftwood recruitment and removal rates within the barrier beach and salt marsh habitats	Low	Study	0	10	1260 funds, grants
Study climate change impacts to natural spit habitats	High	Study	0	200	1260 funds, grants
Study microhabitat characteristics to track changes in distribution and diversity of plant species in the Graveyard RNA	Medium	Study	0	15	1260 funds, grants
Study eelgrass distribution and density in Dungeness Harbor and Bay.	High	Study	0	35	1260 funds, grants, partnerships
Study habitat quality (water quality, forage fish abundance and distribution and micro and macro invertebrate abundance and distribution of mud flat habitat.	Medium	Project	0	30	1260 funds, grants, partnerships
Subtotal (thousands)				**295**	
Surveys and assessments					
Assess abundance and distribution of Lepidopterans on Dungeness and Graveyard spits	High	Project	0	8	ESA funds, grants
Conduct forest assessment	High	Project	0	20	1260 funds

Project Description	Priority	Type	Current Management	Future Management	Potential Fund Source
Conduct road inventory and assessment (Dawley Unit)	Low	Project	0	5	1260 funds
Conduct wetland inventory and hydrological assessment	Medium	Project	0	20	1260 funds
Conduct baseline breeding bird survey of forest habitat	Medium	Survey	0	3	1260 funds, partnerships
Conduct baseline amphibian and bat surveys	Medium	Survey	0	7	1260 funds, partnerships
Conduct baseline aquatic species survey of refuge reach of Dean Creek	Medium	Survey	0	2	1260 funds, partnerships
Assess habitat suitability for anadromous and resident fish of refuge reach of Dean Creek	Medium	Project	0	2	1260 funds, partnerships
Subtotal (thousands)			**0**	**67**	
Habitat management and restoration					
Map bathymetry of impoundment (Dawley)	Medium	Project	0	7	1260 funds
Develop step-down forest management plan	High	Project	0	33	
Remove small dump site (Dawley)	Low	Project	0	5	1260 funds
Slide stabilization on main forest road (Dawley)	High	Project	0	90	1260 funds
Rehabilitate unneeded logging spur roads (Dawley)	Low	Project	0	22	1260 funds
Install new water control structure and water gauge at impoundment (Dawley)	Medium	Project	0	12	1260 funds
Remove USCG road access dike at base of Dungeness Spit if determined to be on refuge lands	Medium	Project	0	45	1260 funds
Rehabilitate road to beach house (Dawley)	High	Project	0	90	1260 funds
Subtotal (thousands)			**0**	**304**	

Project Description	Priority	Type	Current Management	Future Management	Potential Fund Source
Facilities					
Remove and replace caretaker cabin at Dungeness (Mellus cabin)	High	Project	0	350	1260 funds Deferred Maintenance (DM)
Replace caretaker cabin septic system and decommission old system	High	Project	0	18	1260 funds (DM)
Remove beach house (Dawley) and decommission septic system	Medium	Project	0	45	1260 funds (DM)
Remove mobile home, associated shed and decommission septic system (Dawley)	Medium	Project	0	12	1260 funds (DM)
Remove rental house and decommission septic system (Dawley)	Medium	Project	0	32	1260 funds (DM)
Remove large wooden shed (Dawley)	Low	Project	0	8	1260 funds (DM)
Replace dock (Dawley)	Low	Project	0	85	1260 fund (DM)
Subtotal (thousands)			**0**	**550**	
Public Use					
Design, construct and install information and map panels at Cline Spit and Dungeness Landing	High	Project	0	12	8081 funds.
Design, construct and install interpretive panels at New Dungeness Light Station	Medium	Project	0	15	8081 funds
Design, construct and install climate change interpretive panel at main trail kiosk	Medium	Project	0	10	8081 funds
Develop cultural and environmental education materials for use on the Refuge and in the classroom	Low	Project	0	15	1260 funds, grants
Subtotal (thousands)			**0**	**52**	
Total of all one-time project costs				**1,268**	

C.3.2 Annual Operational (Recurring) Costs

Operational costs reflect refuge spending of base funds allocated each year. These are also known as recurring costs and are usually associated with day-to-day operations and projects that last longer than three years. Operational costs use base funding in Service fund code 1260. Table C-3 displays projected annual operating costs to implement strategies under the CCP. The CCP will require increased funding for new or expanded public uses and facilities, habitat management and restoration activities, and new monitoring needs. This table includes such things as salary and operational expenditures such as travel, training, supplies, utilities, and maintenance costs. Project costs listed in Table C-3 include administrative support for all programs and projects as well as permanent and seasonal staff needed year after year to accomplish each project; these staffing costs are not isolated in this table but are included as part of the entire project cost.

Table C-3. Annual Operational (recurring) costs

Activity Description	Current Management Cost est. (K)	Future Management Cost est. (K)	Potential Fund Source
Research: Facilitate and cooperate in specific research projects to benefit refuge resources	7	**15**	1260, Special Projects, Grants
Surveys and assessments: Aerial, boat-based and land survey and assessments; joint wildlife surveys with WDFW; continue GIS-based inventory and monitoring programs for plants and wildlife; derelict fishing gear surveys; creosote log deposition surveys; invasive species monitoring; monitor biodiversity trends; provide administrative and material support for all biological activities.	25	**35**	1260 and special project funds
Habitat management and restoration: Inventory, remove, prevent establishment of, and control invasive plants. Treat infestations with IPM; implement silvicultural practices outlined in step-down forest management plan.	35	**145**	1260 and special project funds
Facilities maintenance: Maintain and make minor repairs on refuge infrastructure and facilities, equipment, vehicles, boats and interpretive and regulatory signs.	100	**140**	1260
Public use opportunities and education: Provide funding for and manage a variety of both on-refuge and off-refuge interpretive and education programs; maintain interpretive panels located on and off the Refuge to offer interpretation through self-guided experience; conduct and manage volunteer program; patrol, enforce regulations and educate visitors to the sensitivity of wildlife resources, replace boundary and regulatory signage as needed.	130	**200**	1260, 8081
Total Recurring Costs	**297**	**535**	

C.3.3 Maintenance Costs

The refuge maintenance program funding need over the next 15 years is defined as funds needed to repair or replace buildings, equipment, and facilities. Maintenance actions include preventative maintenance; cyclic maintenance; repairs; replacement of parts, components, or items of equipment; adjustments, lubrication, and cleaning (non-janitorial) of equipment; painting; resurfacing; rehabilitation; special safety inspections; and other actions to assure continuing service and to prevent breakdown. Maintenance costs include the maintenance "backlog" needs that have come due but are as yet unfunded, as well as the increased maintenance need associated with new facilities

The facilities associated with Dungeness NWR that require maintenance include trails, kiosks, interpretive panels, regulatory signs, roads, parking lots, fencing, public restroom, caretaker cabin and administrative office, shop and garage buildings. Major equipment includes boats, vehicles, tractors, ATVs, and generators. Approximately 65% of operational (non-project) maintenance funding for the Washington Maritime NWR Complex is expended on Dungeness NWR including the Complex headquarters facilities (also see Table C-3); the other approximately 35% is used to maintain facilities, including buildings and equipment, which are located on, or support, the other three Complex Refuges and are not included in this Implementation Plan.

C.3.4 Staffing

Current (2012) staffing and future staffing to implement the programs detailed within the CCP are shown in Table C-4. Current positions serve all six refuges within the Washington Maritime NWR Complex; because there is no separate budget for the individual refuges, we have chosen to present the entire Complex staff in Table C-4. Approximately 55% Complex staff time is expended on Dungeness NWR; the other approximately 45% of staff time is expended on the other five refuges in the Complex. The new position (Environmental Education/Outreach Specialist) will work 70% of the time on Dungeness NWR and the rest of the time on the other refuges in the Complex.

Table C-4. Current and Future Staffing

Current Position	**Status**	**GS & Grade**	**Annual Salary* Cost (K)**	**Annual Salary* (K) x 55%**
Project Leader	PFT	GS-0485-12	107.5	59.1
Deputy Project Leader	PFT	GS-0485-11	91.1	50.1
Wildlife Biologist	PFT	GS-0486-11	87.8	48.3
Park Ranger	PFT	GS-025-09	78.3	43.1
Maintenance Worker	PFT	WG-4749-08	81.7	44.5
Office Automation Clerk	PFT	GS-0326-04	40.5	22.3
Future Position				**Annual Salary (K) x 70%**
Environmental Education/Visitor Services Specialist	PFT	GS-1001-7/9	52.3	36.6
Total current and future staffing costs				**304**

* = salary and benefits
PFT: Permanent Full Time
GS: General Schedule Federal Employee
WG: Wage Grade Federal Employee

C.3.5 Budget Summary

Table C-5 summarizes the data from Tables C-2 and C-3 and displays the overall funding needed for the Washington Maritime National Wildlife Refuge Complex to implement the CCP for Dungeness NWR.

Table C-5. Budget Summary (One-time projects and annual funding needs for Dungeness NWR as identified in the CCP)

Budget Category	Current Management		Future Management	
	One-time cost (K)	Annual recurring cost (K)	One-time cost (K)	Annual recurring cost(K)
Research	-	7	295	15
Surveys and assessments	-	25	67	35
Habitat management and restoration	-	35	304	145
Facilities and maintenance	-	100	550	140
Public use opportunities and education	-	130	52	200
Totals	**-**	**297**	**1,268**	**535**

C.4 Partnership Opportunities

Partnerships are an important component of the implementation of this CCP and are reflected in the goals, objectives, and strategies identified in Chapter 2. The Refuge's location (Olympic Peninsula) facilitates many opportunities for partnerships. Current and past partners include federal and state agencies, Tribes, non-governmental organizations, schools volunteers, and individuals.

Coordinated partnerships efforts will focus on habitat restoration, land protection, environmental education, fish and wildlife monitoring, outreach, and quality wildlife-dependent recreation. Refuge Complex staff will work to strengthen existing partnerships and will actively look for new partnerships to assist in achieving the goals, objectives, and strategies in this CCP.

Jamestown S'Klallam Tribe
The Service has a close working relationship with the Tribe. The Tribe and the Service have collaborated on a number of projects including addressing water quality issues in Dungeness Harbor and Bay. The Service will partner with the Jamestown S'Klallam Tribe and other interested Tribes to deliver education and interpretation programs and materials that focus on the Refuge and area Native American culture. In addition, the Service will partner with interested Tribes for cultural resources inventory, evaluation, and project monitoring, consistent with the regulations of the National Historic Preservation Act.

U. S. Coast Guard (USCG)
The Service will coordinate with the USCG on transfer of the New Dungeness Light Station to the U.S. Fish and Wildlife Service. As part of that transfer the Service will work with the USCG on any unresolved contaminants issues concerning the lighthouse site.

National Oceanic and Atmospheric Administration
National Oceanic and Atmospheric Administration – Fisheries conducts research and monitors marine mammals in the Salish Sea. These activities are managed under a Special Use Permit when conducted on refuge lands and have involved Steller's sea lions, elephant seals, and harbor seals

National Park Service
The Service will partner with Olympic National Park (ONP) on developing and presenting consistent and complementary interpretive material and programs on climate change to visitors and local community members. The Service will formalize an agreement with ONP for support on wildfires for initial attack resources.

U.S. Forest Service
Forest Service personnel from the Olympic National Forest Service staff participated in the preliminary CCP planning phase with several site visits to the forested habitat. The Service will consult with the Olympic National Forest as we develop the Forest Management Plan.

Washington Department of Fish and Wildlife (WDFW)
WDFW's management responsibilities including lands and waters, fish and wildlife, threatened and endangered species and other programs, frequently overlap with USFWS resources and responsibilities. The WDFW and other state agencies are in a unique position to greatly assist the Service in protecting sensitive seabirds and pinnipeds from human disturbance in close proximity to the Complex Refuges. The Service and WDFW share mutual interests in species management, wildlife surveys, developing joint research projects, and education and outreach programs. The WDFW has been closely involved with the Service in waterfowl surveys, pinniped surveys, black oystercatcher and pigeon guillemot surveys, forage fish spawning beach surveys and review of Service's projects in the marine environment.

Washington Department of Ecology (WDOE)
One of Washington Department of Ecology's programs is spill prevention, preparedness, and response. This program focuses on prevention of oil spills to Washington State waters and land, as well as planning for an effective response to oil and hazardous substance spills whenever they occur. The Service will continue its partnership with WDOE in support and maintenance of a regional contingency plan that guides how spills are managed in the Northwest; and in the development and periodic review of Geographic Response Plans.

Washington Department of Natural Resources (WDNR)
Washington Department of Natural Resources has monitored eelgrass in the Salish Sea for a number of years using a variety of techniques including videography. The Service will partner with them for monitoring eelgrass beds in Dungeness Harbor and Bay. In addition, the Refuge will consult with them as we develop the Forest Management Plan. The Refuge uses WNDR's Olympic Region as a dispatching resource for wildfires on the Refuge.

Clallam County
The Service will continue its cooperative relationship with Clallam County Parks on management of the Dungeness Recreation Area that lies immediately adjacent to Dungeness NWR and which refuge visitors must pass through to access the Refuge. The Service leases County property for parking lots and a public restroom at the refuge entrance. In addition, the Service will continue to work with Clallam County Department of Health and Human Services' Division of Environmental Health on water quality issues in Dungeness Harbor and Bay.

Clallam County Marine Resources Committee (MRC)
The Service has partnered with the MRC for a number of years as the Refuge and its resources are important components of the marine ecosystem of the Strait of Juan de Fuca and the Salish Sea. Removal of derelict fishing gear (crab pots) and survey of eelgrass beds in Dungeness Harbor and Bay are projects the MRC has funded in the past and which the Service wishes to continue with the MRC partnership.

University of Washington (UW)
The Refuge participates in the UW's Coastal Observation and Seabird Survey Team (COASST) program. A citizen science project, COASST monitors local marine resources and ecosystem health. In addition to providing beached bird data to the Refuge, these volunteers also act as an "early warning system" to alert the Refuge to any unusual or catastrophic marine events.

Olympic Peninsula Audubon Society (OPAS)
Olympic Peninsula Audubon Society has partnered with the Service on a number of important projects. Members of OPAS assist with the annual Christmas Bird Count and the Refuge's participation in Cornell Lab of Ornithology Feeder Watch program. Breeding bird surveys have also been conducted by OPAS members.

New Dungeness Light Station Association
The New Dungeness Light Station is maintained and operated by the New Dungeness Light Station Association, a non-profit historical organization, under an agreement with the U.S. Coast Guard (USCG). The Association offers light house tours and interpretation every day of the year. In the event that the USCG declares the light station property excess to its needs, the Service will work with the USCG to bring the light station property into the Refuge System. Subsequently, the Service plans to enter into an agreement with the NDLSA to continue their management and maintenance of the light station facilities.

Appendix D. Wilderness Review

D.1 Introduction

D.1.1 Refuge Overview

Dungeness National Wildlife Refuge (NWR or Refuge) consists of the Dungeness Unit, which includes the Graveyard Spit Research Natural Area (RNA), and the Dawley Unit. The Dungeness Unit was established to protect and preserve breeding grounds for native birds in 1915. Originally the Unit was part of a lighthouse reservation, on which the New Dungeness Light Station was built in 1857. Dungeness Spit is the longest sand spit in North America. Extending five miles into the Strait of Juan de Fuca, it provides habitat for a great variety of migratory shorebirds, waterfowl, marine mammals, and marine life. The waters of Dungeness Bay, with its eelgrass beds, mudflats, and tidelands provide food, shelter, and breeding grounds to support a whole ecosystem teeming with life. Large numbers of brant, wigeon, pintail, mallard and bufflehead spend their winters here. Surf smelt, herring, Pacific sand lance and other species of marine fish breed and rear within the bay. Anadromous fish such as chinook, chum, pink, coho salmon and steelhead and cutthroat trout are dependent on nearshore habitats within Dungeness Bay and Harbor during the juvenile rearing period. The bay also serves as a vital nursery area for commercially important species such as marine invertebrates (e.g., Dungeness crab) which seek these areas for refugia. The rare northern elephant seal hauls out on the spit each year. Graveyard Spit supports some of the best remaining coastal strand habitat within the Salish Sea. Upland habitats at the base of Dungeness Spit include forests and sandy bluffs.

The Dawley Unit, located along Sequim Bay, was established as a wildlife sanctuary in 1973. The residential area was heavily developed with the construction of aviaries, ponds, and gardens while the forested tract was altered by logging over the years. The forested area does have an established logging road system, but due to the topography, some areas were protected from further alterations and are considered good second growth forest habitat.

D.1.2 Policy and Direction for Wilderness Reviews

U.S. Fish and Wildlife Service policy (Part 602 FW 3.4 C. (1) (c)) requires that wilderness reviews be completed as part of the CCP process. This review includes the re-evaluation of refuge lands existing during the initial 10-year review period of the Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136), as well as new lands and waters added to the Refuge System since 1974. A preliminary inventory of the wilderness resources is to be conducted during pre-acquisition planning for new or expanded refuges (341 FW 2.4 B, “Land Acquisition Planning”). Refuge System policy on Wilderness Stewardship (610 FW 1-5) includes guidance for conducting wilderness reviews (610 FW 4 – Wilderness Review and Evaluation).

A wilderness review is the process of determining whether the Service should recommend Refuge System lands and waters to Congress for wilderness designation. The wilderness review process consists of three phases: wilderness inventory, wilderness study, and wilderness recommendation.

Wilderness Inventory
The inventory is a broad look at a refuge to identify lands and waters that meet the minimum criteria for wilderness—size, naturalness, and outstanding opportunities for solitude or primitive and unconfined type of recreation. All areas meeting the criteria are preliminarily classified as Wilderness Study Areas (WSAs). If WSAs are identified, the review proceeds to the study phase.

Wilderness Study
During the study phase, WSAs are further analyzed:

1. for all values of ecological, recreational, cultural, economic, symbolic
2. for all resources, including wildlife, vegetation, water, minerals, soils
3. for existing and proposed public uses
4. for existing and proposed refuge management activities within the area,
5. to assess the refuge's ability to manage and maintain the wilderness character in perpetuity, given the current and proposed management activities. Factors for evaluation may include, but are not limited to, staffing and funding capabilities, increasing development and urbanization, public uses, and safety.

We evaluate at least an "All Wilderness Alternative" and a "No Wilderness Alternative" for each WSA to compare the benefits and impacts of managing the area as wilderness as opposed to managing the area under an alternate set of goals, objectives, and strategies that do not involve wilderness designation. We may also develop "Partial Wilderness Alternatives" that evaluate the benefits and impacts of managing portions of a WSA as wilderness.

In the alternatives, we evaluate:

1. the benefits and impacts to wilderness values and other resources
2. how each alternative would achieve the purposes of the Wilderness Act and the National Wilderness Preservation System
3. how each alternative would affect achievement of refuge purpose(s) and the refuge's contribution toward achieving the Refuge System mission
4. how each alternative would affect maintaining and, where appropriate, restoring biological integrity, diversity, and environmental health at various landscape scales
5. other legal and policy mandates
6. whether a WSA can be effectively managed as wilderness by considering the effects of existing private rights, land status and service jurisdiction, refuge management activities and refuge uses, and the need for or possibility of eliminating Section 4(c) prohibited uses

Wilderness Recommendation
If the wilderness study demonstrates that a WSA meets the requirements for inclusion in the National Wilderness Preservation System, a wilderness study report should be written that presents the results of the wilderness review, accompanied by a Legislative Environmental Impact Statement (LEIS). The wilderness study report and LEIS that support wilderness designation are then transmitted through the Secretary of the Interior to the President of United States, and ultimately to the United States Congress for action. Refuge lands recommended for wilderness consideration by the wilderness study report will retain their WSA status and be managed as "… wilderness according to the management direction in the final CCP until Congress makes a decision on the area or we amended the CCP to modify or remove the wilderness recommendation" (610 FW 4.22B). When a WSA is revised or eliminated, or when there is a revision in "wilderness stewardship direction, we include appropriate interagency and tribal coordination, public involvement, and documentation of compliance with NEPA" (610 FW 3.13).

D.1.3 Criteria for Evaluating Lands for Possible Inclusion in the National Wilderness Preservation System

The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136), provides the following description of wilderness:

"A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act as an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions..."

The following criteria for identifying areas as wilderness are outlined in Section 2(c) of the Act and are further expanded upon in Refuge System policy (610 FW 4). The first three criteria are evaluated during the inventory phase; the fourth criterion is evaluated during the study phase.

1. Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
2. Has outstanding opportunities for solitude or a primitive and unconfined type of recreation;
3. Has at least five thousand acres of land or is of a sufficient size as to make practicable its preservation and use in an unimpaired condition; and
4. May also contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

Criterion 3 is further defined in Section 3(c) of the Act as 1) a roadless area of 5,000 contiguous acres or more, or 2) a roadless island. Roadless is defined as the absence of improved roads suitable and maintained for public travel by means of 4-wheeled, motorized vehicles that are intended for highway use.

D.1.4 Relationship to Previous Wilderness Reviews

No previous wilderness reviews have been prepared for Dungeness NWR.

D.2 Wilderness Inventory

The following constitutes the inventory phase of the wilderness review for the Dungeness National Wildlife Refuge.

D.2.1 Lands Considered Under This Wilderness Review

All FWS-owned lands and waters (in fee title) within the Dungeness NWR boundary were considered during this wilderness review.

D.2.2 Inventory Units

The first step of a wilderness assessment is to divide a refuge or other management entity into preliminary wilderness evaluation units. The boundaries of these artificial units can follow the refuge

boundary, but may not cross permanent roadways, private or other non-Federal lands, or non-Service owned waterways. These roads, non-Federal lands, or waterways can form the boundary for an individual evaluation unit. Other obvious incompatible wilderness uses or structures (such as refuge headquarters, residential areas, rights-of-way, and non-jurisdictional waters) may also be eliminated from any evaluation units at this time. Once boundaries have been established for each individual evaluation unit, the criteria in Section D.2.3 are applied to determine each unit's suitability as potential wilderness and the need for further evaluation under the Wilderness Study.

In determining units to be evaluated for wilderness character per this inventory, the Refuge was mapped using geographic information system (GIS) software. Using the major constraints set by the Wilderness Act, specifically land ownership/refuge boundary and permanent road systems, initial large evaluation units were developed by including all contiguous lands within those intractable confines. Through this process, four units were defined for evaluation:

For the purposes of this wilderness review, the 392.3 acre **Dungeness Unit** is defined to include all refuge-owned forested lands at the base of Dungeness Spit and Dungeness and Graveyard spits. Tracts 10a and 12 are not contiguous with the remainder of the unit and thus are considered a separate unit (the 4.9 acre Mellus/Nature Conservancy Unit). The Dungeness Unit consists of coastal strand and spit, coastal lagoon, salt marsh, intertidal mudflat, and upland habitats. Upland habitats include second growth Douglas-fir/western hemlock/western red cedar forest, alder forest, and sandy bluffs. Dungeness Spit is 5.5 miles long and averages 300 feet wide (from mean low water); however the narrowest portion measures approximately 50 feet wide during high tide. Graveyard Spit is about 1.4 miles long and averages 475 feet wide. Cumulatively, Dungeness and Graveyard spits consist of approximately fifteen miles of undeveloped sandy beach. Graveyard Spit was designated a Research Natural Area in 1990 because of its high quality low intertidal, high salinity sandy marsh; coastal spit with native vegetation; and high salinity coastal lagoon. Refuge visitor and administrative facilities are located on this unit.

The forested 4.9 acre **Mellus/Nature Conservancy (Tracts 10a and 12) Unit** is located east of the base of Dungeness Spit and fronts Dungeness Bay and Harbor. There is private property separating this unit from the main Dungeness Unit. This unit provides a buffer for the Refuge and protects the viewshed to the east of the observation platforms along the main trail on the Dungeness Unit.

The 14.7 acre **Dawley North Unit** is located along the southern part of Sequim Bay and north of Highway 101. The residential area was heavily developed with the construction of aviaries, ponds, and gardens. The Dawley North Unit structures and property are in caretaker status and the Service intends to work with other agencies or conservation organizations to pursue cooperative management.

The 116.5 acre **Dawley South Unit** is located south of Highway 101. This unit is primarily forested with a ribbon of riparian forest along Dean Creek running through the southwest corner and a small 1/5th acre impoundment located in the center of the unit. The forest has been altered by logging over the years and is now considered second growth. Consequently, an established logging road system still persists. State and private land border this unit.

D.2.3 Process of Analysis

The following evaluation process was used in identifying the suitability of refuge units for wilderness designation:

- Determination of refuge unit sizes.
- Assessment of the units' capacity to provide opportunities for solitude or primitive and unconfined recreation.
- Assessment of "naturalness" of refuge units.

General guidelines used for evaluating areas for wilderness potential during this wilderness inventory process include:

1. The area should provide a variety of habitat types and associated abiotic features, as well as a nearly complete complement of native plants and wildlife indicative of those habitat types. Non-native and invasive species should comprise a negligible portion of the landscape.
2. The area should be spatially complex (vertically and/or horizontally) and exhibit all levels of vegetation structure typical of the habitat type, have an interspersion of these habitats, and provide avenues for plant and wildlife dispersal.
3. The area should retain the basic natural functions that define and shape the associated habitats, including but not limited to, flooding regimes, fire cycles, unaltered hydrology and flowage regimes, basic predator-prey relationships including herbivory patterns.
4. Due to their size, islands may not meet the habitat guidelines in 1 and 2 above. Islands should, however, exhibit the natural cover type with which they evolved and they should continue to be shaped and modified by natural processes. Islands should be further analyzed during the study portion of the review if they provide habitat for a significant portion of a population, or key life cycle requirements for any resources of concern or listed species.
5. Potential wilderness areas should be relatively free of permanent structures or man-made alterations. Areas may be elevated to the study phase if existing structures or alterations can be removed or remediated within a reasonable timeframe, and prior to wilderness recommendation to the Secretary of the Interior.

Supplemental Values – The Wilderness Act states that an area of wilderness may contain ecological, geological, or other features of scientific, educational, scenic, or historical value. Supplemental values of the area are optional, but the degree to which their presence enhances the area's suitability for wilderness designation should be considered. The evaluation should be based on an assessment of the estimated abundance or importance of each of the features.

More detail on the factors considered and used for each assessment step follows.

Unit Size: Roadless areas meet the size criteria if any one of the following standards applies:

- An area with over 5,000 contiguous acres solely in Service ownership.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or an area that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.

- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

Outstanding Solitude or Primitive or Unconfined Recreation:
A designated wilderness area must provide outstanding opportunities for solitude or a primitive and unconfined type of recreation. Possession of only one of these outstanding opportunities is sufficient for an area to qualify as wilderness, and it is not necessary for one of these outstanding opportunities to be available on every acre. Furthermore, an area does not have to be open to public use and access to qualify under these criteria.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. Primitive recreation activities may provide opportunities to experience challenge and risk, self-reliance, and adventure.

Naturalness and Wildness: the area generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.
This criterion must be evaluated in the context of current natural conditions and societal values and expectations without compromising the original intent of the Wilderness Act. It is well recognized that there are few areas remaining on the planet that could be truly classified as primeval or pristine, with even fewer, if any, existing in the conterminous United States. Likewise, few areas exist that do not exhibit some impact from anthropogenic influences, be it noise, light, or air pollution; water quality or hydrological manipulations; past and current land management practices; roads or trails, suppression of wildfires; invasions by non-native species of plants and animals; or public uses. While allowing for the near-complete pervasiveness of modern society on the landscape, the spirit of the Wilderness Act is to protect lands that still retain the wilderness qualities of being: 1) natural, 2) untrammeled, 3) undeveloped. These three qualities are cornerstones of wilderness character. For areas proposed or designated as wilderness, wilderness character must be monitored to determine baseline conditions and thereafter be periodically monitored to assess the condition of these wilderness qualities. Proposed and designated wilderness areas by law and policy are required to maintain wilderness character through management and/or restoration in perpetuity.

Defining the first two qualities (natural and untrammeled) requires knowledge and understanding of the ecological systems which are being evaluated as potential wilderness. Ecological systems are comprised of three primary attributes – composition, structure, and function. Composition is the components that make up an ecosystem, such as the habitat types, native species of plants and animals, and abiotic (physical and chemical) features. These contribute to the diversity of the area. Structure is the spatial arrangement of the components that contribute to the complexity of the area. Composition and structure are evaluated to determine the naturalness of the area. Function is the processes that result from the interaction of the various components both temporally and spatially, and the disturbance processes that shape the landscape. These processes include, but are not limited to, predator-prey relationships, insect and disease outbreaks, nutrient and water cycles, decomposition, fire, windstorms, flooding, and both general and cyclic weather patterns. Ecological functions are evaluated to determine the wildness or untrammeled quality of the area.

The third quality assessment is whether an area is undeveloped. Undeveloped refers to the absence of permanent structures such as roads, buildings, dams, fences, and other man-made alterations to the landscape. Exceptions can be made for historic structures or structures required for safety or health considerations, providing they are made of natural materials and relatively unobtrusive on the landscape.

D.2.4 Summary of Inventory Results and Conclusion

Table D-1 summarizes the above evaluation factors for each of the units that were delineated and evaluated as described in Sections D.1.1 and D.2.3.

In this inventory, the 392.3 acre Dungeness Unit, 4.9 acre Mellus/Nature Conservancy (Tracts 10a and 12) Unit, 14.7 acre Dawley North Unit, and 116.5 acre Dawley South Unit did not meet the minimum wilderness criteria for size, outstanding opportunities for solitude and primitive/unconfined recreation, or naturalness. While the Refuge contains some excellent examples of coastal habitats, the small acreage, discontinuous refuge lands, and the presence of heavily used roads adjacent to the Refuge results in a determination that Dungeness National Wildlife Refuge does not satisfy minimum wilderness suitability criteria.

Table D-1. Results of Wilderness Inventory for Dungeness NWR

Refuge Unit	Size	Outstanding opportunities for solitude or primitive/unconfined recreation	Naturalness	Summary: Area will move forward for Wilderness Study
Dungeness Unit	No	NE	NE	No
Mellus/Nature Conservancy (Tracts 10a and 12) Unit	No	NE	NE	No
Dawley North Unit	No	NE	NE	No
Dawley South Unit	No	NE	NE	No

Notes:
NE – Not evaluated (once any wilderness criteria was not met, further evaluation was not conducted.)

Document continues on next page.

Appendix E. Biological Resources of Concern

E.1 Introduction

Management direction of individual refuges is driven by refuge purposes and statutory mandates, coupled with species and habitat priorities. Management on a refuge should first and foremost address the individual refuge purposes. Additionally, management should address maintenance and, where appropriate, restoration of Biological Integrity, Diversity, and Environmental Health (BIDEH) as well as management for NWRS Resources of Concern. In this approach, each refuge contributes to the goals of the NWRS (601 FW 1) and achievement of the NWRS Mission.

In concert with this approach, and as an initial step in planning, the planning team identified resources of concern for Dungeness National Wildlife Refuge (NWR or Refuge). As defined in the Policy on Habitat Management Plans (620 FW 1), resources of concern are:

> "all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, State, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect 'migrating waterfowl and shorebirds.' Federal or State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts (620 FW 1.4G)."

To provide a framework for development of goals and objectives in the CCP, the planning team identified resources of concern, following the process outlined in the Service's draft Identifying Refuge Resources of Concern and Management Priorities: A Handbook (USFWS 2009).

E.2 Comprehensive Resources of Concern

A comprehensive list of potential resources of concern was created early in the planning process. The team identified species, species groups, and communities of concern, based upon a review of the Refuge's establishing history and purposes, a description of the key habitat types existing at the Refuge and a review of numerous conservation plans (see Section 1.7 of the CCP), many of which highlight priority species or habitats for conservation. The Comprehensive Resources of Concern list is contained in Table E-1.

Table E-1. Dungeness National Wildlife Refuge Table of Comprehensive Resources of Concern

Species/Habitat	Refuge Purpose Species	BIDEH	Fed ESA Status [1]	State Status [2]	State Rank WNHP [3]	MMPA Species [4]	USFWS Bird of Management Concern or Bird of Conservation Concern [5]	Pacific Region Seabird Plan [6]	N Pacific Coast Shorebird Plan [7]	State Wildlife Action Plan Priorities [8]	TNC WV/PT/GB EA [9]	PIF Species Assessment - BCR5 [10]	Refuge Occurrence	Ecological Significance
SEABIRDS														
Double-crested Cormorant					S4S5B			NCR			X		Year-round	
Pelagic Cormorant					S4B, S4N		BCR5	HC			X		Year-round	
Heermann's Gull					S5N			MC					Migration & winter	
Western Gull					S4B, S4N			LC					Year-round	
Glaucous-winged/Western Gull					S5B, S5N, S4B, S4N								Year-round	Close proximity to largest colony in Salish Sea
Caspian Tern				M	S3B		BCR5	MC					Breeding	First observed in 2003, issues with avian & mammalian predation
Marbled Murrelet			T	T	S3		BCR5	HC		X	X		Adjacent to Dawley Unit, Breeding	
Pigeon Guillemot					S4B, S4N			MC			X		Breeding; foraging	
SHOREBIRDS														
Black-bellied Plover					S4N				3		X		Migration, winter	
Snowy Plover			T	E	S1				5	X			Very limited observations	Reports on Dungeness Spit in 1995, 1996, 2012; nonbreeding
Black Oystercatcher				M	S4		N, R1, BCR5		4	X			Year-round	
Whimbrel					S3N		N, R1, BCR5		4				Migration	
Sanderling					S4N				3		X		Migration, winter	
Western					S4S5N				3		X		Migration	

Species/Habitat	Refuge Purpose Species	BIDEH	Fed ESA Status [1]	State Status [2]	State Rank WNHP [3]	MMPA Species [4]	USFWS Bird of Management Concern or Bird of Conservation Concern [5]	Pacific Region Seabird Plan [6]	N Pacific Coast Shorebird Plan [7]	State Wildlife Action Plan Priorities[8]	TNC WV/PT/GB EA [9]	PIF Species Assessment - BCR5[10]	Refuge Occurrence	Ecological Significance
Sandpiper														
Least Sandpiper					S4N				3		X		Migration	
Dunlin		X			S4S5N				3		X		Migration, winter	
WATERFOWL														
Brant					S3N		GBBDC			X	X		Migration, winter	
Harlequin Duck					S2B, S3N		GBBDC				X		Migration, winter	
Mallard					S5B, S5N		GBBDC							
American Wigeon					S4B, S5N		GBBDC				X		Migration, winter	
Northern Shoveler					S4B, S3N								Migration, winter	
Northern Pintail					S3B, S4N		GBBDC			X			Migration, winter	
Green-winged Teal					S4B, S3N								Migration, winter	
Greater Scaup					S3N		GBBDC			X	X		Migration, winter	
Lesser Scaup					S3N, S4B		GBBDC			X	X		Migration, winter	
Surf Scoter					S3N					X	X		Migration, winter	
White-winged Scoter					S3N					X	X		Migration, winter	
Black Scoter					S3N					X	X		Migration, winter	
Common Goldeneye					S5N								Migration, winter	
Barrow's Goldeneye					S3B, S4N								Migration, winter	
OTHER WATERBIRDS														
Great Blue Heron				M	S4S5B, S5N					X	X		Year-round	Limited abundance
RAPTORS														
Bald Eagle				S	S4B, S4N		N, R1, BCR5			X	X	14	Year-round	

Species/Habitat	Refuge Purpose Species	BIDEH	Fed ESA Status [1]	State Status [2]	State Rank WNHP [3]	MMPA Species [4]	USFWS Bird of Management Concern or Bird of Conservation Concern [5]	Pacific Region Seabird Plan [6]	N Pacific Coast Shorebird Plan [7]	State Wildlife Action Plan Priorities [8]	TNC WV/PT/GB EA [9]	PIF Species Assessment - BCR5 [10]	Refuge Occurrence	Ecological Significance
Northern Harrier					S3B, S3N							12	Year-round	
Sharp-shinned Hawk					S3S4B, S4N							14	Year-round	
Cooper's Hawk					S4B, S4N							15	Year-round	
Merlin					S3B, S4N							13	Migration	
Peregrine Falcon				S	S2B, S3N		N, R1, BCR5			X	X	13	Year-round	
LANDBIRDS														
Snowy Owl				M	S3N							n/a	Irruptive winter visitor	
Band-tailed Pigeon			SC		S4B						X		Year-round	
Short-eared Owl					S2S3B, S3N		N, R1				X	12	Breeding	
Northern Saw-whet Owl					S4B, S4N							15	Migration, winter	
Rufous Hummingbird					S4B		N, R1, BCR5				X	17	Year-round	
Belted Kingfisher					S5							14	Year-round	
Red-breasted Sapsucker					S4S5						X	18	Year-round	
Pileated Woodpecker		X		S	S4							12	Year-round	
Pacific-slope Flycatcher					S4S5B						X	17	Breeding	
Hutton's Vireo					S5							16	Year-round	
Steller's Jay					S5							14	Year-round	
Northwestern Crow					S4?							17	Year-round	
Chestnut-backed Chickadee					S5						X	17	Year-round	
Bewick's Wren					S5		N					11	Year-round	
Golden-crowned Kinglet					S4S5B						X	17	Year-round	
Varied Thrush					S5B, S5N							15	Year-round	
Orange-crowned Warbler					S4B							14	Breeding, migration	

Species/Habitat	Refuge Purpose Species	BIDEH	Fed ESA Status [1]	State Status [2]	State Rank WNHP [3]	MMPA Species [4]	USFWS Bird of Management Concern or Bird of Conservation Concern [5]	Pacific Region Seabird Plan [6]	N Pacific Coast Shorebird Plan [7]	State Wildlife Action Plan Priorities[8]	TNC WV/PT/GB EA [9]	PIF Species Assessment - BCR5[10]	Refuge Occurrence	Ecological Significance
Townsend's Warbler					S4N, S5B							16	Breeding, migration	
Spotted Towhee					S5B, S5N							14	Year-round	
Bullock's Oriole					S4B							14	Migration	
Pine Siskin					S4S5B							14	Year-round	
MARINE MAMMALS														
Pacific Harbor Seal		X		M	S4	X					X		Year-round	pupping site
Northern Elephant Seal					SNA	X							Haul-out	rare
OTHER SPECIES														
Pacific Sand Lance										X	X		Year-round, spawning	key component of the marine food web
Surf Smelt					SNR					X	X		Year-round, spawning	key component of the marine food web
Pacific Herring					SNR						X		Year-round, spawning	key component of the marine food web
Puget Sound Chinook			T	S C	SNR								Year-round, Dungeness Unit	
Hood Canal Summer Chum			T	S C	SNR								varies, Dungeness Unit	
Keen's Myotis				C	S1					X	X		potential at Dawley Unit	
Townsend's Big-eared Bat			S C	C	S2S3					X	X		potential at Dawley Unit	
Cope's Giant Salamander					S3S4						X		potential at Dawley Unit	
Olympic Torrent Salamander					S3						X		potential at Dawley Unit	
Long-legged Myotis			S C	M	S3S4								potential at Dawley Unit	
Long-eared Myotis			S C	M	S4								potential at Dawley Unit	

Species/Habitat	Refuge Purpose Species	BIDEH	Fed ESA Status [1]	State Status [2]	State Rank WNHP [3]	MMPA Species [4]	USFWS Bird of Management Concern or Bird of Conservation Concern [5]	Pacific Region Seabird Plan [6]	N Pacific Coast Shorebird Plan [7]	State Wildlife Action Plan Priorities[8]	TNC WV/PT/GB EA [9]	PIF Species Assessment - BCR5[10]	Refuge Occurrence	Ecological Significance
Western Toad				S	S3						X		Dawley Unit	T&E - forest/wetlands
Red-legged Frog					S4						X		Dawley Unit	
Sand-verbena Moth			C	C	S1?					X			Year-round Graveyard Spit	10 sites globally, 1 observation on Graveyard Spit
NATIVE STRAND PLANTS														
Common Eelgrass		X											year-round	
American Dunegrass		X											year-round	
Large-headed Sedge		X											year-round	
ECOLOGICAL SYSTEMS														
Sandy Bluff		X											to the west of the base of Dungeness Spit	Unarmored bluffs a key conservation issue in the Salish Sea
Barrier Beach		X											Graveyard and Dungeness spits	Dungeness Spit one of the longest natural sand spits in the world
Barrier Lagoon and Mudflats		X											Dungeness Harbor/ within Dungeness and Graveyard spits	
Eelgrass Beds		X											Dungeness Harbor and Bay	Declining habitat type

Species/Habitat	Refuge Purpose Species	BIDEH	Fed ESA Status [1]	State Status [2]	State Rank WNHP [3]	MMPA Species [4]	USFWS Bird of Management Concern or Bird of Conservation Concern [5]	Pacific Region Seabird Plan [6]	N Pacific Coast Shorebird Plan [7]	State Wildlife Action Plan Priorities[8]	TNC WV/PT/GB EA [9]	PIF Species Assessment - BCR5[10]	Refuge Occurrence	Ecological Significance
Salt Marsh		X											Within Graveyard Spit, small sections found within the Harbor at the base of Dungeness Spit	Declining habitat type
Mixed Coniferous Forests		X											Dungeness and Dawley units	Declining habitat type
Seasonal Freshwater Wetlands		X											Dungeness and Dawley units	Declining habitat type
Instream		X											Dawley Unit	
Managed Wetland		X											Dawley Unit	

1 Status under the Endangered Species Act - E = Endangered; T = Threatened; C = Candidate
2 State listing status - E = Endangered; T = Threatened; C = Candidate; S = Sensitive; M = Monitor; R1 = More data required to review status
3 Washington Natural Heritage Program state rank - see http://www1.dnr.wa.gov/nhp/refdesk/lists/stat_rank.html for a description of ranks
4 Species listed under the Marine Mammal Protection Act
5 USFWS Bird of Management Concern (USFWS 2005a) and USFWS Birds of Conservation Concern (USFWS 2008) lists - N = National; R1 = Region 1; BCR5 = Bird Conservation Region 5; GBBDC - Game Bird Below Desired Condition
6 Pacific Region Seabird Conservation Plan (USFWS 2005b) status - HC = High Concern; MC = Moderate Concern; NAR = Not at Risk
7 Northern Pacific Coast Regional Shorebird Conservation Plan (Drut and Buchanan 2000) status - 4 = High Concern; 3 = Moderate Concern
8 Washington Comprehensive Wildlife Conservation Plan priority species (WDFW 2005)
9 The Nature Conservancy Willamette Valley Puget Trough Georgia Basin Ecoregional Assessment (Floberg et al. 2004)
10 PIF Species Assessment Scores - Regionally Important Species (higher #s = higher conservation Concern) (PIF 2010)

E.3 Ecological System Descriptions

Vegetation types and nomenclature in the following section are classified according to the International Terrestrial Ecological System Classification being developed by NatureServe and its natural heritage program members. Ecological systems are being described for the coterminous United States, southern Alaska, and adjacent portions of Mexico and Canada and are defined as follows:

> "Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. A given system will typically manifest itself in a landscape at intermediate geographic scales of tens to thousands of hectares and will persist for 50 or more years. This temporal scale allows typical successional dynamics to be integrated into the concept of each unit. With these temporal and spatial scales bounding the concept of ecological systems, we then integrate multiple ecological factors—or diagnostic classifiers—to define each classification unit. The multiple ecological factors are evaluated and combined in different ways to explain the spatial co-occurrence of plant associations." (Comer et al. 2003)

Thus, ecological systems link together recurring groupings of U.S. National Vegetation Classification (US-NVC) associations and alliances (Grossman et al. 1998, Anderson et al. 1998, Jennings et al. 2003) found in similar physical settings and influenced by similar dynamic processes such as fire or flooding. The nested US-NVC hierarchy groups associations into alliances based on common dominant or diagnostic species in the upper most canopy. By non-hierarchically grouping together associations and alliances using larger-scale environmental patterns and concepts, ecological systems form a "meso-scale" classification that lies between the finer-scale (floristic) classes and the generalized formation (physiognomic) levels of the US-NVC (Comer et al. 2003). As a "meso-scale" classification, ecological systems are more readily mapped, identifiable in the field, and practically understood as ecological units and wildlife habitats. Consequently, regional GAP analysis efforts have generally adopted them as target map units. Given their utility for standardized vegetation type mapping, ecological systems classification was performed for Dungeness National Wildlife Refuge. All ecological system descriptions based on NatureServe (2012) and available online at: http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol.

E.3.1 Shoreline

North Pacific Coastal Cliff and Bluff
This ecological system includes unvegetated or sparsely vegetated rock cliffs and very steep bluffs of glacial deposits along the Pacific Ocean and associated marine and estuarine inlets. It is restricted to degrading slopes from southwestern British Columbia south into central Oregon. It is composed of barren and sparsely vegetated substrates, typically including exposed sediments, bedrock, and scree slopes. Exposure to waves, eroding and desiccating winds, slope failures and sheet erosion create gravelly to rocky substrates that are often unstable. There can be sparse cover of forbs, grasses, lichens and low shrubs.

North Pacific Maritime Coastal Sand Dune and Strand
This system includes beach strand (not the beach itself but sparsely or densely vegetated areas behind the beach), foredunes, sand spits, and active to stabile backdunes and sandsheets derived from quartz

or gypsum sands. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges. Coastal dunes often front portions of inlets and tidal marshes. Dune vegetation typically includes herbaceous, succulent, shrub, and tree species with varying degrees of tolerance for salt spray, wind and sand abrasion, and substrate stability. Dune succession is highly variable, so species composition can vary significantly among occurrences. These dunes can be dominated by *Leymus arenarius* (= *Elymus arenarius*), *Festuca rubra*, *Leymus mollis*, or various forbs adapted to salty dry conditions. *Gaultheria shallon* and *Vaccinium ovatum* are major shrub species. Forested portions of dunes are included within this system and are characterized (at least in the south) by *Pinus contorta var. contorta* early in succession, *Picea sitchensis* somewhat later in the sere, and in some cases *Tsuga heterophylla* later still. *Pseudotsuga menziesii* sometimes codominates in Oregon. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges. Late-sere forests, dominating stabilized dune systems where active dune processes are nearly absent and that compositionally represent the adjacent matrix system, are excluded from this dune system. Interdunal wetlands occur commonly within the matrix of this system and sometimes are extensive in deflation plains or old dune troughs, but are considered part of various separate wetland ecological systems depending on their hydrology, and are not part of this upland system.

E.3.2 Intertidal/Subtidal

Temperate Pacific Intertidal Flat (Dungeness Unit)
Tidal flats form a narrow band along oceanic inlets and are more extensive at the mouths of larger rivers. Algae are the dominant vegetation on mud or gravel flats where little vascular vegetation is present due to daily tidal flooding of salt or brackish water. Characteristic species include *Vaucheria longicaulis* and *Enteromorpha* spp. Vascular species are sparse, if present, and may include salt-tolerant species such as *Eleocharis palustris*, *Salicornia* spp., *Plantago maritima*, *Glaux maritima*, and other plants common to lower salt marshes; cover is less than 10%. The dominant processes are tectonic uplift or subsidence, isostatic rebound, and sediment deposition.

North Pacific Maritime Eelgrass Bed (Dungeness Unit)
Eelgrass beds are found within the subtidal and intertidal zones. Intertidal zones are found with clear water in bays, inlets and lagoons, typically dominated by macrophytic algae and marine aquatic angiosperms along the temperate Pacific Coast. Subtidal portions are never exposed while intertidal areas support species that can tolerate exposure to the air. Common substrates include marine silts, but may also include exposed bedrock and cobble, where many algal species become attached with holdfasts. Beds are dominated by *Zostera marina*.

Transitional Vegetation Herbaceous-Woody Mix (Dungeness Unit)
Transitional Vegetation Short Shrub (Dungeness and Dawley units)

E.3.3 Forest

North Pacific Lowland Riparian Forest and Shrubland (Dungeness and Dawley units)
Lowland riparian systems are linear in character, occurring on floodplains or lower terraces of rivers and streams. Major broadleaf dominant species are *Acer macrophyllum*, *Alnus rubra*, *Populus balsamifera* ssp. *trichocarpa*, *Salix sitchensis*, *Salix lucida* ssp. *lasiandra*, *Cornus sericea*, and *Fraxinus latifolia*. Conifers tend to increase with succession in the absence of major disturbance.

Conifer-dominated types are relatively uncommon and not well-described; *Abies grandis*, *Picea sitchensis*, and *Thuja plicata* are important. Riverine flooding and the succession that occurs after major flooding events are the major natural processes that drive this system. Very early-successional stages can be sparsely vegetated or dominated by herbaceous vegetation.

North Pacific Maritime Dry-Mesic Douglas-Fir-Western Hemlock Forest (Dungeness and Dawley units)

This ecological system occurs throughout low-elevation western Washington, except on extremely dry or moist to very wet sites. These forests occur on the drier to intermediate moisture habitats and microhabitats within the Western Hemlock Zone of the Pacific Northwest. Climate is relatively mild and moist to wet, however mean annual precipitation can be as low as 20 inches in the extreme rainshadow, falling predominantly as winter rain. Snowfall ranges from rare to regular, and summers are relatively dry. This is generally the most extensive forest in the lowlands on the west side of the Cascades and forms the matrix within which other systems occur as patches including North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest and North Pacific Dry Douglas-fir Forest and Woodland.

Overstory canopy is dominated by *Pseudotsuga menziesii*, with *Tsuga heterophylla* generally present in the subcanopy or as a canopy dominant in old-growth stands. *Abies grandis*, *Thuja plicata*, and *Acer macrophyllum* codominants are also represented. In the driest climatic areas, *Tsuga heterophylla* may be absent, and *Thuja plicata* takes its place as a late-seral or subcanopy tree species. *Gaultheria shallon*, *Mahonia nervosa*, *Rhododendron macrophyllum*, *Linnaea borealis*, *Achlys triphylla*, and *Vaccinium ovatum* typify the poorly to well-developed shrub layer. *Acer circinatum* is a common codominant with one of more of these other species. The fern *Polystichum munitum* can be codominant with one or more of the evergreen shrubs on sites with intermediate moisture availability (mesic). Young stands may lack *Tsuga heterophylla* or *Thuja plicata*, especially in the Puget Lowland. *Tsuga heterophylla* is generally the dominant regenerating tree species. Other common associates include *Acer macrophyllum*, *Abies grandis*, and *Pinus monticola*. This is in contrast to North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest, which occurs on sites where soils remain moist to subirrigated for much of the year and fires were less frequent. Fire is (or was) the major natural disturbance. In the past (pre-1880), fires were high-severity or, less commonly, moderate-severity, with natural return intervals of 100 years or less in the driest areas, to a few hundred years in areas with more moderate to wet climates. This system was typified by a moderate-severity fire regime involving occasional stand-replacing fires and more frequent moderate-severity fires. This fire regime would create a complex mosaic of stand structures across the landscape.

North Pacific Maritime Mesic-Wet Douglas-Fir-Western Hemlock Forest (Dungeness and Dawley units)

This ecological system occurs throughout low-elevation western Washington, except on extremely dry sites and in the hypermaritime zone near the outer coast where it is rare. These forests occur on moist habitats and microhabitats, mainly lower slopes or valley landforms, within the Western Hemlock Zone of the Pacific Northwest. They differ from North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest primarily in having more hydrophilic undergrowth species, moist to subirrigated soils, high abundance of shade- and moisture-tolerant canopy trees, as well as higher stand productivity, due to higher soil moisture and lower fire frequency. Climate is relatively mild and moist to wet, however this system can be found in areas with mean annual precipitation as low as 20 inches in the extreme rainshadow (predominantly as winter rain). Snowfall ranges from rare to regular (but consistent winter snowpacks are absent or minimal), and summers are relatively

dry. In some wetter climatic areas, it forms the matrix within which other systems occur as patches, especially riparian wetlands. In this area, it occurs as small to large patches within a matrix of North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest and North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland.

Overstory canopy is dominated by *Pseudotsuga menziesii*, *Tsuga heterophylla*, and/or *Thuja plicata*, as well as *Chamaecyparis lawsoniana* in western Oregon, away from the coast. *Pseudotsuga menziesii* is usually at least present to more typically codominant or dominant. *Acer macrophyllum* and *Alnus rubra* (the latter primarily where there has been historic logging disturbance) are commonly found as canopy or subcanopy codominants, especially at lower elevations. In a natural landscape, small patches can be dominated in the canopy by these broadleaf trees for several decades after a severe fire. *Polystichum munitum*, *Oxalis oregana*, *Rubus spectabilis*, and *Oplopanax horridus* typify the poorly to well-developed herb and shrub layers. *Gaultheria shallon*, *Mahonia nervosa*, *Rhododendron macrophyllum*, and *Vaccinium ovatum* are often present but are generally not as abundant as the aforementioned indicators; except where *Chamaecyparis lawsoniana* is a canopy codominant, they may be the dominant understory. *Acer circinatum* is a very common codominant as a tall shrub. Stands included are best represented on lower mountain slopes of the coastal ranges with high precipitation, long frost-free periods, and low fire frequencies. Young stands may lack *Tsuga heterophylla* or *Thuja plicata*, especially in the Puget Lowland. *Tsuga heterophylla* is generally the dominant regenerating tree species. Other common associates include *Abies grandis*, which can be a codominant especially in the Willamette Valley - Puget Trough - Georgia Basin ecoregion. Soils are moist to somewhat wet but not saturated for much of the year and are well-drained to somewhat poorly drained. Typical soils for *Polystichum* sites would be deep, fine- to moderately coarse-textured, and for *Oplopanax* sites, soils typically have an impermeable layer at a moderate depth. Both types of soils are well-watered from upslope sources, seeps, or hyperheic sources. This is in contrast to North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest, which occurs on well-drained soils, south-facing slopes, and dry ridges and slopes where soils remain mesic to dry for much of the year. Fire is (or was) the major natural disturbance in all but the wettest climatic areas. In the past (pre-1880), fires were less commonly high-severity, typically mixed-severity or moderate-severity, with natural return intervals of a few hundred to several hundred years. This system was formerly supported by occasional, stand-replacing fires. More frequent moderate-severity fires would generally not burn these moister microsites.

North Pacific Oak Woodland (Dungeness Unit)
This system is associated with dry, predominantly low-elevation sites and/or sites that experienced frequent presettlement fires. In the Puget Lowland and Georgia Basin, this system is primarily found on dry sites, typically either shallow bedrock soils or deep gravelly glacial outwash soils. Even where more environmentally limited, the system is strongly associated with a pre-European settlement, low-severity fire regime. Succession in the absence of fire tends to favor increased shrub dominance in the understory, increased tree density, and increased importance of conifers, with the end result being conversion to a conifer forest. The vegetation ranges from savanna and woodland to forest dominated by deciduous broadleaf trees, mostly *Quercus garryana*. Codominance by the evergreen conifer *Pseudotsuga menziesii* is common. This system is borderline between small patch and large patch in its dynamics.

E.3.4 Wetlands

North Pacific Hardwood-Conifer Swamp (Dungeness and Dawley units)
Also known as Palustrine forested Wetland in the Cowardin classification system (Cowardin et al. 1979), North Pacific Hardwood-Conifer Swamps mostly small-patch size, occurring sporadically in glacial depressions, in river valleys, around the edges of lakes and marshes, or on slopes with seeps that form subirrigated soils. This system is indicative of poorly drained, mucky areas, and areas are often a mosaic of moving water and stagnant water. Soils can be woody peat, muck, or mineral. Typical of extensive upland forests, this type can be dominated by any one or a number of conifer and hardwood species (*Tsuga heterophylla*, *Picea sitchensis*, *Tsuga mertensiana*, *Chamaecyparis nootkatensis*, *Pinus contorta var. contorta*, *Alnus rubra*, *Fraxinus latifolia*, *Betula papyrifera*) that are capable of growing on saturated or seasonally flooded soils. Overstory is often less than 50% cover, but shrub understory can have high cover.

Temperate Pacific Tidal Salt and Brackish Marsh (Dungeness Unit)
Also known as Estuarine Emergent Wetland in the Cowardin classification system (Cowardin et al. 1979), intertidal salt and brackish marshes are primarily associated with estuaries or coastal lagoons. Salt marshes are limited to bays and behind sand spits or other locations protected from wave action. Typically these areas form with a mixture of inputs from freshwater sources into coastal saltwater, so they commonly co-occur with brackish marshes. This is a small-patch system, confined to specific environments defined by ranges of salinity, tidal inundation regime, and soil texture. Patches usually occur as zonal mosaics of multiple communities. They vary in location and abundance with daily and seasonal dynamics of freshwater input from inland balanced against evaporation and tidal flooding of saltwater. Summer-dry periods result in decreased freshwater inputs from inland. Hypersaline environments within salt marshes occur in "salt pans" where tidal water collects and evaporates. Characteristic plant species include *Distichlis spicata*, *Monanthochloe littoralis*, *Limonium californicum*, *Jaumea carnosa*, *Salicornia* spp., *Suaeda* spp., *Batis maritima*, and *Triglochin* spp. Low marshes are located in areas that flood every day and are dominated by a variety of low-growing forbs and low to medium-height graminoids, especially *Salicornia virginica*, *Distichlis spicata*, *Schoenoplectus maritimus* (= *Scirpus maritimus*), *Schoenoplectus americanus* (= *Scirpus americanus*), *Carex lyngbyei*, and *Triglochin maritima*. High marshes are located in areas that flood infrequently and are dominated by medium-tall graminoids and low forbs, especially *Deschampsia caespitosa*, *Argentina egedii*, *Juncus balticus*, and *Symphyotrichum subspicatum* (= *Aster subspicatus*). Transition zone (slightly brackish) marshes are often dominated by *Typha* spp. or *Schoenoplectus acutus*. The invasive weed *Lepidium latifolium* is a problem in many of these marshes. Rare plant species include *Cordylanthus maritimus* ssp. *maritimus*.

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Appendix F. Statement of Compliance

STATEMENT OF COMPLIANCE
for Implementation of the
Dungeness National Wildlife Refuge, Clallam County, Washington
Comprehensive Conservation Plan

The following executive orders and legislative acts were reviewed as they apply to implementation of the Dungeness National Wildlife Refuge Comprehensive Conservation Plan (CCP).

National Environmental Policy Act (1969), as Amended (42 U.S.C. § 4321 et seq.)
The planning process has been conducted in accordance with National Environmental Policy Act (NEPA) implementing procedures, with U.S. Department of the Interior and U.S. Fish and Wildlife Service (Service) procedures, and in coordination with the affected public. The requirements of NEPA (42 U.S. Code [U.S.C.] § 4321 et seq.) and its implementing regulations in 40 Code of Federal Regulations (CFR) 1500-1508 have been satisfied in the procedures used to reach decisions. These procedures included the development of a range of alternatives for the CCP; analysis of the likely effects of each alternative; and public involvement throughout the planning process. The start of the scoping period was announced through a *Federal Register* notice, news releases to local newspapers, the Service's refuge planning website, and a planning update. The draft CCP/environmental assessment (EA) was released for a 30-day public comment period. The affected public was notified of the availability of the document through a *Federal Register* notice, news releases to local newspapers, the Service's refuge planning website, and a planning update. Copies of the draft CCP/EA and/or planning updates were distributed to an extensive mailing list. Upon request, the public comment period was extended to 90 days. In addition, the Service participated in a variety of public outreach efforts throughout the planning process (see Appendix K).

The CCP is programmatic in many respects and specific details of certain projects and actions cannot be determined until a later date depending on funding and implementation schedules. Certain projects or actions may require additional NEPA compliance.

National Historic Preservation Act (1966), as Amended (16 U.S.C. § 470 et seq.)
The management of the archaeological and cultural resources of the Refuge will comply with the regulations of Section 106 of the National Historic Preservation Act. Historic properties will be maintained and repaired as funding becomes available. Maintenance and improvement of historic resources will result in positive impacts to cultural resources; however, determining whether a particular action has the potential to affect cultural resources is an ongoing process that occurs as step-down and site-specific project plans are developed. Should additional historic properties be identified or acquired in the future, the Service will comply with the National Historic Preservation Act if any management actions have the potential to affect these properties.

Executive Order 12372. Intergovernmental Review
Coordination and consultation with affected Tribal, local and State governments, other Federal agencies, and the landowners has been completed through personal contact by refuge staff, refuge supervisors and/or inclusion of the appropriate entities on the CCP mailing list.

Executive Order 13175. Consultation and Coordination with Indian Tribal Governments
As required under the Secretary of the Interior Order 3206—American Indian Tribal Rights, Federal Tribal Responsibilities, and the Endangered Species Act—the Project Leader notified and consulted interested tribes. Refuge staff consulted with representatives of the Jamestown S'Klallam Indian Tribe during the planning process.

Executive Order 12898. Federal Actions to Address Environmental Justice in Minority and Low-Income Populations
All Federal actions must address and identify, as appropriate, disproportionally high and adverse human health or environmental effects of its programs, policies, and activities on minority populations, low-income populations, and Indian Tribes in the United States. The CCP was evaluated and no adverse human health or environmental effects were identified for minority or low-income populations, Indian tribes, or anyone else.

Wilderness Preservation Act of 1964 (16 U.S.C. § 1131 et seq.)
The Service has evaluated the suitability of the Refuge for wilderness designation through the "Inventory" phase according to the guidelines of the Wilderness Review process as described in 610 FW 4. In this inventory no areas on the Refuge were found to meet the minimum wilderness criteria for size, naturalness or outstanding opportunities for solitude and primitive/unconfined recreation (see Appendix D for additional details).

Architectural Barriers Act of 1968, as Amended (42 U.S.C. § 4151 et seq.)
The Architectural Barriers Act requires access to Federal facilities for people with disabilities. Access for persons with disabilities has been considered during the planning process and actions related to access are found in Chapter 2 of the CCP.

National Wildlife Refuge System Administration Act of 1966, as Amended (16 U.S.C. § 668dd-668ee)
This Act requires the Service to develop and implement a CCP for each refuge. The CCP identifies and describes refuge purposes; the vision and goals for the Refuge; fish, wildlife, and plant populations and related habitats on the Refuge; archaeological and cultural values of the Refuge; issues that may affect populations and habitats of fish, wildlife, and plants; actions necessary to restore and improve biological diversity on the Refuge; and opportunities for wildlife-dependent recreation, as required by the Act.

During the CCP process, the refuge manager evaluated all existing and proposed uses at the Refuge. Priority wildlife-dependent uses (hunting, fishing, wildlife observation and photography, environmental education and interpretation) are considered automatically appropriate under Service policy and thus exempt from appropriate uses review. Compatibility determinations have been prepared for all uses found appropriate (see Appendices A and B).

Executive Order 13186. Responsibilities of Federal Agencies to Protect Migratory Birds
This Order directs agencies to take certain actions to further implement the Migratory Bird Treaty Act. A provision of the Order directs Federal agencies to consider the impacts of their activities, especially in reference to birds on the Service's list of Birds of Conservation Concern. It also directs agencies to incorporate conservation recommendations and objectives in the North American Waterbird Conservation Plan and bird conservation plans developed by Partners in Flight into agency planning as described in Chapter 1. The effects to refuge habitats used by migratory birds from

habitat, public use, and cultural resources actions were assessed within Chapter 6 of the draft CCP/EA, which was incorporated by reference into this document.

Endangered Species Act (1973), as Amended (16 U.S.C. § 1531 et seq.)
This Act provides for the conservation of threatened and endangered species of fish, wildlife, and plants by Federal action and by encouraging the establishment of state programs. Documentation is required under Section 7 of the Act. Refuge policy requires the refuge manager to document issues that affect or may affect endangered species before initiating projects. Consultation on specific projects would be conducted prior to implementation to avoid any adverse impacts to these species and their habitats.

Coastal Zone Management Act, as Amended (16 U.S.C. § 1451 et seq.)
Section 307(c)(1) of the Coastal Zone Management Act of 1972 as amended, requires each Federal agency conducting or supporting activities directly affecting the coastal zone, to conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state coastal management programs. The implementation of the Dungeness NWR CCP is consistent with the Coastal Zone Management Act.

Executive Order 11990. Protection of Wetlands
The CCP is consistent with Executive Order 11990 because CCP implementation would protect any existing wetlands.

Executive Order 11988. Floodplain Management
Under this order, Federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." The CCP is consistent with Executive Order 11988 because CCP implementation would maintain and enhance riverine, riparian, wetland habitats located within floodplains on the Refuge, which will minimize flood impacts and continue to contribute to the natural and beneficial fish and wildlife resource values unique to the area.

Integrated Pest Management (IPM), 517 DM 1 and 7 RM 14
In accordance with 517 DM 1 and 7 RM 14, an integrated pest management (IPM) approach has been adopted to eradicate, control, or contain pest and invasive species on the Refuge. In accordance with 517 DM 1, only pesticides registered with the US Environmental Protection Agency (USEPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and as provided in regulations, orders, or permits issued by USEPA may be applied on lands and waters under refuge jurisdiction.

See 602 FW 3, Exhibit 2 for other potential compliance requirements

[signature] 4/23/13

Chief, Branch of Refuge Planning — Date

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Appendix G. Integrated Pest Management

G.1 Background

IPM is an interdisciplinary approach utilizing methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on refuge lands and waters to achieve wildlife and habitat management goals and objectives. IPM is also a scientifically based, adaptive management process where available scientific information and best professional judgment of the refuge staff as well as other resource experts will be used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. In accordance with 43 CFR 46.145, adaptive management will be particularly relevant where long-term impacts may be uncertain and future monitoring will be needed to make adjustments in subsequent implementation decisions. After a tolerable pest population (threshold) is determined considering achievement of refuge resource objectives and the ecology of pest species, one or more methods, or combinations thereof, will be selected that are feasible, efficacious, and most protective of non-target resources, including native species (fish, wildlife, and plants), and Service personnel, Service authorized agents, volunteers, and the public. Staff time and available funding will be considered when determining feasibility/practicality of various treatments.

IPM techniques to address pests are presented as CCP strategies (see Chapter 2 of this CCP) in an adaptive management context to achieve refuge resource objectives. In order to satisfy requirements for IPM planning as identified in the Director's Memo (dated September 9, 2004) entitled *Integrated Pest Management Plans and Pesticide Use Proposals: Updates, Guidance, and an Online Database*, the following elements of an IPM program have been incorporated into this CCP:

- Habitat and/or wildlife objectives that identify pest species and appropriate thresholds to indicate the need for and successful implementation of IPM techniques; and
- Monitoring before and/or after treatment to assess progress toward achieving objectives including pest thresholds.

Where pesticides would be necessary to address pests, this Appendix provides a structured procedure to evaluate potential effects of proposed uses involving ground-based applications to refuge biological resources and environmental quality in accordance with effects analyses presented in Chapter 6 (Environmental Consequences) of the Dungeness National Wildlife Refuge Draft CCP/EA (USFWS 2012). Only pesticide uses that likely would cause minor, temporary, or localized effects to refuge biological resources and environmental quality with appropriate best management practices (BMPs), where necessary, would be allowed for use on the Refuge.

This Appendix does not describe the more detailed process to evaluate potential effects associated with aerial applications of pesticides. However, the basic framework to assess potential effects to refuge biological resources and environmental quality from aerial application of pesticides would be similar to the process described in this Appendix for ground-based treatments of other pesticides.

G.2 Pest Management Laws and Policies

In accordance with Service policy 569 FW 1 (Integrated Pest Management), plant, invertebrate, and vertebrate pests on units of the National Wildlife Refuge System can be controlled to ensure balanced

wildlife and fish populations in support of refuge-specific wildlife and habitat management objectives. Pest control on federal (refuge) lands and waters also is authorized under the following legal mandates:

- National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd-668ee);
- Plant Protection Act of 2000 (7 USC 7701 *et seq*.);
- Noxious Weed Control and Eradication Act of 2004 (7 USC 7781-7786, Subtitle E);
- Federal Insecticide, Fungicide, and Rodenticide Act of 1996 (7 USC 136-136y);
- National Invasive Species Act of 1996 (16 USC 4701);
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC 4701);
- Food Quality Protection Act of 1996 (7 USC 136);
- Executive Order 13148, Section 601(a);
- Executive Order 13112; and
- Animal Damage Control Act of 1931 (7 USC 426-426c, 46 Stat. 1468).

Pests are defined as "…living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety" from Department policy 517 DM 1 (Integrated Pest Management Policy). Similarly, 569 FW 1 defines pests as "…invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." 517 DM 1 also defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Throughout the remainder of this CCP, the terms pest and invasive species are used interchangeably because both can prevent/impede achievement of refuge wildlife and habitat objectives and/or degrade environmental quality.

In general, control of pests (vertebrate or invertebrate) on the Refuge would conserve and protect the nation's fish, wildlife, and plant resources as well as maintain environmental quality. From 569 FW 1, animal or plant species that are considered pests may be managed if the following criteria are met:

- Threat to human health and wellbeing or private property, the acceptable level of damage by the pest has been exceeded, or State or local government has designated the pest as noxious;
- Detrimental to resource objectives as specified in a refuge resource management plan (e.g., comprehensive conservation plan, habitat management plan), if available; and
- Control would not conflict with attainment of resource objectives or the purposes for which the Refuge was established.

The specific justifications for pest management activities on the Refuge are the following:

- Protect human health and wellbeing;
- Prevent substantial damage to important to refuge resources;
- Protect newly introduced or re-establish native species;
- Control non-native (exotic) species in order to support existence for populations of native species;
- Prevent damage to private property; and
- Provide the public with quality, compatible wildlife-dependent recreational opportunities.

In accordance with Service policy 620 FW 1 (Habitat Management Plans), there are additional management directives regarding invasive species found on the Refuge:

- "We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere."
- "Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and prevent new and expanded infestations of invasive species. Conduct refuge habitat management activities to prevent, control, or eradicate invasive species..."

Animal species damaging/destroying federal property and/or detrimental to the management program of a refuge may be controlled as described in 50 CFR 31.14 (Official Animal Control Operations). For example, the incidental removal of beaver damaging refuge infrastructure (e.g., clogging with subsequent damaging of water control structures) and/or negatively affecting habitats (e.g., removing woody species from existing or restored riparian) managed on refuge lands may be conducted without a pest control proposal. We recognize beavers are native species and most of their activities or refuge lands represent a natural process beneficial for maintaining wetland habitats. Exotic nutria, whose denning and burrowing activities in wetland dikes causes cave-ins and breaches, can be controlled using the most effective techniques considering site-specific factors without a pest control proposal. Along with the loss of quality wetland habitats associated with breaching of impoundments, the safety of refuge staff and public (e.g., auto tour routes) driving on structurally compromised levees and dikes can be threatened by sudden and unexpected cave-ins.

Trespass and feral animals also may be controlled on refuge lands. Based upon 50 CFR 28.43 (Destruction of Dogs and Cats), dogs and cats running at large on a national wildlife refuge and observed in the act of killing, injuring, harassing or molesting humans or wildlife may be disposed of in the interest of public safety and protection of the wildlife. Feral animals should be disposed by the most humane method(s) available and in accordance with relevant Service directives (including Executive Order 11643). Disposed wildlife specimens may be donated or loaned to public institutions. Donation or loans of resident wildlife species will only be made after securing State approval (50 CFR 30.11 [Donation and Loan of Wildlife Specimens]). Surplus wildlife specimens may be sold alive or butchered, dressed and processed subject to federal and state laws and regulations (50 CFR 30.12 [Sale of Wildlife Specimens]).

G.3 Strategies

To fully embrace IPM as identified in 569 FW 1, the following strategies, where applicable, would be carefully considered on the Refuge for each pest species.

G.3.1 Prevention

This would be the most effective and least expensive long-term management option for pests. It encompasses methods to prevent new introductions or the spread of the established pests to un-infested areas. It requires identifying potential routes of invasion to reduce the likelihood of infestation. Hazard Analysis and Critical Control Points (HACCP) planning can be used determine if current management activities on a refuge may introduce and/or spread invasive species in order to identify appropriate BMPs for prevention. See http://www.haccp-nrm.org/ for more information about HACCP planning.

Prevention may include source reduction, using pathogen-free or weed-free seeds or fill; exclusion methods (e.g., barriers) and/or sanitation methods (e.g., wash stations) to prevent re-introductions by various mechanisms including vehicles, personnel, livestock, and horses. Because invasive species are frequently the first to establish newly disturbed sites, prevention would require a reporting mechanism for early detection of new pest occurrences with quick response to eliminate any new satellite pest populations. Prevention would require consideration of the scale and scope of land management activities that may promote pest establishment within un-infested areas or promote reproduction and spread of existing populations. Along with preventing initial introduction, prevention would involve halting the spread of existing infestations to new sites (Mullin et al. 2000). The primary reason for prevention would be to keep pest-free lands or waters from becoming infested. Executive Order 11312 emphasizes the priority for prevention with respect to managing pests.

The following would be methods to prevent the introduction and/or spread of pests on refuge lands:

- Before beginning ground-disturbing activities (e.g., disking, scraping), inventory and prioritize pest infestations in project operating areas and along access routes. Refuge staff would identify pest species on-site or within reasonably expected potential invasion vicinity. Where possible, the refuge staff would begin project activities in un-infested areas before working in pest-infested areas.
- The refuge staff would locate and use pest-free project staging areas. They would avoid or minimize travel through pest-infested areas, or restrict to those periods when spread of seed or propagules of invasive plants would be least likely.
- The refuge staff would determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned of pests. Where possible, the refuge staff would clean equipment before entering lands at on-refuge approved cleaning site(s). This practice does not pertain to vehicles traveling frequently in and out of the project area that will remain on roadways. Seeds and plant parts of pest plants would need to be collected, where practical. The refuge staff would remove mud, dirt, and plant parts from project equipment before moving it into a project area.
- The refuge staff would clean all equipment, before leaving the project site, if operating in areas infested with pests. The refuge staff would determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned.
- Refuge staff, their authorized agents, and refuge volunteers would, where possible, inspect, remove, and properly dispose of seed and parts of invasive plants found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and then properly discarding of them (e.g., incinerating).
- The refuge staff would evaluate options, including closure, to restrict the traffic on sites with on-going restoration of desired vegetation. The refuge staff would revegetate disturbed soil (except travel ways on surfaced projects) to optimize plant establishment for each specific site. Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching as necessary. The refuge staff would use native material, where appropriate and feasible. The refuge staff would use certified weed-free or weed-seed-free hay or straw where certified materials are reasonably available.
- The refuge staff would provide information, training, and appropriate pest identification materials to permit holders and recreational visitors. The refuge staff would educate them about pest identification, biology, impacts, and effective prevention measures.
- The refuge staff would require grazing permittees to utilize preventative measures for their livestock while on refuge lands.

- The refuge staff would inspect borrow material for invasive plants prior to use and transport onto and/or within refuge lands.
- The refuge staff would consider invasive plants in planning for road maintenance activities.
- The refuge staff would restrict off-road travel to designated routes.

The following would be methods to prevent the introduction and/or spread of pests into refuge waters:

- The refuge staff would inspect boats (including air boats), trailers, and other boating equipment. Where possible, the refuge staff would remove any visible plants, animals, or mud before leaving any waters or boat launching facilities. Where possible, the refuge staff would drain water from motor, live well, bilge, and transom wells while on land before leaving the site. If possible, the refuge staff would wash and dry boats, downriggers, anchors, nets, floors of boats, propellers, axles, trailers, and other boating equipment to kill pests not visible at the boat launch.
- Where feasible, the refuge staff would maintain a 100-foot buffer of aquatic pest-free clearance around boat launches and docks or quarantine areas when cleaning around culverts, canals, or irrigation sites. Where possible, the refuge staff would inspect and clean equipment before moving to new sites or one project area to another.

These prevention methods to minimize/eliminate the introduction and/or spread of pests were taken verbatim or slightly modified from Appendix E of the U.S. Forest Service's Preventing and Managing Invasive Plants Final Environmental Impact Statement (2005).

G.3.2 Mechanical/Physical Methods

These methods would remove and destroy, disrupt the growth of, or interfere with the reproduction of pest species. For plants species, these treatments can be accomplished by hand, hand tool (manual), or power tools (mechanical) and include pulling, grubbing, digging, tilling/disking, cutting, swathing, grinding, shearing, girdling, mowing, and mulching of the pest plants.

For animal species, Service employees or their authorized agents could use mechanical/physical methods (including trapping) to control pests as a refuge management activity. Based upon 50 CFR 31.2, trapping can be used on a refuge to reduce surplus wildlife populations for a "balanced conservation program" in accordance with federal or state laws and regulations. In some cases, non-lethally trapped animals would be relocated to off-refuge sites with prior approval from the state.

Each of these tools would be efficacious to some degree and applicable to specific situations. In general, mechanical controls can effectively control annual and biennial pest plants. However, to control perennial plants, the root system has to be destroyed or it would resprout and continue to grow and develop. Mechanical controls are typically not capable of destroying a perennial plant's root system. Although some mechanical tools (e.g., disking, plowing) may damage root systems, they may stimulate regrowth producing a denser plant population that may aid in the spread depending upon the target species (e.g., Canada thistle). In addition, steep terrain and soil conditions would be major factors that can limit the use of many mechanical control methods.

Some mechanical control methods (e.g., mowing), which would be used in combination with herbicides, can be a very effective technique to control perennial species. For example, mowing

perennial plants followed sequentially by treating the plant regrowth with a systemic herbicide often would improve the efficacy of the herbicide compared to herbicide treatment only.

G.3.3 Cultural Methods

These methods would involve manipulating habitat to increase pest mortality by reducing its suitability to the pest. Cultural methods would include water-level manipulation, mulching, winter cover crops, changing planting dates to minimize pest impact, prescribed burning (facilitate revegetation, increase herbicide efficacy, and remove litter to assist in emergence of desirable species), flaming with propane torches, trap crops, crop rotations that would include non-susceptible crops, moisture management, addition of beneficial insect habitat, reducing clutter, proper trash disposal, planting or seeding desirable species to shade or out-compete invasive plants, applying fertilizer to enhance desirable vegetation, prescriptive grazing, and other habitat alterations.

G.3.4 Biological Control Agents

Classical biological control would involve the deliberate introduction and management of natural enemies (parasites, predators, or pathogens) to reduce pest populations. Many of the most ecologically or economically damaging pest species in the United States originated in foreign countries. These newly introduced pests, which are free from natural enemies found in their country or region of origin, may have a competitive advantage over cultivated and native species. This competitive advantage often allows introduced species to flourish, and they may cause widespread economic damage to crops or out compete and displace native vegetation. Once the introduced pest species population reaches a certain level, traditional methods of pest management may be cost prohibitive or impractical. Biological controls typically are used when these pest populations have become so widespread that eradication or effective control would be difficult or no longer practical.

Biological control has advantages as well as disadvantages. Benefits would include reducing pesticide usage, host specificity for target pests, long-term self-perpetuating control, low cost/acre, capacity for searching and locating hosts, synchronizing biological control agents to hosts' life cycles, and the unlikelihood that hosts will develop resistance to agents. Disadvantages would include the following: limited availability of agents from their native lands, the dependence of control on target species density, slow rate at which control occurs, biotype matching, the difficulty and expense of conflicts over control of the target pest, and host specificity when host populations are low.

A reduction in target species populations from biological controls is typically a slow process, and efficacy can be highly variable. It may not work well in a particular area although it does work well in other areas. Biological control agents would require specific environmental conditions to survive over time. Some of these conditions are understood; whereas, others are only partially understood or not at all.

Biological control agents would not eradicate a target pest. When using biological control agents, residual levels of the target pest typically are expected; the agent population level or survival would be dependent upon the density of its host. After the pest population decreases, the population of the biological control agent would decrease correspondingly. This is a natural cycle. Some pest populations (e.g., invasive plants) would tend to persist for several years after a biological control

agent becomes established due to seed reserves in the soil, inefficiencies in the agents search behavior, and the natural lag in population buildup of the agent.

The full range of pest groups potentially found on refuge lands and waters would include diseases, invertebrates (insects, mollusks), vertebrates, and invasive plants (the most common group). Often it is assumed that biological control would address many if not most of these pest problems. There are several well-documented success stories of biological control of invasive weed species in the Pacific Northwest including Mediterranean sage, St. Johnswort (Klamath weed) and tansy ragwort. Emerging success stories include Dalmatian toadflax, diffuse knapweed, leafy spurge, purple loosestrife and yellow star thistle. However, historically, each new introduction of a biological control agent in the United States has only about a 30% success rate (Coombs et al. 2004). Refer to Coombs et al. (2004) for the status of biological control agents for invasive plants in the Pacific Northwest.

Introduced species without desirable close relatives in the United States would generally be selected as biological controls. Natural enemies that are restricted to one or a few closely related plants in their country of origin are targeted as biological controls (Center et al. 1997, Hasan and Ayres 1990).

The refuge staff would ensure introduced agents are approved by the applicable authorities. Except for a small number of formulated biological control products registered by USEPA under FIFRA, most biological control agents are regulated by the U.S. Department of Agriculture (USDA)-Animal Plant Health Inspection Service, Plant Protection and Quarantine (APHIS-PPQ). State departments of agriculture and, in some cases, county agricultural commissioners or weed districts, have additional approval authority.

Federal permits (USDA-APHIS-PPQ Form 526) are required to import biocontrols agents from another state. Form 526 may be obtained by writing:

USDA-APHIS-PPQ
Biological Assessment and Taxonomic Support
4700 River Road, Unit 113
Riverdale, MD 20737

Or through the internet at:

http://www.aphis.usda.gov/ppq/permits/bioligical/weedbio.html

The Service strongly supports the development, and legal and responsible use of appropriate, safe, and effective biological control agents for nuisance and non-indigenous or pest species.

State and county agriculture departments may also be sources for biological control agents or they may have information about where biological control agents may be obtained. Commercial sources should have an Application and Permit to Move Live Plant Pests and Noxious Weeds (USDA-PPQ Form 226 USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, MD 20737) to release specific biological control agents in a state and/or county. Furthermore, certification regarding the biological control agent's identity (genus, specific epithet, sub-species and variety) and purity (e.g., parasite free, pathogen free, and biotic and abiotic contaminants) should be specified in purchase orders.

Biological control agents are subject to 7 RM 8 (Exotic Species Introduction and Management). In addition, the refuge staff would follow the International Code of Best Practice for Classical

Biological Control of Weeds (http://sric.ucdavis.edu/exotic/exotic.htm) as ratified by delegates to the X International Symposium on Biological Control of Weeds, Bozeman, MT, July 9, 1999. This code identifies the following:

- Release only approved biological control agents,
- Use the most effective agents,
- Document releases, and
- Monitor for impact to the target pest, non-target species, and the environment.

Biological control agents formulated as pesticide products and registered by the USEPA (e.g., *Bti*) are also subject to PUP review and approval (see below).

A record of all releases would be maintained with date(s), location(s), and environmental conditions of the release site(s); the identity, quantity, and condition of the biological control agents released; and other relevant data and comments such as weather conditions. Systematic monitoring to determine the establishment and effectiveness of the release is also recommended.

NEPA documents regarding biological and other environmental effects of biological control agents prepared by another federal agency, where the scope is relevant to evaluation of releases on refuge lands, would be reviewed. Possible source agencies for such NEPA documents include the Bureau of Land Management, U.S. Forest Service, National Park Service, U.S. Department of Agriculture-Animal and Plant Health Inspection Service, and the military services. It might be appropriate to incorporate by reference parts or all of existing document(s) from the review. Incorporating by reference (43 CFR 46.135) is a technique used to avoid redundancies in analysis. It also can reduce the bulk of a Service NEPA document, which only must identify the documents that are incorporated by reference. In addition, relevant portions must be summarized in the Service NEPA document to the extent necessary to provide the decision maker and public with an understanding of relevance of the referenced material to the current analysis.

G.3.5 Pesticides

The selective use of pesticides would be based upon pest ecology (including mode of reproduction), the size and distribution of its populations, site-specific conditions (e.g., soils, topography), known efficacy under similar site conditions, and the capability to utilize best management practices (BMPs) to reduce/eliminate potential effects to non-target species, sensitive habitats, and potential to contaminate surface and groundwater. All pesticide usage (pesticide, target species, application rate, and method of application) would comply with the applicable federal (FIFRA) and state regulations pertaining to pesticide use, safety, storage, disposal, and reporting. Before pesticides can be used to eradicate, control, or contain pests on refuge lands and waters, pesticide use proposals (PUPs) would be prepared and approved in accordance with 569 FW 1. PUP records would provide a detailed, time-, site-, and target-specific description of the proposed use of pesticides on the Refuge. All PUPs would be created, approved or disapproved, and stored in the Pesticide Use Proposal System (PUPS), which is a centralized database only accessible on the Service's intranet (https://systems.fws.gov/pups). Only Service employees would be authorized to access PUP records for a refuge in this database.

Application equipment would be selected to provide site-specific delivery to target pests while minimizing/eliminating direct or indirect (e.g., drift) exposure to non-target areas and degradation of surface and groundwater quality. Where possible, target-specific equipment (e.g., backpack sprayer,

wiper) would be used to treat target pests. Other target-specific equipment to apply pesticides would include soaked wicks or paint brushes for wiping vegetation and lances, hatchets, or syringes for direct injection into stems. Granular pesticides may be applied using seeders or other specialized dispensers. In contrast, aerial spraying (e.g., fixed wing or helicopter) would only be used where access is difficult (remoteness) and/or the size/distribution of infestations precludes practical use of ground-based methods.

Because repeated use of one pesticide may allow resistant organisms to survive and reproduce, multiple pesticides with variable modes of action would be considered for treatments on refuge lands and waters. This is especially important if multiple applications within years and/or over a growing season likely would be necessary for habitat maintenance and restoration activities to achieve resource objectives. Integrated chemical and non-chemical controls also are highly effective, where practical, because pesticide-resistant organisms can be removed from the site.

Cost may not be the primary factor in selecting a pesticide for use on a refuge. If the least expensive pesticide would potentially harm natural resources or people, then a different product would be selected, if available. The most efficacious pesticide available with the least potential to degrade environment quality (soils, surface water, and groundwater) as well as least potential effect to native species and communities of fish, wildlife, plants, and their habitats would be acceptable for use on refuge lands in the context of an IPM approach.

G.3.6 Habitat Restoration/Maintenance

Restoration and/or proper maintenance of refuge habitats associated with achieving wildlife and habitat objectives would be essential for long-term prevention, eradication, or control (at or below threshold levels) of pests. Promoting desirable plant communities through the manipulation of species composition, plant density, and growth rate is an essential component of invasive plant management (Masters et al. 1996, Masters and Shely 2001, Brooks et al. 2004). The following three components of succession could be manipulated through habitat maintenance and restoration: site availability, species availability, and species performance (Cox and Anderson 2004). Although a single method (e.g., herbicide treatment) may eliminate or suppress pest species in the short term, the resulting gaps and bare soil create niches that are conducive to further invasion by the species and/or other invasive plants. On degraded sites where desirable species are absent or in low abundance, revegetation with native/desirable grasses, forbs, and legumes may be necessary to direct and accelerate plant community recovery, and achieve site-specific objectives in a reasonable time frame. The selection of appropriate species for revegetation would be dependent on a number of factors including resource objectives and site-specific, abiotic factors (e.g., soil texture, precipitation/ temperature regimes, and shade conditions). Seed availability and cost, ease of establishment, seed production, and competitive ability also would be important considerations.

G.4 Priorities for Treatments

For many refuges, the magnitude (number, distribution, and sizes of infestations) of pest problems is too extensive and beyond the available capital resources to effectively address during any single field season. To manage pests in the Refuge, it would be essential to prioritize treatment of infestations. Highest priority treatments would be focused on early detection and rapid response to eliminate infestations of new pests, if possible. This would be especially important for aggressive pests potentially impacting species, species groups, communities, and/or habitats associated refuge

purpose(s), NWRS resources of concern (federally listed species, migratory birds, selected marine mammals, and interjurisdictional fish), and native species for maintaining/restoring biological integrity, diversity, and environmental health.

The next priority would be treating established pests that appear in one or more previously un-infested areas. Moody and Mack (1988) demonstrated through modeling that small, new outbreaks of invasive plants eventually would infest an area larger than the established, source population. They also found that control efforts focusing on the large, main infestation rather than the new, small satellites reduced the chances of overall success. The lowest priority would be treating large infestations (sometimes monotypic stands) of well-established pests. In this case, initial efforts would focus upon containment of the perimeter followed by work to control/eradicate the established infested area. If containment and/or control of a large infestation is not effective, then efforts would focus upon halting pest reproduction or managing source populations. Maxwell et al. (2009) found treating fewer populations that are sources represents an effective long-term strategy to reduce of total number of invasive populations and decreasing meta-population growth rates.

Although state-listed noxious weeds would always be of high priority for management, other pest species known to cause substantial ecological impact would also be considered. For example, cheatgrass may not be listed by a state as noxious, but it can greatly alter fire regimes in shrub steppe habitats resulting in large monotypic stands that displace native bunch grasses, forbs, and shrubs. Pest control would likely require a multi-year commitment from the refuge staff. Essential to the long-term success of pest management would be pre- and post-treatment monitoring, assessment of the successes and failures of treatments, and development of new approaches when proposed methods do not achieve desired outcomes.

G.5 Best Management Practices (BMPs)

BMPs can minimize or eliminate possible effects associated with pesticide usage to non-target species and/or sensitive habitats as well as degradation of water quality from drift, surface runoff, or leaching. Based upon the Department of Interior Pesticide Use Policy (517 DM 1) and the Service Integrated Pest Management policy (569 FW 1), the use of applicable BMPs (where feasible) also would likely ensure that pesticide uses may not adversely affect federally listed species and/or their critical habitats through determinations made using the process described in 50 CFR part 402.
The following are BMPs pertaining to mixing/handling and applying pesticides for all ground-based treatments of pesticides, which would be considered and utilized, where feasible, based upon target- and site-specific factors and time-specific environmental conditions. Although not listed below, the most important BMP to eliminate/reduce potential impacts to non-target resources would be an IPM approach to prevent, control, eradicate, and contain pests.

G.5.1 Pesticide Handling and Mixing

- As a precaution against spilling, spray tanks would not be left unattended during filling.
- All pesticide containers would be triple rinsed and the rinsate would be used as water in the sprayer tank and applied to treatment areas.
- All pesticide spray equipment would be properly cleaned. Where possible, rinsate would be used as part of the make-up water in the sprayer tank and applied to treatment areas.
- The refuge staff would triple rinse and recycle (where feasible) pesticide containers.
- All unused pesticides would be properly discarded at a local “safe send” collection.

- Pesticides and pesticide containers would be lawfully stored, handled, and disposed of in accordance with the label and in a manner safeguarding human health, fish, and wildlife and prevent soil and water contaminant.
- The refuge staff would consider the water quality parameters (e.g., pH, hardness) that are important to ensure greatest efficacy where specified on the pesticide label.
- All pesticide spills would be addressed immediately using procedures identified in the refuge spill response plan.

G.5.2 Applying Pesticides

- Pesticide treatments would only be conducted by or under the supervision of Service personnel and non-Service applicators with the appropriate state or BLM certification to safely and effectively conduct these activities on refuge lands and waters.
- The refuge staff would comply with all federal, state, and local pesticide use laws and regulations as well as Departmental, Service, and NWRS pesticide-related policies. For example, the refuge staff would use application equipment and apply rates for the specific pest(s) identified on the pesticide label as required under FIFRA.
- Before each treatment season and prior to mixing or applying any product for the first time each season, all applicators would review the labels, MSDSs, and Pesticide Use Proposal (PUPs) for each pesticide, determining the target pest, appropriate mix rate(s), PPE, and other requirements listed on the pesticide label.
- A 1-foot no-spray buffer from the water's edge would be used, where applicable and where it does not detrimentally influence effective control of pest species.
- Use low-impact herbicide application techniques (e.g., spot treatment, cut stump, oil basal, Thinvert system applications) rather than broadcast foliar applications (e.g., boom sprayer, other larger tank wand applications), where practical.
- Use low-volume rather than high-volume foliar applications where low-impact methods above are not feasible or practical, to maximize herbicide effectiveness and ensure correct and uniform application rates.
- Applicators would use and adjust spray equipment to apply the coarsest droplet size spectrum with optimal coverage of the target species while reducing drift.
- Applicators would use the largest droplet size that results in uniform coverage.
- Applicators would use drift reduction technologies such as low-drift nozzles, where possible.
- Where possible, spraying would occur during low (average<7 mph and preferably 3 to 5 mph) and consistent direction wind conditions with moderate temperatures (typically <85°F).
- Where possible, applicators would avoid spraying during inversion conditions (often associated with calm and very low wind conditions) that can cause large-scale herbicide drift to non-target areas.
- Equipment would be calibrated regularly to ensure that the proper rate of pesticide is applied to the target area or species.
- Spray applications would be made at the lowest height for uniform coverage of target pests to minimize/eliminate potential drift.
- If windy conditions frequently occur during afternoons, spraying (especially boom treatments) would typically be conducted during early morning hours.
- Spray applications would not be conducted on days with >30% forecast for rain within 6 hours, except for pesticides that are rapidly rain fast (e.g., glyphosate in 1 hour) to minimize/eliminate potential runoff.

- Where possible, applicators would use drift retardant adjuvants during spray applications, especially adjacent to sensitive areas.
- Where possible, applicators would use a non-toxic dye to aid in identifying target area treated as well as potential over spray or drift. A dye can also aid in detecting equipment leaks. If a leak is discovered, the application would be stopped until repairs can be made to the sprayer.
- For pesticide uses associated with cropland and facilities management, buffers, as appropriate, would be used to protect sensitive habitats, especially wetlands and other aquatic habitats.
- When drift cannot be sufficiently reduced through altering equipment set up and application techniques, buffer zones may be identified to protect sensitive areas downwind of applications. The refuge staff would only apply adjacent to sensitive areas when the wind is blowing the opposite direction.
- Applicators would utilize scouting for early detection of pests to eliminate unnecessary pesticide applications.
- The refuge staff would consider timing of application so native plants are protected (e.g., senescence) while effectively treating invasive plants.
- Rinsate from cleaning spray equipment after application would be recaptured and reused or applied to an appropriate pest plant infestation.
- Application equipment (e.g., sprayer, ATV, tractor) would be thoroughly cleaned and PPE would be removed/disposed of on-site by applicators after treatments to eliminate the potential spread of pests to un-infested areas.
- Cleaning boots (or use rubber boots to aid in sanitation) and brush off clothing in a place where monitoring is feasible to control for new seed transportation.

G.6 Safety

G.6.1 Personal Protective Equipment

All applicators would wear the specific personal protective equipment (PPE) identified on the pesticide label. The appropriate PPE would be worn at all times during handling, mixing, and applying. PPE can include the following: disposable (e.g., Tyvek) or laundered coveralls; gloves (latex, rubber, or nitrile); rubber boots; and/or an NIOSH-approved respirator. Because exposure to concentrated product is usually greatest during mixing, extra care should be taken while preparing pesticide solutions. Persons mixing these solutions can be best protected if they wear long gloves, an apron, footwear, and a face shield.

Coveralls and other protective clothing used during an application would be laundered separately from other laundry items. Transporting, storing, handling, mixing and disposing of pesticide containers would be consistent with label requirements, USEPA and OSHA requirements, and Service policy.

If a respirator is necessary for a pesticide use, then the following requirements would be met in accordance with Service safety policy: a written Respirator Program, fit testing, physical examination (including pulmonary function and blood work for contaminants), and proper storage of the respirator.

G.6.2 Notification

The restricted entry interval (REI) is the time period required after the application at which point someone may safely enter a treated area without PPE. Refuge staff, authorized management agents of the Service, volunteers, and members of the public who could be in or near a pesticide treated area within the stated re-entry time period on the label would be notified about treatment areas. Posting would occur at any site where individuals might inadvertently become exposed to a pesticide during other activities on the Refuge. Where required by the label and/or state-specific regulations, sites would also be posted on its perimeter and at other likely locations of entry. The refuge staff would also notify appropriate private property owners of an intended application, including any private individuals who have requested notification. Special efforts would be made to contact nearby individuals who are beekeepers or who have expressed chemical sensitivities.

G.6.3 Medical Surveillance

Medical surveillance may be required for Service personnel and approved volunteers who mix, apply, and/or monitor use of pesticides (see 242 FW 7 [Pesticide Users] and 242 FW 4 [Medical Surveillance]). In accordance with 242 FW 7.12A, Service personnel would be medically monitoring if one or more of the following criteria is met: exposed or may be exposed to concentrations at or above the published permissible exposure limits or threshold limit values (see 242 FW 4); use pesticides in a manner considered "frequent pesticide use"; or use pesticides in a manner that requires a respirator (see 242 FW 14 for respirator use requirements). In 242 FW 7.7A, "**Frequent Pesticide Use** means when a person applying pesticide handles, mixes, or applies pesticides, with a Health Hazard rating of 3 or higher, for 8 or more hours in any week or 16 or more hours in any 30-day period." Under some circumstances, individuals may be medically monitored who use pesticides infrequently (see Section G.7.7), experience an acute exposure (sudden, short-term), or use pesticides with a health hazard ranking of 1 or 2. This decision would consider the individual's health and fitness level, the pesticide's specific health risks, and the potential risks from other pesticide-related activities. Refuge cooperators (e.g., cooperative farmers) and other authorized agents (e.g., state and county employees) would be responsible for their own medical monitoring needs and costs.

Standard examinations (at refuge expense) of appropriate refuge staff would be provided by the nearest certified occupational health and safety physician as determined by Federal Occupational Health.

G.6.4 Certification and Supervision of Pesticide Applicators

Appropriate refuge staff or approved volunteers handling, mixing, and/or applying or directly supervising others engaged in pesticide use activities would be trained and state or federally (BLM) licensed to apply pesticides to refuge lands or waters. In accordance with 242 FW 7.18A and 569 FW 1.10B, certification is required to apply restricted use pesticides based upon USEPA regulations. For safety reasons, all individuals participating in pest management activities with general use pesticides also are encouraged to attend appropriate training or acquire pesticide applicator certification. The certification requirement would be for a commercial or private applicator depending upon the state. New staff unfamiliar with proper procedures for storing, mixing, handling, applying, and disposing of herbicides and containers would receive orientation and training before handling or using any products. Documentation of training would be kept in the files at the refuge office.

G.6.5 Record Keeping

Labels and material safety data sheets
Pesticide labels and material safety data sheets (MSDSs) would be maintained at the refuge shop and laminated copies in the mixing area. These documents also would be carried by field applicators, where possible. A written reference (e.g., note pad, chalk board, dry erase board) for each tank to be mixed would be kept in the mixing area for quick reference while mixing is in progress. In addition, approved PUPs stored in the PUPS database typically contain website links (URLs) to pesticide labels and MSDSs.

Pesticide use proposals (PUPs)
A PUP would be prepared for each proposed pesticide use associated with annual pest management on refuge lands and waters. A PUP would include specific information about the proposed pesticide use including the common and chemical names of the pesticide(s), target pest species, size and location of treatment site(s), application rate(s) and method(s), and federally listed species determinations, where applicable.

In accordance with Service guidelines (Director's memo [December 12, 2007]), refuge staff may receive up to five-year approvals for Washington Office and field reviewed proposed pesticide uses based upon meeting identified criteria including an approved IPM plan, where necessary (see http://www.fws.gov/contaminants/Issues/IPM.cfm). For a refuge, an IPM plan (requirements described herein) can be completed independently or in association with a CCP or a habitat management plan (HMP) if IPM strategies and potential environmental effects are adequately addressed within appropriate NEPA documentation.

PUPs would be created, approved or disapproved, and stored as records in the Pesticide Use Proposal System (PUPS), which is centralized database on the Service's intranet (https://systems.fws.gov/pups). Only Service employees can access PUP records in this database.

Pesticide usage
In accordance with 569 FW 1, the refuge Project Leader would be required to maintain records of all pesticides annually applied on lands or waters under refuge jurisdiction. This would encompass pesticides applied by other federal agencies, state and county governments, non-government applicators including cooperators and their pest management service providers with Service permission. For clarification, pesticide means all insecticides, insect and plant growth regulators, desiccants, herbicides, fungicides, rodenticides, acaricides, nematicides, fumigants, avicides, and piscicides.

The following usage information can be reported for approved PUPs in the PUPS database:

- Pesticide trade name(s)
- Active ingredient(s)
- Total acres treated
- Total amount of pesticides used (lbs. or gallons)
- Total amount of active ingredient(s) used (lbs.)
- Target pest(s)
- Efficacy (% control)

To determine whether treatments are efficacious (eradicating, controlling, or containing the target pest) and achieving resource objectives, habitat and/or wildlife response would be monitored both pre- and post-treatment, where possible. Considering available annual funding and staffing, appropriate monitoring data regarding characteristics (attributes) of pest infestations (e.g., area, perimeter, degree of infestation-density, % cover, density) as well as habitat and/or wildlife response to treatments may be collected and stored in a relational database (e.g., Refuge Habitat Management Database), preferably a geo-referenced data management system (e.g., Refuge Lands GIS) to facilitate data analyses and subsequent reporting. In accordance with adaptive management, data analysis and interpretation would allow treatments to be modified or changed over time, as necessary, to achieve resource objectives considering site-specific conditions in conjunction with habitat and/or wildlife responses. Monitoring could also identify short- and long-term impacts to natural resources and environmental quality associated with IPM treatments in accordance with adaptive management principles identified in 43 CFR 46.145.

G.7 Evaluating Pesticide Use Proposals

Pesticides would only be used on refuge lands for habitat management as well as croplands/facilities maintenance after approval of a PUP. In general, proposed pesticide uses on refuge lands would only be approved where there would likely be minor, temporary, or localized effects to fish and wildlife species as well as minimal potential to degrade environmental quality. Potential effects to listed and non-listed species would be evaluated with quantitative ecological risk assessments and other screening measures. Potential effects to environmental quality would be based upon pesticide characteristics of environmental fate (water solubility, soil mobility, soil persistence, and volatilization) and other quantitative screening tools. Ecological risk assessments as well as characteristics of environmental fate and potential to degrade environmental quality for pesticides would be documented in Chemical Profiles (see Section G.7.5). These profiles would include threshold values for quantitative measures of ecological risk assessments and screening tools for environmental fate that represent minimal potential effects to species and environmental quality. In general, only pesticide uses with appropriate BMPs (see Section G.4) for habitat management and cropland/facilities maintenance on refuge lands that would potentially have minor, temporary, or localized effects on refuge biological and environmental quality (threshold values not exceeded) would be approved.

G.7.1 Overview of Ecological Risk Assessment

An ecological risk assessment process would be used to evaluate potential adverse effects to biological resources as a result of a pesticide(s) proposed for use on refuge lands. It is an established quantitative and qualitative methodology for comparing and prioritizing risks of pesticides and conveying an estimate of the potential risk for an adverse effect. This quantitative methodology provides an efficient mechanism to integrate best available scientific information regarding hazard, patterns of use (exposure), and dose-response relationships in a manner that is useful for ecological risk decision-making. It would provide an effective way to evaluate potential effects where there is missing or unavailable scientific information (data gaps) to address reasonable, foreseeable adverse effects in the field as required under 40 CFR Part 1502.22. Protocols for ecological risk assessment of pesticide uses on the Refuge were developed through research and established by the U.S. Environmental Protection Agency (2004). Assumptions for these risk assessments are presented in Section G.7.2.

The toxicological data used in ecological risk assessments are typically results of standardized laboratory studies provided by pesticide registrants to the USEPA to meet regulatory requirements under FIFRA. These studies assess the acute (lethality) and chronic (reproductive) effects associated with short- and long-term exposure to pesticides on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. Other effects data publicly available would also be utilized for risk assessment protocols described herein. Toxicity endpoint and environmental fate data are available from a variety of resources. Some of the more useful resources can be found in Section G.7.5.

Table G-1. Ecotoxicity tests used to evaluate potential effects to birds, fish, and mammals to establish toxicity endpoints for risk quotient calculations

Species Group	Exposure	Measurement endpoint
Bird	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[1]
Fish	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[2]
Mammal	Acute	Oral Lethal Dose (LD_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[3]

[1]Measurement endpoints typically include a variety of reproductive parameters (e.g., number of eggs, number of offspring, eggshell thickness, and number of cracked eggs).
[2]Measurement endpoints for early life stage/life cycle typically include embryo hatch rates, time to hatch, growth, and time to swim-up.
[3]Measurement endpoints include maternal toxicity, teratogenic effects or developmental anomalies, evidence of mutagenicity or genotoxicity, and interference with cellular mechanisms such as DNA synthesis and DNA repair.

G.7.2 Determining Ecological Risk to Fish and Wildlife

The potential for pesticides used on the Refuge to cause direct adverse effects to fish and wildlife would be evaluated using USEPA's Ecological Risk Assessment Process (USEPA 2004). This deterministic approach, which is based upon a two-phase process involving estimation of environmental concentrations and then characterization of risk, would be used for ecological risk assessments. This method integrates exposure estimates (estimated environmental concentration [EEC] and toxicological endpoints [e.g., LC_{50} and oral LD_{50}]) to evaluate the potential for adverse effects to species groups (birds, mammals, and fish) representative of legal mandates for managing units of the NWRS. This integration is achieved through risk quotients (RQs) calculated by dividing the EEC by acute and chronic toxicity values selected from standardized toxicological endpoints or published effect (Table G-1).

$$RQ = EEC/Toxicological\ Endpoint$$

The level of risk associated with direct effects of pesticide use would be characterized by comparing calculated RQs to the appropriate Level of Concern (LOC) established by U.S. Environmental Protection Agency (1998 [Table G-2]). The LOC represents a quantitative threshold value for screening potential adverse effects to fish and wildlife resources associated with pesticide use. The following are four exposure-species group scenarios that would be used to characterize ecological risk to fish and wildlife on the Refuge: acute-listed species, acute-nonlisted species, chronic-listed species, and chronic-nonlisted species.

Acute risk would indicate the potential for mortality associated with short-term dietary exposure to pesticides immediately after an application. For characterization of acute risks, median values from LC50 and LD50 tests would be used as toxicological endpoints for RQ calculations. In contrast, chronic risks would indicate the potential for adverse effects associated with long-term dietary exposure to pesticides from a single application or multiple applications over time (within a season and over years). For characterization of chronic risks, the no observed concentration (NOAEC) or no observed effect concentration (NOEC) for reproduction would be used as toxicological endpoints for RQ calculations. Where available, the NOAEC would be preferred over a NOEC value.

Listed species are those federally designated as threatened, endangered, or proposed in accordance with the Endangered Species Act of 1973 (16 USC 1531-1544, 87 Stat. 884, as amended-Public Law 93-205). For listed species, potential adverse effects would be assessed at the individual level because loss of individuals from a population could detrimentally impact a species. In contrast, risks to nonlisted species would consider effects at the population level. A RQ<LOC would indicate the proposed pesticide use "may affect, not likely to adversely affect" individuals (listed species) and it would not pose an unacceptable risk for adverse effects to populations (non-listed species) for each taxonomic group (Table G-2). In contrast, an RQ>LOC would indicate a "may affect, likely to adversely affect" for listed species and it would also pose unacceptable ecological risk for adverse effects to nonlisted species.

Table G-2. Presumption of unacceptable risk for birds, fish, and mammals (USEPA 1998)

Risk Presumption		**Level of Concern**	
		Listed Species	**Non-listed Species**
Acute	Birds	0.1	0.5
	Fish	0.05	0.5
	Mammals	0.1	0.5
Chronic	Birds	1.0	1.0
	Fish	1.0	1.0
	Mammals	1.0	1.0

Environmental exposure

Following release into the environment through application, pesticides would experience several different routes of environmental fate. Pesticides which would be sprayed can move through the air (e.g., particle or vapor drift) and may eventually end up in other parts of the environment such as non-target vegetation, soil, or water. Pesticides applied directly to the soil may be washed off the soil into nearby bodies of surface water (e.g., surface runoff) or may percolate through the soil to lower soil layers and groundwater (e.g., leaching) (Baker and Miller 1999, Pope et al. 1999, Butler et al. 1998, Ramsay et al. 1995, EXTOXNET 1993). Pesticides which would be injected into the soil may also be subject to the latter two fates. The aforementioned possibilities are by no means complete, but it does indicate movement of pesticides in the environment is very complex with transfers occurring continually among different environmental compartments. In some cases, these exchanges occur not only between areas that are close together, but it also may involve transportation of pesticides over long distances (Barry 2004, Woods 2004).

Terrestrial exposure

The ECC for exposure to terrestrial wildlife would be quantified using an USEPA screening-level approach (USEPA 2004). This screening-level approach is not affected by product formulation

because it evaluates pesticide active ingredient(s). This approach would vary depending upon the proposed pesticide application method: spray or granular.

Terrestrial-spray application

For spray applications, exposure would be determined using the Kanaga nomogram method (USEPA 2004, USEPA 2012, Pfleeger et al. 1996) through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3 (USEPA 2005). To estimate the maximum (initial) pesticide residue on short grass (<20 cm tall) as a general food item category for terrestrial vertebrate species, T-REX input variables would include the following from the pesticide label: maximum pesticide application rate (pounds active ingredient [acid equivalent]/acre) and pesticide half-life (days) in soil. Although there are other food item categories (tall grasses; broadleaf plants and small insects; and fruits, pods, seeds and large insects), short grass was selected because it would yield maximum EECs (240 ppm per lb. ai/acre) for worst-case risk assessments. Short grass is not representative of forage for carnivorous species (e.g., raptors), but it would characterize the maximum potential exposure through the diet of avian and mammalian prey items. Consequently, this approach would provide a conservative screening tool for pesticides that do not biomagnify.

For RQ calculations in T-REX, the model would require the weight of surrogate species and Mineau scaling factors (Mineau et al. 1996). Body weights of bobwhite quail and mallard are included in T-REX by default, but body weights of other organisms (Table 3) would be entered manually. The Mineau scaling factor accounts for small-bodied bird species that may be more sensitive to pesticide exposure than would be predicted only by body weight. Mineau scaling factors would be entered manually with values ranging from 1 to 1.55 that are unique to a particular pesticide or group of pesticides. If specific information to select a scaling factor is not available, then a value of 1.15 would be used as a default. Alternatively, zero would be entered if it is known that body weight does not influence toxicity of pesticide(s) being assessed. The upper bound estimate output from the T-REX Kanaga nomogram would be used as an EEC for calculation of RQs. This approach would yield a conservative estimate of ecological risk.

Table G-3. Average body weight of selected terrestrial wildlife species frequently used in research to establish toxicological endpoints (Dunning 1984)

Species	Body Weight (kg)
Mammal (15 g)	0.015
House sparrow	0.0277
Mammal (35 g)	0.035
Starling	0.0823
Red-winged blackbird	0.0526
Common grackle	0.114
Japanese quail	0.178
Bobwhite quail	0.178
Rat	0.200
Rock dove (aka pigeon)	0.542
Mammal (1,000 g)	1.000
Mallard	1.082
Ring-necked pheasant	1.135

Terrestrial – granular application

Granular pesticide formulations and pesticide-treated seed would pose a unique route of exposure for avian and mammalian species. The pesticide is applied in discrete units which birds or mammals might ingest accidentally with food items or intentionally as in the case of some bird species actively seeking and picking up gravel or grit to aid digestion or seed as a food source. Granules may also be consumed by wildlife foraging on earthworms, slugs or other soft-bodied soil organisms to which the granules may adhere.

Terrestrial wildlife RQs for granular formulations or seed treatments would be calculated by dividing the maximum milligrams of active ingredient (a.i.) exposed (e.g., EEC) on the surface of an area equal to 1 square foot by the appropriate LD50 value multiplied by the surrogate's body weight (Table G-3). An adjustment to surface area calculations would be made for broadcast, banded, and in-furrow applications. An adjustment also would be made for applications with and without incorporation of the granules. Without incorporation, it would be assumed that 100% of the granules remain on the soil surface available to foraging birds and mammals. Press wheels push granules flat with the soil surface, but they are not incorporated into the soil. If granules are incorporated in the soil during band or T-band applications or after broadcast applications, it would be assumed only 15% of the applied granules remain available to wildlife. It would be assumed that only 1% of the granules are available on the soil surface following in-furrow applications.

EECs for pesticides applied in granular form and as seed treatments would be determined considering potential ingestion rates of avian or mammalian species (e.g., 10-30% body weight/day). This would provide an estimate of maximum exposure that may occur as a result of granule or seed treatment spills such as those that commonly occur at end rows during application and planting. The availability of granules and seed treatments to terrestrial vertebrates would also be considered by calculating the loading per unit area (LD_{50}/ft^2) for comparison to USEPA Level of Concerns (USEPA 1998). The T-REX version 1.2.3 (USEPA 2005) contains a submodel which automates Kanaga exposure calculations for granular pesticides and treated seed.

The following formulas would be used to calculate EECs depending upon the type of granular pesticide application:

- In-furrow applications assume a typical value of 1% granules, bait, or seed remain unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}580\ mg/lbs)(1\%\ exposed))] / \{[(43{,}560\ ft.^2/acre)/(row\ spacing\ (ft.))] / (row\ spacing\ (ft.)\}$$

or

$$mg\ a.i./ft^2 = [(lbs\ product/1{,}000\ ft.\ row)(\%\ a.i.)(1{,}000\ ft\ row)(453{,}580\ mg/lb.)(1\%\ exposed)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Incorporated banded treatments assume that 15% of granules, bait, and seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/1{,}000\ row\ ft.)(\%\ a.i.)(453{,}580\ mg/lb.)(1\text{-}\%\ incorporated)] / (1{,}000\ ft.)(band\ width\ (ft.))$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Broadcast treatment without incorporation assumes 100% of granules, bait, seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}590\ mg/lb.)] / (43{,}560\ ft.^2/acre)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

Where:

- *% of pesticide biologically available = 100% without species specific ingestion rates*
- *Conversion for calculating mg a.i./ft.^{2} using ounces: 453,580 mg/lb. /16 = 28,349 mg/oz.*

The following equation would be used to calculate an RQ based on the EEC calculated by one of the above equations. The EEC would be divided by the surrogate LD_{50} toxicological endpoint multiplied by the body weight (Table G-3) of the surrogate.

$$RQ = EEC / [LD_{50}\ (mg/kg) * body\ weight\ (kg)]$$

As with other risk assessments, an RQ>LOC would be a presumption of unacceptable ecological risk. An RQ<LOC would be a presumption of acceptable risk with only minor, temporary, or localized effects to species.

Aquatic exposure

Exposures to aquatic habitats (e.g., wetlands, meadows, ephemeral pools, water delivery ditches) would be evaluated separately for ground-based pesticide treatments of habitats managed for fish and wildlife compared with cropland/facilities maintenance. The primary exposure pathway for aquatic organisms from any ground-based treatments likely would be particle drift during the pesticide application. However, different exposure scenarios would be necessary as a result of contrasting application equipment and techniques as well as pesticides used to control pests on agricultural lands (especially those cultivated by cooperative farmers for economic return from crop yields) and facilities maintenance (e.g., roadsides, parking lots, trails) compared with other managed habitats on the Refuge. In addition, pesticide applications may be done <25 feet of the high water mark of aquatic habitats for habitat management treatments; whereas, no-spray buffers (≥25 feet) would be used for croplands/facilities maintenance treatments.

Habitat treatments

For the worst-case exposure scenario to non-target aquatic habitats, EECs (Table 4) would be would be derived from Urban and Cook (1986) that assumes an intentional overspray to an entire, non-target water body (1-foot depth) from a treatment <25 feet from the high water mark using the max application rate (acid basis [see above]). However, use of BMPs for applying pesticides (see Section G.4.2) would likely minimize/eliminate potential drift to non-target aquatic habitats during actual treatments. If there would be unacceptable (acute or chronic) risk to fish and wildlife with the simulated 100% overspray (RQ>LOC), then the proposed pesticide use may be disapproved or the PUP would be approved at a lower application rate to minimize/eliminate unacceptable risk to aquatic organisms (RQ=LOC).

Table G-4. Estimated Environmental Concentrations (ppb) of pesticides in aquatic habitats (1 foot depth) immediately after direct application (Urban and Cook 1986)

Lbs/acre	EEC (ppb)
0.10	36.7
0.20	73.5
0.25	91.9
0.30	110.2
0.40	147.0
0.50	183.7
0.75	275.6
1.00	367.5
1.25	459.7
1.50	551.6
1.75	643.5
2.00	735.7
2.25	827.6
2.50	919.4
3.00	1,103.5
4.00	1,471.4
5.00	1,839
6.00	2,207
7.00	2,575
8.00	2,943
9.00	3,311
10.00	3,678

Cropland/facilities maintenance treatments

Field drift studies conducted by the Spray Drift Task Force, which is a joint project of several agricultural chemical businesses, were used to develop a generic spray drift database. From this database, the AgDRIFT computer model was created to satisfy USEPA pesticide registration spray drift data requirements and as a scientific basis to evaluate off-target movement of pesticides from particle drift and assess potential effects of exposure to wildlife. Several versions of the computer model have been developed (i.e., v2.01 through v2.10). The Spray Drift Task Force AgDRIFT® model version 2.01 (SDTF 2003, AgDRIFT 2001) would be used to derive EECs resulting from drift of pesticides to refuge aquatic resources from ground-based pesticide applications >25 feet from the high water mark. The Spray Drift Task Force AgDRIFT model is publicly available at http://www.agdrift.com. At this website, click "AgDRIFT 2.0" and then click "Download Now" and follow the instructions to obtain the computer model.

The AgDRIFT model is composed of submodels called tiers. Tier I Ground submodel would be used to assess ground-based applications of pesticides. Tier outputs (EECs) would be calculated with AgDRIFT using the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium droplet size, EPA-defined wetland, and a ≥25-foot distance (buffer) from treated area to water.

Use of information on effects of biological control agents, pesticides, degradates, and adjuvants

NEPA documents regarding biological and other environmental effects of biological control agents, pesticides, degradates, and adjuvants prepared by another federal agency, where the scope would be

relevant to evaluation of effects from pesticide uses on refuge lands, would be reviewed. Possible source agencies for such NEPA documents would include the Bureau of Land Management, U.S. Forest Service, National Park Service, U.S. Department of Agriculture-Animal and Plant Health Inspection Service, and the military services. It might be appropriate to incorporate by reference parts or all of existing document(s). Incorporating by reference (40 CFR 1502.21) is a technique used to avoid redundancies in analysis. It also would reduce the bulk of a Service NEPA document, which only would identify the documents that are incorporated by reference. In addition, relevant portions would be summarized in the Service NEPA document to the extent necessary to provide the decision maker and public with an understanding of relevance of the referenced material to the current analysis.

In accordance with the requirements set forth in 43 CFR 46.135, the Service would specifically incorporate through reference ecological risk assessments prepared by the U.S. Forest Service (http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm) and Bureau of Land Management (http://www.blm.gov/wo/st/en/prog/more/veg_eis.html). These risk assessments and associated documentation also are available in total with the administrative record for the Final Environmental Impact Statement entitled *Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants* (USFS 2005) and *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS* (PEIS) (BLM 2007). In accordance with 43 CFR 46.120(d), use of existing NEPA documents by supplementing, tiering to, incorporating by reference, or adopting previous NEPA environmental analyses would avoid redundancy and unnecessary paperwork.

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide and adjuvant uses prepared by the U.S. Forest Service would be incorporated by reference:

- 2,4-D
- Chlorsulfuron
- Clopyralid
- Dicamba
- Glyphosate
- Imazapic
- Imazapyr
- Metsulfuron methyl
- Picloram
- Sethoxydim
- Sulfometuron methyl
- Triclopyr
- Nonylphenol polyethylate (NPE) based surfactants

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide uses as well as evaluation of risks associated with pesticide degradates and adjuvants prepared by the Bureau of Land Management would be incorporated by reference:

- Bromacil
- Chlorsulfuron
- Diflufenzopyr

- Diquat
- Diuron
- Fluridone
- Imazapic
- Overdrive (diflufenzopyr and dicamba)
- Sulfometuron methyl
- Tebuthiuron
- Pesticide degradates and adjuvants (*Appendix D – Evaluation of risks from degradates, polyoxyethylene-amine (POEA) and R-11, and endocrine disrupting chemicals*)

Assumptions for ecological risk assessments

There are a number of assumptions involved with the ecological risk assessment process for terrestrial and aquatic organisms associated with utilization of the U.S. Environmental Protection Agency's (2004) process. These assumptions may be risk neutral or may lead to an over- or under-estimation of risk from pesticide exposure depending upon site-specific conditions. The following describes these assumptions, their application to the conditions typically encountered, and whether or not they may lead to recommendations that are risk neutral, underestimate, or overestimate ecological risk from potential pesticide exposure.

- Indirect effects would not be evaluated by ecological risk assessments. These effects include the mechanisms of indirect exposure to pesticides: consuming prey items (fish, birds, or small mammals), reductions in the availability of prey items, and disturbance associated with pesticide application activities.
- Exposure to a pesticide product can be assessed based upon the active ingredient. However, exposure to a chemical mixture (pesticide formulation) may result in effects that are similar or substantially different compared to only the active ingredient. Non-target organisms may be exposed directly to the pesticide formulation or only various constituents of the formulation as they dissipate and partition in the environment. If toxicological information for both the active ingredient and formulated product are available, then data representing the greatest potential toxicity would be selected for use in the risk assessment process (USEPA 2004). As a result, this conservative approach may lead to an overestimation of risk characterization from pesticide exposure.
- Because toxicity tests with listed or candidate species or closely related species are not available, data for surrogate species would be most often used for risk assessments. Specifically, bobwhite quail and mallard duck are the most frequently used surrogates for evaluating potential toxicity to federally listed avian species. Bluegill sunfish, rainbow trout, and fathead minnow are the most common surrogates for evaluating toxicity for freshwater fishes. However, sheep's head minnow can be an appropriate surrogate marine species for coastal environments. Rats and mice are the most common surrogates for evaluating toxicity for mammals. Interspecies sensitivity is a major source of uncertainty in pesticide assessments. As a result of this uncertainty, data are selected for the most sensitive species tested within a taxonomic group (birds, fish, and mammals) given the quality of the data is acceptable. If additional toxicity data for more species of organisms in a particular group are available, the selected data would not be limited to the species previously listed as common surrogates.
- The Kanaga nomogram outputs maximum EEC values that may be used to calculate an average daily concentration over a specified interval of time, which is referred to as a time-weighted-average (TWA). The maximum EEC would be selected as the exposure input for both acute and chronic risk assessments in the screening-level evaluations. The initial or

maximum EEC derived from the Kanaga nomogram represents the maximum expected instantaneous or acute exposure to a pesticide. Acute toxicity endpoints are determined using a single exposure to a known pesticide concentration typically for 48 to 96 hours. This value is assumed to represent ecological risk from acute exposure to a pesticide. On the other hand, chronic risk to pesticide exposure is a function of pesticide concentration and duration of exposure to the pesticide. An organism's response to chronic pesticide exposure may result from either the concentration of the pesticide, length of exposure, or some combination of both factors. Standardized tests for chronic toxicity typically involve exposing an organism to several different pesticide concentrations for a specified length of time (days, weeks, months, years or generations). For example, avian reproduction tests include a 10-week exposure phase. Because a single length of time is used in the test, time response data are usually not available for inclusion into risk assessments. Without time response data it is difficult to determine the concentration which elicited a toxicological response.

- Using maximum EECs for chronic risk estimates may result in an overestimate of risk, particularly for compounds that dissipate rapidly. Conversely, using TWAs for chronic risk estimates may underestimate risk if it is the concentration rather than the duration of exposure that is primarily responsible for the observed adverse effect. The maximum EEC would be used for chronic risk assessments although it may result in an overestimate of risk. TWAs may be used for chronic risk assessments, but they would be applied judiciously considering the potential for an underestimate or overestimate of risk. For example, the number of days exposure exceeds a Level of Concern may influence the suitability of a pesticide use. The greater the number of days the EEC exceeds the Level of Concern translates into greater the ecological risk. This is a qualitative assessment, and is subject to reviewer's expertise in ecological risk assessment and tolerance for risk.
- The length of time used to calculate the TWA can have a substantial effect on the exposure estimates and there is no standard method for determining the appropriate duration for this estimate. The T-REX model assumes a 21-week exposure period, which is equivalent to avian reproductive studies designed to establish a steady-state concentration for bioaccumulative compounds. However, this does not necessarily define the true exposure duration needed to elicit a toxicological response. Pesticides, which do not bioaccumulate, may achieve a steady-state concentration earlier than 21 weeks. The duration of time for calculating TWAs would require justification and it would not exceed the duration of exposure in the chronic toxicity test (approximately 70 days for the standard avian reproduction study). An alternative to using the duration of the chronic toxicity study is to base the TWA on the application interval. In this case, increasing the application interval would suppress both the estimated peak pesticide concentration and the TWA. Another alternative to using TWAs would be to consider the number of days that a chemical is predicted to exceed the LOC.
- Pesticide dissipation is assumed to be first-order in the absence of data suggesting alternative dissipation patterns such as bi-phasic. Field dissipation data would generally be the most pertinent for assessing exposure in terrestrial species that forage on vegetation. However, these data are often not available and it can be misleading particularly if the compound is prone to "wash-off." Soil half-life is the most common degradation data available. Dissipation or degradation data that would reflect the environmental conditions typical of refuge lands would be utilized, if available.
- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column.

- Actual habitat requirements of any particular terrestrial species are not considered, and it is assumed that species exclusively and permanently occupy the treated area, or adjacent areas receiving pesticide at rates commensurate with the treatment rate. This assumption would produce a maximum estimate of exposure for risk characterization. This assumption would likely lead to an overestimation of exposure for species that do not permanently and exclusively occupy the treated area (USEPA 2004).
- Exposure through incidental ingestion of pesticide contaminated soil is not considered in the USEPA risk assessment protocols. Research suggests <15% of the diet can consist of incidentally ingested soil depending upon species and feeding strategy (Beyer et al. 1994). An assessment of pesticide concentrations in soil compared to food item categories in the Kanaga nomogram indicates incidental soil ingestion would not likely increase dietary exposure to pesticides. Inclusion of soil into the diet would effectively reduce the overall dietary concentration compared to the present assumption that the entire diet consists of a contaminated food source (Fletcher et al. 1994). An exception to this may be soil-applied pesticides in which exposure from incidental ingestion of soil may increase. Potential for pesticide exposure under this assumption may be underestimated for soil-applied pesticides and overestimated for foliar-applied pesticides. The concentration of a pesticide in soil would likely be less than predicted on food items.
- Exposure through inhalation of pesticides is not considered in the USEPA risk assessment protocols. Such exposure may occur through three potential sources: spray material in droplet form at time of application, vapor phase with the pesticide volatilizing from treated surfaces, and airborne particulates (soil, vegetative matter, and pesticide dusts). The USEPA (1990) reported exposure from inhaling spray droplets at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size (particles reaching the lung) in birds is limited to maximum diameter of 2 to 5 microns. The spray droplet spectra covering the majority of pesticide application scenarios indicate that less than 1% of the applied material is within the respirable particle size. This route of exposure is further limited because the permissible spray drop size distribution for ground pesticide applications is restricted to ASAE medium or coarser drop size distribution.
- Inhalation of a pesticide in the vapor phase may be another source of exposure for some pesticides under certain conditions. This mechanism of exposure to pesticides occurs post application, and it would pertain to those pesticides with a high vapor pressure. The USEPA is currently evaluating protocols for modeling inhalation exposure from pesticides including near-field and near-ground air concentrations based upon equilibrium and kinetics-based models. Risk characterization for exposure with this mechanism is unavailable.
- The effect from exposure to dusts contaminated with the pesticide cannot be assessed generically as partitioning issues related to application site soils and chemical properties of the applied pesticides render the exposure potential from this route highly situation specific.
- Dermal exposure may occur through three potential sources: direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, incidental contact with contaminated vegetation, or contact with contaminated water or soil. Interception of spray and incidental contact with treated substrates may pose risk to avian wildlife (Driver et al. 1991). However, available research related to wildlife dermal contact with pesticides is extremely limited, except dermal toxicity values are common for some mammals used as human surrogates (rats and mice). The USEPA is currently evaluating protocols for modeling dermal exposure. Risk characterization may be underestimated for this route of exposure, particularly with high risk pesticides such as some organophosphates or carbamate

insecticides. If protocols are established by the USEPA for assessing dermal exposure to pesticides, they would be considered for incorporation into pesticide assessment protocols.

- Exposure to a pesticide may occur from consuming surface water, dew or other water on treated surfaces. Water soluble pesticides have the potential to dissolve in surface runoff and puddles in a treated area may contain pesticide residues. Similarly, pesticides with lower organic carbon partitioning characteristics and higher solubility in water have a greater potential to dissolve in dew and other water associated with plant surfaces. Estimating the extent to which such pesticide loadings to drinking water occurs is complex and would depend upon the partitioning characteristics of the active ingredient, soils types in the treatment area, and the meteorology of the treatment area. In addition, the use of various water sources by wildlife is highly species-specific. Currently, risk characterization for this exposure mechanism is not available. The USEPA is actively developing protocols to quantify drinking water exposures from puddles and dew. If and when protocols are formally established by the USEPA for assessing exposure to pesticides through drinking water, these protocols would be incorporated into pesticide risk assessment protocols.
- Risk assessments are based upon the assumption that the entire treatment area would be subject to pesticide application at the rates specified on the label. In most cases, there is potential for uneven application of pesticides through such plausible incidents such as changes in calibration of application equipment, spillage, and localized releases at specific areas in or near the treated field that are associated with mixing and handling and application equipment as well as applicator skill. Inappropriate use of pesticides and the occurrence of spills represent a potential underestimate of risk. It is likely not an important factor for risk characterization. All pesticide applicators are required to be certified by the state in which they apply pesticides. Certification training includes the safe storage, transport, handling, and mixing of pesticides; equipment calibration; and proper application with annual continuing education.
- The USEPA relies on Fletcher (1994) for setting the assumed pesticide residues in wildlife dietary items. The USEPA (2004) "believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify." Fletcher's (1994) research suggests that the pesticide active ingredient residue assumptions used by the USEPA represent a 95th percentile estimate. However, research conducted by Pfleeger et al. (1996) indicates USEPA residue assumptions for short grass was not exceeded. Baehr and Habig (2000) compared USEPA residue assumptions with distributions of measured pesticide residues for the USEPA's UTAB database. Overall residue selection level tends to overestimate risk characterization. This is particularly evident when wildlife individuals are likely to have selected a variety of food items acquired from multiple locations. Some food items may be contaminated with pesticide residues whereas others are not contaminated. However, it is important to recognize differences in species feeding behavior. Some species may consume whole above-ground plant material, but others will preferentially select different plant structures. Also, species may preferentially select a food item although multiple food items may be present. Without species specific knowledge regarding foraging behavior characterizing ecological risk other than in general terms is not possible.
- Acute and chronic risk assessments rely on comparisons of wildlife dietary residues with LC_{50} or NOEC values expressed as concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake

estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods are not accounting for a potentially important aspect of food requirements.

- There are several other assumptions that can affect non-target species not considered in the risk assessment process. These include possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic and biotic factors) and behavioral changes induced by exposure to a pesticide. These factors may exist at some level contributing to adverse effects to non-target species, but they are usually characterized in the published literature in only a general manner limiting their value in the risk assessment process.
- It is assumed that aquatic species exclusively and permanently occupy the water body being assessed. Actual habitat requirements of aquatic species are not considered. With the possible exception of scenarios where pesticides are directly applied to water, it is assumed that no habitat use considerations specific for any species would place the organisms in closer proximity to pesticide use sites. This assumption produces a maximum estimate of exposure or risk characterization. It would likely be realistic for many aquatic species that may be found in aquatic habitats within or in close proximity to treated terrestrial habitats. However, the spatial distribution of wildlife is usually not random because wildlife distributions are often related to habitat requirements of species. Clumped distributions of wildlife may result in an under- or over-estimation of risk depending upon where the initial pesticide concentration occurs relative to the species or species habitat.
- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column. Additional chemical exposure from materials associated with suspended solids or food items is not considered because partitioning onto sediments likely is minimal. Adsorption and bioconcentration occurs at lower levels for many newer pesticides compared with older more persistent bioaccumulative compounds. Pesticides with RQs close to the listed species level of concern, the potential for additional exposure from these routes may be a limitation of risk assessments, where potential pesticide exposure or risk may be underestimated.
- Mass transport losses of pesticide from a water body (except for losses by volatilization, degradation and sediment partitioning) would not be considered for ecological risk assessment. The water body would be assumed to capture all pesticide active ingredients entering as runoff, drift, and adsorbed to eroded soil particles. It would also be assumed that pesticide active ingredient is not lost from the water body by overtopping or flow-through, nor is concentration reduced by dilution. In total, these assumptions would lead to a near maximum possible water-borne concentration. However, this assumption would not account for the potential to concentrate pesticide through the evaporative loss. This limitation may have the greatest impact on water bodies with high surface-to-volume ratios such as ephemeral wetlands, where evaporative losses are accentuated and applied pesticides have low rates of degradation and volatilization.
- For acute risk assessments, there would be no averaging time for exposure. An instantaneous peak concentration would be assumed, where instantaneous exposure is sufficient in duration to elicit acute effects comparable to those observed over more protracted exposure periods (typically 48 to 96 hours) tested in the laboratory. In the absence of data regarding time-to-

toxic event, analyses and latent responses to instantaneous exposure, risk would likely be overestimated.

- For chronic exposure risk assessments, the averaging times considered for exposure are commensurate with the duration of invertebrate life-cycle or fish-early life stage tests (e.g., 21-28 days and 56-60 days, respectively). Response profiles (time to effect and latency of effect) to pesticides likely vary widely with mode of action and species and should be evaluated on a case-by-case basis as available data allow. Nevertheless, because the USEPA relies on chronic exposure toxicity endpoints based on a finding of no observed effect, the potential for any latent toxicity effects or averaging time assumptions to alter the results of an acceptable chronic risk assessment prediction is limited. The extent to which duration of exposure from water-borne concentrations overestimate or underestimate actual exposure depends on several factors. These include the following: localized meteorological conditions, runoff characteristics of the watershed (e.g., soils, topography), the hydrological characteristics of receiving waters, environmental fate of the pesticide active ingredient, and the method of pesticide application. It should also be understood that chronic effects studies are performed using a method that holds water concentration in a steady state. This method is not likely to reflect conditions associated with pesticide runoff. Pesticide concentrations in the field increase and decrease in surface water on a cycle influenced by rainfall, pesticide use patterns, and degradation rates. As a result of the dependency of this assumption on several undefined variables, risk associated with chronic exposure may in some situations underestimate risk and overestimate risk in others.
- There are several other factors that can affect non-target species not considered in the risk assessment process. These would include the following: possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic [not pesticides] and biotic factors), and sub-lethal effects such as behavioral changes induced by exposure to a pesticide. These factors may exist at some level contributing to adverse effects to non-target species, but they are not routinely assessed by regulatory agencies. Therefore, information on the factors is not extensive limiting their value for the risk assessment process. As this type of information becomes available, it would be included, either quantitatively or qualitatively, in this risk assessment process.
- USEPA is required by the Food Quality Protection Act to assess the cumulative risks of pesticides that share common mechanisms of toxicity, or act the same within an organism. Currently, USEPA has identified four groups of pesticides that have a common mechanism of toxicity requiring cumulative risk assessments. These four groups are: the organophosphate insecticides, N-methyl carbamate insecticides, triazine herbicides, and chloroacetanilide herbicides.

G.7.3 Pesticide Mixtures and Degradates

Pesticide products are usually a formulation of several components generally categorized as active ingredients and inert or other ingredients. The term active ingredient is defined by the FIFRA as preventing, destroying, repelling, or mitigating the effects of a pest, or it is a plant regulator, defoliant, desiccant, or nitrogen stabilizer. In accordance with FIFRA, the active ingredient(s) must be identified by name(s) on the pesticide label along with its relative composition expressed in percentage(s) by weight. In contrast, inert ingredient(s) are not intended to affect a target pest. Their role in the pesticide formulation is to act as a solvent (keep the active ingredient is a liquid phase), an

emulsifying or suspending agent (keep the active ingredient from separating out of solution), or a carrier (such as clay in which the active ingredient is impregnated on the clay particle in dry formulations). For example, if isopropyl alcohol would be used as a solvent in a pesticide formulation, then it would be considered an inert ingredient. FIFRA only requires that inert ingredients identified as hazardous and associated percent composition, and the total percentage of all inert ingredients must be declared on a product label. Inert ingredients that are not classified as hazardous are not required to be identified.

The USEPA (September 1997) issued Pesticide Regulation Notice 97-6, which encouraged manufacturers, formulators, producers, and registrants of pesticide products to voluntarily substitute the term "other ingredients" for "inert ingredients" in the ingredient statement. This change recognized that all components in a pesticide formulation potentially could elicit or contribute to an adverse effect on non-target organisms and, therefore, are not necessarily inert. Whether referred to as "inerts" or "other ingredients," these constituents within a pesticide product have the potential to affect species or environmental quality. The USEPA categorizes regulated inert ingredients into the following four lists (http://www.epa.gov/opprd001/inerts/index.html):

- List 1 – Inert Ingredients of Toxicological Concern
- List 2 – Potentially Toxic Inert Ingredients
- List 3 – Inerts of Unknown Toxicity
- List 4 – Inerts of Minimal Toxicity

Several of the List 4 compounds are naturally-occurring earthen materials (e.g., clay materials, simple salts) that would not elicit toxicological response at applied concentrations. However, some of the inerts (particularly the List 3 compounds and unlisted compounds) may have moderate to high potential toxicity to aquatic species based on MSDSs or published data.

Comprehensively assessing potential effects to non-target fish, wildlife, plants, and/or their habitats from pesticide use is a complex task. It would be preferable to assess the cumulative effects from exposure to the active ingredient, its degradates, and inert ingredients, as well as other active ingredients in the spray mixture. However, it would only be feasible to conduct deterministic risk assessments for each component in the spray mixture singly. Limited scientific information is available regarding ecological effects (additive or synergistic) from chemical mixtures that typically rely upon broadly encompassing assumptions. For example, the U.S. Forest Service (2005) found that mixtures of pesticides used in land (forest) management likely would not cause additive or synergistic effects to non-target species based upon a review of scientific literature regarding toxicological effects and interactions of agricultural chemicals (ATSDR 2004). Moreover, information on inert ingredients, adjuvants, and degradates is often limited by the availability of and access to reliable toxicological data for these constituents.

Toxicological information regarding "other ingredients" may be available from sources such as the following:

- TOMES (a proprietary toxicological database including USEPA's IRIS, the Hazardous Substance Data Bank, the Registry of Toxic Effects of Chemical Substances [RTECS]).
- USEPA's ECOTOX database, which includes AQUIRE (a database containing scientific papers published on the toxic effects of chemicals to aquatic organisms).
- TOXLINE (a literature searching tool).
- Material Safety Data Sheets (MSDSs) from pesticide suppliers.
- Other sources such as the Farm Chemicals Handbook.

Because there is a lack of specific inert toxicological data, inert(s) in a pesticide may cause adverse ecological effects. However, inert ingredients typically represent only a small percentage of the pesticide spray mixture, and it would be assumed that negligible effects would be expected to result from inert ingredient(s).

Although the potential effects of degradates should be considered when selecting a pesticide, it is beyond the scope of this assessment process to consider all possible breakdown chemicals of the various product formulations containing an active ingredient. Degradates may be more or less mobile and more or less hazardous in the environment than their parent pesticides (Battaglin et al. 2003). Differences in environmental behavior (e.g., mobility) and toxicity between parent pesticides and degradates would make assessing potential degradate effects extremely difficult. For example, a less toxic and more mobile, bioaccumulative, or persistent degradate may have potentially greater effects on species and/or degrade environmental quality. The lack of data on the toxicity of degradates for many pesticides would represent a source of uncertainty for assessing risk.

A USEPA-approved label specifies whether a product can be mixed with one or more pesticides. Without product-specific toxicological data, it would not possible to quantify the potential effects of these mixtures. In addition, a quantitative analysis could only be conducted if reliable scientific information allowed a determination of whether the joint action of a mixture would be additive, synergistic, or antagonistic. Such information would not likely exist unless the mode of action would be common among the chemicals and receptors. Moreover, the composition of and exposure to mixtures would be highly site- and/or time-specific and, therefore, it would be nearly impossible to assess potential effects to species and environmental quality.

To minimize or eliminate potential negative effects associated with applying two or more pesticides as a mixture, the use would be conducted in accordance with the labeling requirements. Labels for two or more pesticides applied as a mixture should be completely reviewed, where products with the least potential for negative effects would be selected for use on the Refuge. This is especially relevant when a mixture would be applied in a manner that may already have the potential for an effect(s) associated with an individual pesticide (e.g., runoff to ponds in sandy watersheds). Use of a tank mix under these conditions would increase the level of uncertainty in terms of risk to species or potential to degrade environmental quality.

Adjuvants generally function to enhance or prolong the activity of pesticide. For terrestrial herbicides, adjuvants aid in the absorption into plant tissue. Adjuvant is a broad term that generally applies to surfactants, selected oils, anti-foaming agents, buffering compounds, drift control agents, compatibility agents, stickers, and spreaders. Adjuvants are not under the same registration requirements as pesticides and the USEPA does not register or approve the labeling of spray adjuvants. Individual pesticide labels identify types of adjuvants approved for use with it. In general, adjuvants compose a relatively small portion of the volume of pesticides applied. Selection of adjuvants with limited toxicity and low volumes would be recommended to reduce the potential for the adjuvant to influence the toxicity of the pesticide.

G.7.4 Determining Effects to Soil and Water Quality

The approval process for pesticide uses would consider potential to degrade water quality on and off refuge lands. A pesticide can only affect water quality through movement away from the treatment

site. After application, pesticide mobilization can be characterized by one or more of the following (Kerle et al. 1996):

- Attach (sorb) to soil, vegetation, or other surfaces and remain at or near the treated area;
- Attach to soil and move off-site through erosion from runoff or wind;
- Dissolve in water that can be subjected to runoff or leaching.

As an initial screening tool, selected chemical characteristics and rating criteria for a pesticide can be evaluated to assess potential to enter ground and/or surface waters. These would include the following: persistence, sorption coefficient (K_{oc}), groundwater ubiquity score (GUS), and solubility.

Persistence, which is expressed as half-life ($t_{½}$), represents the length of time required for 50% of the deposited pesticide to degrade (completely or partially). Persistence in the soil can be categorized as the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996). Half-life data are usually available for aquatic and terrestrial environments.

Another measure of pesticide persistence is dissipation time (DT_{50}). It represents the time required for 50% of the deposited pesticide to degrade and move from a treated site; whereas, half-life describes the rate for degradation only. As for half-life, units of dissipation time are usually expressed in days. Field or foliar dissipation time is the preferred data for use to estimate pesticide concentrations in the environment. However, soil half-life is the most common persistence data cited in published literature. If field or foliar dissipation data are not available, soil half-life data may be used. The average or representative half-life value of most important degradation mechanism would be selected for quantitative analysis for both terrestrial and aquatic environments.

Mobility of a pesticide is a function of how strongly it is adsorbed to soil particles and organic matter, its solubility in water, and its persistence in the environment. Pesticides strongly adsorbed to soil particles, relatively insoluble in water, and not environmentally persistent would be less likely to move across the soil surface into surface waters or to leach through the soil profile and contaminate groundwater. Conversely, pesticides that are not strongly adsorbed to soil particles, are highly water soluble, and are persistent in the environment would have greater potential to move from the application site (off-site movement).

The degree of pesticide adsorption to soil particles and organic matter (Kerle et al. 1996) is expressed as the soil adsorption coefficient (K_{oc}). The soil adsorption coefficient is measured as micrograms of pesticide per gram of soil (µg/g) that can range from near zero to the thousands. Pesticides with higher K_{oc} values are strongly sorbed to soil and, therefore, would be less subject to movement.

Water solubility describes the amount of pesticide that would dissolve in a known quantity of water. The water solubility of a pesticide is expressed as milligrams of pesticide dissolved in a liter of water (mg/L or parts per million [ppm]). Pesticide with solubility <0.1 ppm are virtually insoluble in water, 100-1,000 ppm are moderately soluble, and >10,000 ppm highly soluble (USGS 2000). As pesticide solubility increases, there would be greater potential for off-site movement.

The Groundwater Ubiquity Score (GUS) is a quantitative screening tool to estimate a pesticide's potential to move in the environment. It utilizes soil persistence and adsorption coefficients in the following formula.

$$GUS = log_{10}(t_{½}) \times [4 - log_{10}(K_{oc})]$$

The potential pesticide movement rating would be based upon its GUS value. Pesticides with a GUS <0.1 would considered to have an extremely low potential to move toward groundwater. Values of 1.0-2.0 would be low, 2.0-3.0 would be moderate, 3.0-4.0 would be high, and >4.0 would have a very high potential to move toward groundwater.

Water solubility describes the amount of pesticide dissolving in a specific quantity of water, where it is usually measured as mg/L or ppm. Solubility is useful as a comparative measure because pesticides with higher values are more likely to move by runoff or leaching. GUS, water solubility, t½, and K_{oc} values are available for selected pesticides from the OSU Extension Pesticide Properties Database at http://npic.orst.edu/ppdmove.htm. Many of the values in this database were derived from the SCS/ARS/CES Pesticide Properties Database for Environmental Decision Making (Wauchope et al. 1992).

Soil properties influence the fate of pesticides in the environment. The following six properties are mostly likely to affect pesticide degradation and the potential for pesticides to move off-site by leaching (vertical movement through the soil) or runoff (lateral movement across the soil surface).

- Permeability is the rate of water movement vertically through the soil. It is affected by soil texture and structure. Coarse textured soils (e.g., high sand content) have a larger pore size and they are generally more permeable than fine textured soils (i.e., high clay content). The more permeable soils would have a greater potential for pesticides to move vertically down through the soil profile. Soil permeability rates (inches/hour) are usually available in county soil survey reports.
- Soil texture describes the relative percentage of sand, silt, and clay. In general, greater clay content with smaller the pore size would lower the likelihood and rate water that would move through the soil profile. Clay also serves to adsorb (bind) pesticides to soil particles. Soils with high clay content would adsorb more pesticide than soils with relatively low clay content. In contrast, sandy soils with coarser texture and lower water holding capacity would have a greater potential for water to leach through them.
- Soil structure describes soil aggregation. Soils with a well-developed soil structure have looser, more aggregated, structure that would be less likely to be compacted. Both characteristics would allow for less restricted flow of water through the soil profile resulting in greater infiltration.
- Organic matter would be the single most important factor affecting pesticide adsorption in soils. Many pesticides are adsorbed to organic matter which would reduce their rate of downward movement through the soil profile. Also, soils high in organic matter would tend to hold more water, which may make less water available for leaching.
- Soil moisture affects how fast water would move through the soil. If soils are already wet or saturated before rainfall or irrigation, excess moisture would run off rather than infiltrate into the soil profile. Soil moisture also would influence microbial and chemical activity in soil, which affects pesticide degradation.
- Soil pH would influence chemical reactions that occur in the soil which in turn determines whether or not a pesticide would degrade, rate of degradation, and, in some instances, which degradation products are produced.

Based upon the aforementioned properties, soils most vulnerable to groundwater contamination would be sandy soils with low organic matter. In contrast, the least vulnerable soils would be well-drained clayey soils with high organic matter. Consequently, pesticides with the lowest potential for movement in conjunction with appropriate best management practices (see below) would be used in

an IPM framework to treat pests while minimizing effects to non-target biota and protecting environmental quality.

Along with soil properties, the potential for a pesticide to affect water quality through runoff and leaching would consider site-specific environmental and abiotic conditions including rainfall, water table conditions, and topography (Huddleston 1996).

- Water is necessary to separate pesticides from soil. This can occur in two basic ways. Pesticides that are soluble move easily with runoff water. Pesticide-laden soil particles can be dislodged and transported from the application site in runoff. The concentration of pesticides in the surface runoff would be greatest for the first runoff event following treatment. The rainfall intensity and route of water infiltration into soil, to a large extent, determine pesticide concentrations and losses in surface runoff. The timing of the rainfall after application also would have an effect. Rainfall interacts with pesticides at a shallow soil depth (¼ to ½ inch), which is called the mixing zone (Baker and Miller 1999). The pesticide/water mixture in the mixing zone would tend to leach down into the soil or runoff depending upon how quickly the soil surface becomes saturated and how rapidly water can infiltrate into the soil. Leaching would decrease the amount of pesticide available near the soil surface (mixing zone) to runoff during the initial rainfall event following application and subsequent rainfall events.
- Terrain slope would affect the potential for surface runoff and the intensity of runoff. Steeper slopes would have greater potential for runoff following a rainfall event. In contrast, soils that are relatively flat would have little potential for runoff, except during intense rainfall events. In addition, soils in lower areas would be more susceptible to leaching as a result of receiving excessive water from surrounding higher elevations.
- Depth to groundwater would be an important factor affecting the potential for pesticides to leach into groundwater. If the distance from the soil surface to the top of the water table is shallow, pesticides would have less distance to travel to reach groundwater. Shallower water tables that persist for longer periods would be more likely to experience groundwater contamination. Soil survey reports are available for individual counties. These reports provide data in tabular format regarding the water table depths and the months during which it persists. In some situations, a hard pan exists above the water table that would prevent pesticide contamination from leaching.

G.7.5 Determining Effects to Air Quality

Pesticides may volatilize from soil and plant surfaces and move from the treated area into the atmosphere. The potential for a pesticide to volatilize is determined by the pesticide's vapor pressure which would be affected by temperature, sorption, soil moisture, and the pesticide's water solubility. Vapor pressure is often expressed in mm Hg. To make these numbers easier to compare, vapor pressure may be expressed in exponent form ($I \times 10^{-7}$), where I represents a vapor pressure index. In general, pesticides with $I<10$ would have a low potential to volatilize; whereas, pesticides with $I>1{,}000$ would have a high potential to volatilize (OSU 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database.

G.7.6 Preparing a Chemical Profile

The following instructions would be used by Service personnel to complete Chemical Profiles for pesticides. Specifically, profiles would be prepared for pesticide active ingredients (e.g., glyphosate,

imazapic) that would be contained in one or more trade name products that are registered and labeled with USEPA. All information fields under each category (e.g., Toxicological Endpoints, Environmental Fate) would be completed for a Chemical Profile. If no information is available for a specific field, then "No data are available in references" would be recorded in the profile. Available scientific information would be used to complete Chemical Profiles. Each entry of scientific information would be shown with applicable references.

Completed Chemical Profiles would provide a structured decision-making process utilizing quantitative assessment/screening tools with threshold values (where appropriate) that would be used to evaluate potential biological and other environmental effects to refuge resources. For ecological risk assessments presented in these profiles, the "worst-case scenario" would be evaluated to determine whether a pesticide could be approved for use considering the maximum single application rate specified on pesticide labels for habitat management and croplands/facilities maintenance treatments pertaining to refuges. Where the "worst-case scenario" likely would only result in minor, temporary, and localized effects to listed and non-listed species with appropriate BMPs (see Section G.5), the proposed pesticide's use in a PUP would have a scientific basis for approval under any application rate specified on the label that is at or below rates evaluated in a Chemical Profile. In some cases, the Chemical Profile would include a lower application rate than the maximum labeled rate in order to protect refuge resources. As necessary, Chemical Profiles would be periodically updated with new scientific information or as pesticides with the same active ingredient are proposed for use on the Refuge in PUPs.

Throughout this section, threshold values (to prevent or minimize potential biological and environmental effects) would be clearly identified for specific information presented in a completed Chemical Profile. Comparison with these threshold values provides an explicit scientific basis to approve or disapprove PUPs for habitat management and cropland/facilities maintenance on refuge lands. In general, PUPs would be approved for pesticides with Chemical Profiles where there would be no exceedances of threshold values. However, BMPs are identified for some screening tools that would minimize/eliminate potential effects (exceedance of the threshold value) as a basis for approving PUPs.

Date: Service personnel would record the date when the Chemical Profile is completed or updated. Chemical Profiles (e.g., currently approved pesticide use patterns) would be periodically reviewed and updated, as necessary. The most recent review date would be recorded on a profile to document when it was last updated.

Trade Name(s): Service personnel would accurately and completely record the trade name(s) from the pesticide label, which includes a suffix that describes the formulation (e.g., WP, DG, EC, L, SP, I, II or 64). The suffix often distinguishes a specific product among several pesticides with the same active ingredient. Service personnel would record a trade name for each pesticide product with the same active ingredient.

Common chemical name(s): Service personnel would record the common name(s) listed on the pesticide label or material safety data sheet (MSDS) for an active ingredient. The common name of a pesticide is listed as the active ingredient on the title page of the product label immediately following the trade name, and the MSDS, Section 2: Composition/Information on Ingredients. A Chemical Profile is completed for each active ingredient.

Pesticide Type: Service personnel would record the type of pesticide for an active ingredient as one of the following: herbicide, desiccant, fungicide, fumigant, growth regulator, insecticide, piscicide, or rodenticide.

EPA Registration Number(s): This number (EPA Reg. No.) appears on the title page of the label and MSDS, Section 1: Chemical Product and Company Description. It is not the EPA Establishment Number that is usually located near it. Service personnel would record the EPA Reg. No. for each trade name product with an active ingredient based upon PUPs.

Pesticide Class: Service personnel would list the general chemical class for the pesticide (active ingredient). For example, malathion is an organophosphate and carbaryl is a carbamate.

CAS (Chemical Abstract Service) Number: This number is often located in the second section (Composition/Information on Ingredients) of the MSDS. The MSDS table listing components usually contains this number immediately prior to or following the % composition.

Other Ingredients: From the most recent MSDS for the proposed pesticide product(s), Service personnel would include any chemicals in the pesticide formulation not listed as an active ingredient that are described as toxic or hazardous, or regulated under the Superfund Amendments and Reauthorization Act (SARA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substances Control Act (TSCA), Occupational Safety and Health Administration (OSHA), State Right-to-Know, or other listed authorities. These are usually found in MSDS sections titled "Hazardous Identifications," "Exposure Control/Personal Protection," and "Regulatory Information." If concentrations of other ingredients are available for any compounds identified as toxic or hazardous, then Service personnel would record this information in the Chemical Profile by trade name. MSDS(s) may be obtained from the manufacturer, manufacturer's website or from an on-line database maintained by Crop Data Management Systems, Inc. (see list below).

G.7.7 Toxicological Endpoints

Toxicological endpoint data would be collected for acute and chronic tests with mammals, birds, and fish. Data would be recorded for species available in the scientific literature. If no data are found for a particular taxonomic group, then "No data are available in references" would be recorded as the data entry. Throughout the Chemical Profile, references (including toxicological endpoint data) would be cited using parentheses (#) following the recorded data.

Mammalian LD_{50}: For test species in the scientific literature, Service personnel would record available data for oral lethal dose (LD50) in mg/kg-bw (body weight) or ppm-bw. Most common test species in scientific literature are the rat and mouse. The lowest LD50 value found for a rat would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk to mammals (see Table 1 in Section G.7.1).

Mammalian LC_{50}: For test species in the scientific literature, Service personnel would record available data for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). Most common test species in scientific literature are the rat and mouse. The lowest LC_{50} value found for a rat would be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Mammalian Reproduction: For test species listed in the scientific literature, Service personnel would record the test results (e.g., Lowest Observed Effect Concentration [LOEC], Lowest Observed Effect Level [LOEL], No Observed Adverse Effect Level [NOAEL], No Observed Adverse Effect Concentration [NOAEC]) in mg/kg-bw or mg/kg-diet for reproductive test procedure(s) (e.g., generational studies [preferred], fertility, new born weight). Most common test species available in scientific literature are rats and mice. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for a rat would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

Avian LD_{50}: For test species available in the scientific literature, Service personnel would record values for oral lethal dose (LD_{50}) in mg/kg-bw or ppm-bw. Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LD_{50} value found for an avian species would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Avian LC_{50}: For test species available in the scientific literature, Service personnel would record values for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LC_{50} value found for an avian species would be used as a toxicological endpoint for dietary-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Avian Reproduction: For test species available in the scientific literature, Service personnel would record test results (e.g., LOEC, LOEL, NOAEC, NOAEL) in mg/kg-bw or mg/kg-diet consumed for reproductive test procedure(s) (e.g., early life cycle, reproductive). Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for an avian species would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

Fish LC_{50}: For test freshwater or marine species listed in the scientific literature, Service personnel would record a LC_{50} in ppm or mg/L. Most common test species available in the scientific literature are the bluegill, rainbow trout, and fathead minnow (marine). Test results for many game species may also be available. The lowest LC_{50} value found for a freshwater fish species would be used as a toxicological endpoint for RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Fish Early Life Stage (ELS)/Life Cycle: For test freshwater or marine species available in the scientific literature, Service personnel would record test results (e.g., LOEC, NOAEL, NOAEC, LOAEC) in ppm for test procedure(s) (e.g., early life cycle, life cycle). Most common test species available in the scientific literature are bluegill, rainbow trout, and fathead minnow. Test results for other game species may also be available. The lowest test value found for a fish species (preferably freshwater) would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

Other: For test invertebrate as well as non-vascular and vascular plant species available in the scientific literature, Service personnel would record LC_{50}, LD_{50}, LOEC, LOEL, NOAEC, NOAEL, or EC_{50} (environmental concentration) values in ppm or mg/L. Most common test invertebrate species available in scientific literature are the honey bee and the water flea (*Daphnia magna*). Green algae (*Selenastrum capricornutum*) and pondweed (*Lemna minor*) are frequently available test species for aquatic non-vascular and vascular plants, respectively.

G.7.8 Ecological Incident Reports

After a site has been treated with pesticide(s), wildlife may be exposed to these chemical(s). When exposure is high relative to the toxicity of the pesticides, wildlife may be killed or visibly harmed (incapacitated). Such events are called ecological incidents. The USEPA maintains a database (Ecological Incident Information System) of ecological incidents. This database stores information extracted from incident reports submitted by various federal and state agencies and non-government organizations. Information included in an incident report is date and location of the incident, type and magnitude of effects observed in various species, use(s) of pesticides known or suspected of contributing to the incident, and results of any chemical residue and cholinesterase activity analyses conducted during the investigation.

Incident reports can play an important role in evaluating the effects of pesticides by supplementing quantitative risk assessments. All incident reports for pesticide(s) with the active ingredient and associated information would be recorded.

G.7.9 Environmental Fate

Water Solubility: Service personnel would record values for water solubility (S_w), which describes the amount of pesticide that dissolves in a known quantity of water. S_w is expressed as mg/L (ppm). Pesticide S_w values would be categorized as one of the following: insoluble <0.1 ppm, moderately soluble = 100 to 1,000 ppm, highly soluble >10,000 ppm (USGS 2000). As pesticide S_w increases, there would be greater potential to degrade water quality through runoff and leaching.

S_w would be used to evaluate potential for bioaccumulation in aquatic species [see **Octanol-Water Partition Coefficient (K_{ow})** below].

Soil Mobility: Service personnel would record available values for soil adsorption coefficient (K_{oc} [µg/g]). It provides a measure of a chemical's mobility and leaching potential in soil. K_{oc} values are directly proportional to organic content, clay content, and surface area of the soil. K_{oc} data for a pesticide may be available for a variety of soil types (e.g., clay, loam, sand).

K_{oc} values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

Soil Persistence: Service personnel would record values for soil half-life (t½), which represents the length of time (days) required for 50% of the deposited pesticide to degrade (completely or partially) in the soil. Based upon the t½ value, soil persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

Threshold for Approving PUPs:

If soil t½ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
If soil t½ >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the ***Specific***

Best Management Practices (BMPs) *section to minimize potential surface runoff and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Along with K_{oc}, soil t½ values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

Soil Dissipation: Dissipation time (DT_{50}) represents the time required for 50% of the deposited pesticide to degrade and move from a treated site; whereas, soil t½ describes the rate for degradation only. As for t½, units of dissipation time are usually expressed in days. Field dissipation time would be the preferred data for use to estimate pesticide concentrations in the environment because it is based upon field studies compared to soil t½, which is derived in a laboratory. However, soil t½ is the most common persistence data available in the published literature. If field dissipation data are not available, soil half-life data would be used in a Chemical Profile. The average or representative half-life value of most important degradation mechanism would be selected for quantitative analysis for both terrestrial and aquatic environments.

Based upon the DT_{50} value, environmental persistence in the soil also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

Threshold for Approving PUPs:

If soil DT_{50} ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
If soil DT_{50} >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the ***Specific Best Management Practices (BMPs)*** *section to minimize potential surface runoff and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Along with K_{oc}, soil DT50 values (preferred over soil t½) would be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below), if available.

Aquatic Persistence: Service personnel would record values for aquatic t½, which represents the length of time required for 50% of the deposited pesticide to degrade (completely or partially) in water. Based upon the t½ value, aquatic persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

Threshold for Approving PUPs:

If aquatic t½ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
If aquatic t½ >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the ***Specific Best Management Practices (BMPs)*** *section to minimize potential surface runoff and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated*.

Aquatic Dissipation: Dissipation time (DT_{50}) represents the time required for 50% of the deposited pesticide to degrade or move (dissipate); whereas, aquatic t½ describes the rate for degradation only. As for t½, units of dissipation time are usually expressed in days. Based upon the DT_{50} value, environmental persistence in aquatic habitats also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

Threshold for Approving PUPs:

If aquatic DT_{50} ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
If aquatic DT_{50} >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the ***Specific Best Management Practices (BMPs)*** *section to minimize potential surface runoff and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Potential to Move to Groundwater: Groundwater Ubiquity Score (GUS) = $\log_{10}$(soil t ½) x [4 – $\log_{10}(K_{oc})$]. If a DT_{50} value is available, it would be used rather than a t ½ value to calculate a GUS score. Based upon the GUS value, the potential to move toward groundwater would be recorded as one of the following categories: extremely low potential<1.0, low - 1.0 to 2.0, moderate - 2.0 to 3.0, high - 3.0 to 4.0, or very high>4.0.

Threshold for Approving PUPs:

If GUS ≤4.0, then a PUP would be approved without additional BMPs to protect water quality.
If GUS >4.0, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the ***Specific Best Management Practices (BMPs)*** *section to minimize potential surface runoff and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*

- *Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Volatilization: Pesticides may volatilize (evaporate) from soil and plant surfaces and move off-target into the atmosphere. The potential for a pesticide to volatilize is a function of its vapor pressure that is affected by temperature, sorption, soil moisture, and the pesticide's water solubility. Vapor pressure is often expressed in mm Hg. To make these values easier to compare, vapor pressure would be recorded by Service personnel in exponential form ($I \times 10^{-7}$), where I represents a vapor pressure index. In general, pesticides with I<10 would have low potential to volatilize; whereas, pesticides with I >1,000 would have a high potential to volatilize (OSU 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database (see References).

Threshold for Approving PUPs:

If I ≤1,000, then a PUP would be approved without additional BMPs to minimize drift and protect air quality.
If I >1,000, then a PUP would only be approved with additional BMPs specifically to minimize drift and protect air quality. One or more BMPs such as the following would be included in the ***Specific Best Management Practices (BMPs)*** *section to reduce volatilization and potential to drift and degrade air quality:*

- *Do not treat when wind velocities are <2 or >10 mph with existing or potential inversion conditions.*
- *Apply the large-diameter droplets possible for spray treatments.*
- *Avoid spraying when air temperatures >85°F.*
- *Use the lowest spray height possible above target canopy.*
- *Where identified on the pesticide label, soil incorporate pesticide as soon as possible during or after application.*

Octanol-Water Partition Coefficient (K_{ow}): The octanol-water partition coefficient (K_{ow}) is the concentration of a pesticide in octanol and water at equilibrium at a specific temperature. Because octanol is an organic solvent, it is considered a surrogate for natural organic matter. Therefore, K_{ow} would be used to assess potential for a pesticide to bioaccumulate in tissues of aquatic species (e.g., fish). If K_{ow} >1,000 or S_w<1 mg/L and soil t½>30 days, then there would be high potential for a pesticide to bioaccumulate in aquatic species such as fish (USGS 2000).

Threshold for Approving PUPs:

If there is not a high potential for a pesticide to bioaccumulate in aquatic species, then the PUP would be approved.
If there is a high potential to bioaccumulate in aquatic species (Kow>1,000 or Sw<1 mg/L and soil t½>30 days), then the PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Bioaccumulation/Bioconcentration: The physiological process where pesticide concentrations in tissue would increase in biota because they are taken and stored at a faster rate than they are

metabolized or excreted. The potential for bioaccumulation would be evaluated through bioaccumulation factors (BAFs) or bioconcentration factors (BCFs). Based upon BAF or BCF values, the potential to bioaccumulate would be recorded as one of the following: low – 0 to 300, moderate – 300 to 1,000, or high >1,000 (Calabrese and Baldwin 1993).

Threshold for Approving PUPs:

If BAF or BCF≤1,000, then a PUP would be approved without additional BMPs.
If BAF or BCF>1,000, then a PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Worst-Case Ecological Risk Assessment
Max Application Rates (acid equivalent): Service personnel would record the highest application rate of an active ingredient (ae basis) for habitat management and cropland/facilities maintenance treatments in this data field of a Chemical Profile. These rates can be found in Table CP.1 under the column heading "Max Product Rate – Single Application (lbs/acre – AI on acid equiv basis)". This table would be prepared for a Chemical Profile from information specified in labels for trade name products identified in PUPs. If these data are not available in pesticide labels, then write "NS" for "not specified on label" in this table.

EECs: An estimated environmental concentration (ECC) represents potential exposure to fish and wildlife (birds and mammals) from using a pesticide. EECs would be derived by Service personnel using an USEPA screening-level approach (USEPA 2004). For each max application rate [see description under **Max Application Rates (acid equivalent)**], Service personnel would record 2 EEC values in a Chemical Profile; these would represent the worst-case terrestrial and aquatic exposures for habitat management and croplands/facilities maintenance treatments. For terrestrial and aquatic EEC calculations, see description for data entry under **Presumption of Unacceptable Risk/Risk Quotients**, which is the next field for a Chemical Profile.

Presumption of Unacceptable Risk/Risk Quotients: Service personnel would calculate and record acute and chronic risk quotients (RQs) for birds, mammals, and fish using the provided tabular formats for habitat management and/or cropland/facilities maintenance treatments. RQs recorded in a Chemical Profile would represent the worst-case assessment for ecological risk. See Section G.7.2 for discussion regarding the calculations of RQs.

For aquatic assessments associated with habitat management treatments, RQ calculations would be based upon selected acute and chronic toxicological endpoints for fish and the EEC would be derived from Urban and Cook (1986) assuming 100% overspray to an entire 1-foot deep water body using the max application rate (ae basis [see above]).

For aquatic assessments associated with cropland/facilities maintenance treatments, RQ calculations would be done by Service personnel based upon selected acute and chronic toxicological endpoints for fish and an EEC would be derived from the aquatic assessment in AgDRIFT® model version 2.01 under Tier I ground-based application with the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium/coarse droplet size, 20 swaths, EPA-defined wetland, and 25-foot distance (buffer) from treated area to water.

See Section G.7.2 for more details regarding the calculation of EECs for aquatic habitats for habitat management and cropland/facilities maintenance treatments.

For terrestrial avian and mammalian assessments, RQ calculations would be done by Service personnel based upon dietary exposure, where the "short grass" food item category would represent the worst-case scenario. For terrestrial spray applications associated with habitat management and cropland/facilities maintenance treatments, exposure (EECs and RQs) would be determined using the Kanaga nomogram method through the USEPA's T-REX version 1.2.3. T-REX input variables would include the following: max application rate (acid basis [see above]) and pesticide half-life (days) in soil to estimate the initial, maximum pesticide residue concentration on general food items for terrestrial vertebrate species in short (<20 cm tall) grass.

For granular pesticide formulations and pesticide-treated seed with a unique route of exposure for terrestrial avian and mammalian wildlife, see Section G.7.2 for the procedure that would be used to calculate RQs.

All calculated RQs in both tables would be compared with Levels of Concern (LOCs) established by USEPA (see Table G-2 in Section G.7.2). If a calculated RQ exceeds an established LOC value (in brackets inside the table), then there would be a potential for an acute or chronic effect (unacceptable risk) to federally listed (T&E) species and nonlisted species. See Section G.7.2 for detailed descriptions of acute and chronic RQ calculations and comparison to LOCs to assess risk.

Threshold for approving PUPs:

If RQs≤LOCs, then a PUP would be approved without additional BMPs.
If RQs>LOCs, then a PUP would only be approved with additional BMPs specifically to minimize exposure (ecological risk) to bird, mammal, and/or fish species. One or more BMPs such as the following would be included in the ***Specific Best Management Practices (BMPs)*** *section to reduce potential risk to non-listed or listed species:*

- *Lower application rate and/or fewer number of applications so RQs≤LOCs*
- *For aquatic assessments (fish) associated with cropland/facilities maintenance, increase the buffer distance beyond 25 feet so RQs≤LOCs.*

Justification for Use: Service personnel would describe the reason for using the pesticide based control of specific pests or groups of pests. In most cases, the pesticide label would provide the appropriate information regarding control of pests to describe in the section.

Specific Best Management Practices (BMPs): Service personnel would record specific BMPs necessary to minimize or eliminate potential effects to non-target species and/or degradation of environmental quality from drift, surface runoff, or leaching. These BMPs would be based upon scientific information documented in previous data fields of a Chemical Profile. Where necessary and feasible, these specific practices would be included in PUPs as a basis for approval.

If there are no specific BMPs that are appropriate, then Service personnel would describe why the potential effects to refuge resources and/or degradation of environmental quality is outweighed by the overall resource benefit(s) from the proposed pesticide use in the BMP section of the PUP. See Section G.4 of this document for a complete list of BMPs associated with mixing and applying pesticides appropriate for all PUPs with ground-based treatments that would be additive to any necessary, chemical-specific BMPs.

References: Service personnel would record scientific resources used to provide data/information for a chemical profile. Use the number sequence to uniquely reference data in a chemical profile.

The following on-line data resources are readily available for toxicological endpoint and environmental fate data for pesticides:

1. California Product/Label Database. Department of Pesticide Regulation, California Environmental Protection Agency. (http://www.cdpr.ca.gov/docs/label/labelque.htm#regprods)

2. ECOTOX database. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. (http://cfpub.epa.gov/ecotox/)

3. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. Cooperative effort of University of California-Davis, Oregon State University, Michigan State University, Cornell University and University of Idaho through Oregon State University, Corvallis, Oregon. (http://extoxnet.orst.edu/pips/ghindex.html)

4. FAO specifications and evaluations for plant protection products. Pesticide Management Unit, Plant Protection Services, Food and Agriculture Organization, United Nations. (http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPP/Pesticid/)

5. Human health and ecological risk assessments. Pesticide Management and Coordination, Forest Health Protection, U.S. Department of Agriculture, U.S. Forest Service. (http://www.fs.fed.us/foresthealth/pesticide/risk.htm)

6. Pesticide Chemical Fact Sheets. Clemson University Pesticide Information Center. (http://entweb.clemson.edu/pesticid/Document/Labels/factshee.htm)

7. Pesticide Fact Sheets. Published by Information Ventures, Inc. for Bureau of Land Management, Department of Interior; Bonneville Power Administration, U.S. Department of Energy; and Forest Service, U.S. Department of Agriculture. (http://infoventures.com/e-hlth/pesticide/pest-fac.html)
8. Pesticide Fact Sheets. National Pesticide Information Center. (http://npic.orst.edu/npicfact.htm)

9. Pesticide Fate Database. U.S. Environmental Protection Agency, Washington, D.C. (http://cfpub.epa.gov/pfate/home.cfm).

10. Pesticide product labels and material safety data sheets. Crop Data Management Systems, Inc. (CDMS) (http://www.cdms.net/pfa/LUpdateMsg.asp) or multiple websites maintained by agrichemical companies.

11. Registered Pesticide Products (Oregon database). Oregon Department of Agriculture. (http://www.oda.state.or.us/dbs/pest_products/search.lasso)

12. Regulatory notes. Pest Management Regulatory Agency, Health Canada, Ontario, Canada. (http://www.hc-sc.gc.ca/pmra-arla/)

13. Reptile and Amphibian Toxicology Literature. Canadian Wildlife Service, Environment Canada, Ontario, Canada. (http://www.cws-scf.ec.gc.ca/nwrc-cnrf/ratl/index_e.cfm)

14. Specific Chemical Fact Sheet – New Active Ingredients, Biopesticide Fact Sheet and Registration Fact Sheet. U.S. Environmental Protection Agency, Washington, D.C. (http://www.epa.gov/pestidides/factsheets/chemical_fs.htm)

15. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Invasive Species Initiative. The Nature Conservancy. (http://tnsweeds.ucdavis.edu/handbook.html)

16. Wildlife Contaminants Online. U.S. Geological Survey, Department of Interior, Washington, D.C. (http://www.pwrc.usgs.gov/contaminants-online/)

17. One-liner database. 2000. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, D.C.

Chemical Profile

Date:			
Trade Name(s):		**Common Chemical Name(s):**	
Pesticide Type:		**EPA Registration Number:**	
Pesticide Class:		**CAS Number:**	
Other Ingredients:			

Toxicological Endpoints

Mammalian LD_{50}:	
Mammalian LC_{50}:	
Mammalian Reproduction:	
Avian LD_{50}:	
Avian LC_{50}:	
Avian Reproduction:	
Fish LC_50:	

Fish ELS/Life Cycle:	
Other:	

Ecological Incident Reports

Environmental Fate

Water solubility (S_w):	
Soil Mobility (K_{oc}):	
Soil Persistence ($t_{½}$):	
Soil Dissipation (DT_{50}):	
Aquatic Persistence ($t_{½}$):	
Aquatic Dissipation (DT_{50}):	
Potential to Move to Groundwater (GUS score):	
Volatilization (mm Hg):	
Octanol-Water Partition Coefficient (K_{ow}):	
Bioaccumulation/Bioconcentration:	**BAF:** **BCF:**

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** **Croplands/Facilities Maintenance:**
EECs	**Terrestrial (Habitat Management):** **Terrestrial (Croplands/Facilities Maintenance):** **Aquatic (Habitat Management):** **Aquatic (Croplands/Facilities Maintenance):**

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Justification for Use:	
Specific Best Management Practices (BMPs):	
References:	

Table CP.1 Pesticide Name

Trade Name[a]	Treatment Type[b]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate -Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.
[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

G.8 Specific Weed Control Plans

G.8.1 Cheatgrass, Downy brome

Priority: Medium: cheatgrass is widely distributed throughout the Protection Island, along roadways, and has invaded remnant native prairie and shrubland communities. Cheatgrass is prolific in dry upland habitat and competes with native plant species in especially disturbed soils such as those found in bluff and grassland habitat, both future restoration sites. It interferes with primary habitat management goals across the landscape, but the infestation is too large to eradicate with available technology.

Description: Cheatgrass is a cool season annual grass that grows from 4 - 30 inches tall, reproducing by seed. Leaf sheaths and flat blades are covered with dense soft hairs. Mature cheatgrass seed heads are slender; 2 - 6 inches long and usually droop to one side. It easily competes with more desirable perennial grasses for moisture because of its fall, winter semi-dormant, and early spring growth habit. Seeds mature in mid to late June and plants dry and cure by the end of June, leading to hazardous fire conditions.

Current Distribution on the Refuge: Cheatgrass is widely distributed throughout Protection Island, portions of Graveyard Spit and unknown on other refuge islands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites and other disturbed soil areas.

Objectives:

a. Monitor all newly seeded areas and other disturbed sites (e.g., remediation areas, wildfire areas, road cuts) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Control cheatgrass to reduce competition with native plants germinating in the spring. Keep cheatgrass to less than 40% of the live vegetation ground cover and prevent it from spreading beyond its original infestation area.
d. Maintain healthy stands of native perennial plants.

Control Options:

The chemical treatment of cheatgrass with an appropriate herbicide provides the most effective control. Currently, glyphosate (Roundup™, Roundup Pro™), Clethodim (Select™) and imazapic (Plateau™) are the herbicides used to control cheatgrass on the Refuge. The identified chemical control agents were selected on their versatility and selectivity in prairie restoration areas (Plateau™ and Select™) and complete control in areas requiring devegetation with minimal risk to groundwater contamination (Roundup™). Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Clethodim (Select™) is considered as a selective herbicide for use in grasslands, restoration areas, fence lines and rights of way. Other agents indicated for cheatgrass control but not selected for use are quizalofop, fluazifop-p-butyl, sethoxydim, sulfometuron methyl, and metribuzin. Clethodim is considered less toxic to avian and other wildlife species than other selective grass herbicides (quizalofop, fluazifop-p-butyl, sethoxydim, and metribuzin). Clethodim has a short half-life in soil and the EPA considers the

chemical a low threat to groundwater quality. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Mechanical control of cheatgrass also is conducted on the Refuge with mixed results. Mowing before seed ripening probably prevents some re-seeding, but oftentimes the plants produce new stems and seeds at the mowed height. Mowing after seed ripening kills adult plants, but dropped seeds are already viable. Repeated mowing during the growing season may be the most effective mechanical treatment, but is very labor-intensive and only practical on small infestations. Mowing is not possible in areas where cheatgrass starts seeding at height too low for the mower, steep slopes, and inaccessible islands. Prescribed burns in the spring or fall also help to control cheatgrass by stimulating native perennial grass growth or top killing seedlings.

The cultural methods (e.g., cover crop) after plowing, discing, etc. often compete with the initial flush of cheatgrass growth and can help improve the control with herbicides before seeding with native perennial species. After restoration, the maintenance of healthy native plant communities and the minimization of disturbance help to prevent the spread of cheatgrass back into the area.

Treatment Schedule: Cheatgrass should be sprayed in the fall or early spring when plants are less than 10 cm tall and actively growing, and non-target plants are dormant.

G.8.2 *Carduus nutans* (musk thistle)

Priority: Medium: musk thistle has a limited distribution throughout the Refuge along roadways, and has invaded remnant native prairie and shrubland communities. Musk thistle is prolific in dry upland habitat and competes with native plant species in disturbed soils such as those found in recently seeded habitat restoration sites. It interferes with primary habitat management goals across the landscape, and the infestation is not too large therefore this species is targeted for eradicate.

Description: Musk thistle is a biennial which grows up to 6 feet tall. Leaves are dark green, deeply lobed, spiny, and extend onto the stem. Flowers are 11/2 to 3 inches in diameter and are usually deep rose, violet or purple. Musk thistle spreads rapidly to form dense stands that crowd out desirable plants.

Current Distribution on the Refuge: Musk thistle is widely distributed throughout the refuge at low densities but can be especially prolific in disturbed soils.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor all newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species if ground cover is needed.
c. Control musk thistle to reduce competition with native plants germinating in the spring. Keep patches of musk thistle to less than one acre in area and less than 40% of live vegetation cover.
d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical control of musk thistle has been successful in preventing seed production and subsequent spread. Musk thistle is mowed at flowering in habitat restoration sites, along roadways, and in disturbed areas undergoing remediation. Dense stands are often mowed twice when new flowers appear. Repeated mowing during the growing season may be the most effective mechanical treatment, but is very labor-intensive. Small infestations of musk thistle rosettes also are removed by hand digging when labor is available.

The biological control agent, *Rhinocyllus conicus* (seed head weevil) is established in Washington state, but has had limited effect on thistle control and a negative side effect of this bio-controls that it also attacks native thistle species. There are no known native thistle species occurring on any refuge unit. The larvae of this weevil eat the seeds in mature flower heads. This bio-control is probably effective in reducing musk thistle seed production by up to 50% based on casual observation. Infestations of individual plants or widely dispersed individuals would be examined for the presence of the *Rhinocyllus conicus* larvae and adults and left in place if infected. These infected plants can be used as nurseries for the insects with the harvested individuals relocated to larger thistle patches. The chemical treatment of musk thistle with an appropriate herbicide also provides effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™) glyphosate (Roundup™, Roundup Pro™, Rodeo™), metsulfuron methyl (Escort™) and imazapic (Plateau™) are the herbicides that could be used to control small musk thistle infestations on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Imazapic is used in dry upland sites with low leaching potential. Metsulfuron is extremely effective on thistle and common mullein plants. Imazapic and metsulfuron can be broadcast in restoration areas where native grasses and resistant native broadleafs are essential for restoration success. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

The mechanical methods of plowing, discing, etc., often cause an initial flush of musk thistle rosettes that may be controlled with herbicides before seeding with native perennial species. After restoration, the maintenance of healthy native plant communities and the minimization of disturbance help to prevent the spread of musk thistle back into the area.

Treatment Schedule: Musk thistle should be repeatedly mowed at flowering to prevent seed production and/or sprayed in the rosette stage in fall or late spring during bolting or when desirable non-target plants are dormant. Spraying in the early summer when the plants have bolted or rosettes in the fall are also effective control methods. Other options would be used according to the label recommendations.

G.8.3 Diffuse knapweed

Priority: High: The spread of diffuse knapweed is an increasing problem in many areas in Washington. It is considered one of the most important rangeland weeds in North America. The State of Washington considers this species one of the top ten priority weeds targeted for control, particularly for preventing new infestations. Diffuse knapweed infests disturbed areas where it forms dense colonies in pastures, croplands, waste places, and rights-of-way. It is a prolific seed producer, fast spreading, and highly agonistic with native plants often out competing them.

Description: Diffuse knapweed grows as an annual or short-lived perennial forb. The diffusely branched stems of mature plants are 1 to 2 feet tall, rough to the touch, and tipped with numerous slender, white to purplish flower heads. Prominent yellow bracts with comb-like margin projections subtend the flower. The leaves are pinnately divided near the plant's base; the leaf margins appear entire towards the inflorescence. Flowering occurs from July through September.

Current Distribution on the Refuge: No known infestations are present on any refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat 100% of diffuse knapweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knapweed and knapweed seed bank. Map and measure larger infestation patches using geographic information software and a global positioning system device. Treat patches to prevent increase in the infestation area.
d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling or digging is a feasible control of small infestations and individual plants. The taproot would be removed to at least 2 inches below the ground surface.

Insect species that target diffuse knapweed include the seedhead weevils (*Larinus minutus*), broad-nosed seedhead weevil (*Bangasternus fausti*) are not well established, and seed head fly (*Urophora affinis*), seed head fly (*Urophora quadrifasciata*), and root boring/gall beetle (*Sphenoptera jugoslavica)* are available for mass collections. These insects reduce seed production which assists in slowing or eliminating spread. Biological agents would be an option in areas that are prohibited to other forms of control and pending the availability of the insect. Biological control of diffuse knapweed on the Refuge has not been attempted in the past.

The chemical treatment of diffuse knapweed with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone) glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) would be the herbicides used to control diffuse knapweed on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other recommended chemical treatments for diffuse knapweed are picloram, clopyralid, dicamba, and 2,4-D. The Refuge avoids the use of restricted use pesticides like picloram. Clopyralid is not recommended for use on permeable soils due to potential groundwater contamination. Dicamba has low toxicity for wildlife but is not recommended for use near water. Aquatic formulations of glyphosate currently serve for weed control near water. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Hand removal would be conducted 2 to 3 times during the growing season, the first removal occurring early in the season (June) before bolt. Established areas too large to

practically control by hand, or in areas prohibited to chemical control, would be mowed monthly to prevent floret emergence and seed production.

The release of seed head weevils will occur as the leaves of the plants appear in June to the budding stage. Control is less effective if seeds have already formed.

The application of aminopyralid, glyphosate or imazapic would occur once during the growing season (June - November). The most effective time of control is during the rosette or bolt stage before budding. Annual treatment is necessary as long as there is a viable seed source.

G.8.4 Spotted knapweed

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control. Spotted knapweed infests disturbed areas where it forms dense colonies in pastures, croplands, waste places, and rights-of-way. It is a prolific seed producer, fast spreading, and highly agonistic with native plants – often out-competing them. Populations enlarge by peripheral expansion of existing stands. Biodiversity, livestock and wildlife forage quality are reduced with infestations of spotted knapweed.

Description: Spotted knapweed is a biennial or short-lived perennial forb with a deep taproot. Plants reach 1 to 3 feet with one or more branched stems. The basal leaves vary in morphology from entire to pinnate and elliptical to oblanceolate. The principal stem leaves are pinnately divided. Flowers are primarily light purple (rarely white). Involucral bracts are stiff with a finely branched, dark tip. Flowering occurs from June through September.

Current Distribution on the Refuge: No known infestations are present on any refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., restoration areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat and control 100% of spotted knapweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knapweed and knapweed seed bank. Map and measure larger infestation patches using geographic information software and a global positioning system device. Treat patches to prevent increase in the infestation area.
d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling or digging is a feasible control of small infestations and individual plants. The taproot would be removed to at least 2 inches below the ground surface. Entire plants would be removed from the site to limit the source of available seeds.

Biological control of spotted knapweed is not effective in eliminating stands. Insect larvae are available that target flowers, roots, shoots, and leaves leading to reduced seed production. Two commonly used organisms that target spotted knapweed roots are the sulfur knapweed moth

(*Agapeta zoegana*) and the knapweed weevil (*Cyphocleonus achates*). Biological control could be used in new and current infestations that cannot be controlled by hand or chemical treatment. The chemical treatment of spotted knapweed with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) would be the herbicides used to control spotted knapweed on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Other recommended chemical treatments for diffuse knapweed are picloram, clopyralid, dicamba, and 2,4-D. The Refuge avoids the use of restricted use pesticides like picloram. Clopyralid is not recommended for use on permeable soils due to potential groundwater contamination. Dicamba has low toxicity for wildlife but is not recommended for use near water. Aquatic formulations of glyphosate currently serve for weed control near water. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Hand removal would be conducted 2 to 3 times during the growing season, the first removal occurring early in the season (June) before bolt. Established areas too large to practically control by hand, or in areas prohibited to chemical control, would be mowed monthly to prevent floret emergence and seed production.

Selected biological control insect(s) would be, if used, released during the optimal time for both insect and plant to provide the greatest effectiveness for controlling spotted knapweed. Aminoryralid, glyphosate, or imazapic would be applied once during the growing season (June - November). The most effective time of control is during the bolt to bud stage. Annual treatment is necessary as long as there is a viable seed source.

G.8.5 Meadow Knapweed

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control. Meadow knapweed invades open, disturbed areas. This species forms monotypic stands, suppressing the growth of other vegetation. Reproduction is primarily from seeds and crown.

Description: Meadow knapweed is a perennial growing from a woody root crown, with 20 to 40 inch tall upright stems. Its basal leaves can be up to six inches long and 1.25 inches wide, tapering at both ends. The stem leaves are lance-shaped, stalkless, and sometimes shallowly lobed, while the uppermost leaves are smaller and not lobed. The rose-purple to occasionally white flowers occur in solitary, oval, or almost globe-shaped flower heads at the ends of branches. The light to dark brown involucral bracts are roundish, with a torn, thin, papery margin, or a comb-like, fringed margin. More apparent on outer bracts, the fringes are about equal in width to the central body of the bract. Meadow knapweed flowers from July to September, producing ivory-white to light brown seeds that may or may not have a barely noticeable plume. However, because it is a hybrid, meadow knapweed traits are highly variable.

Current Distribution on the Refuge: No known infestations are present on any refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat and control 100% of Meadow knapweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knapweed and knapweed seedbank. Map and measure larger infestation patches using geographic information software and a global positioning system device. Treat patches to prevent increase in the infestation area.
d. Maintain healthy stands of native perennial plants

Control Options:
Removal of the above-ground tissue by mowing or hand-scything weakens the plant, reduces root growth, and prevents seed production, but would not eliminate the infestation.

Biological control with the seed head gall fly, *Urophora quadrifasciata*, has had fair success on meadow knapweed.

The reseeding of disturbed areas is effective in preventing the infestation of meadow knapweed. The chemical treatment of Meadow knapweed with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) would be the herbicides used to control Meadow knapweed on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Glyphosate is a nonspecific herbicide and the use of it should be accompanied by seeding, planting, or use in areas where native vegetation is prolific. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Top growth would be removed before bolting during the growing season (June - mid-August) to weaken Russian knapweed plants. Plants that re-emerge (mid-August to September) are smaller and more vulnerable to further top removal and herbicide effect.

Glyphosate would be applied once or twice during the growing season (June - November). Top-growth of Russian knapweed can be controlled by applying herbicide during the bud stage. Root control is achieved by timing applications to the late bud and fall growth stage. Other listed chemical would be used according to the label recommendations.

G.8.6 Bohemian knotweed

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control. The most common invasive knotweeds in western Washington, this species is a hybrid between giant and Japanese knotweed and shares characters of both parent species. It was introduced as an ornamental in its own right but has become very widespread in our region, especially along rivers and roadways. This plant spreads mostly by stem and root fragments and is usually found in disturbed areas such as flood zones and roadsides.

Currently, most Bohemian knotweed plants are males and therefore lack seeds. Recent findings have found that seed-bearing hybrids have appeared, probably indicating a back-cross with giant or Japanese knotweed. The existence of seeding hybrids may allow this plant to spread even more rapidly in the future.

Description: Plants are usually 6.5 to 10 feet tall. Stems are stout, cane-like, hollow between the nodes, somewhat reddish-brown and usually branched. The plants die back above ground at the end of the growing season. However, the dead reddish brown canes often persist throughout the winter. The stem nodes are swollen and surrounded by thin papery sheaths. Leaves can be either spade or heart-shaped, usually more heart-shaped lower down on the stems and more spade-shaped near the branch ends. This variability in leaf shape is one identifying character since the parent species generally have either heart-shaped or spade-shaped leaves.

One key identifying feature is the hairs on the leaf undersides especially along the midvein. Bohemian knotweed has hairs that are short and broad-based (triangular-shaped), compared with long and wavy in giant knotweed and reduced to barely noticeable bumps in Japanese knotweed. The flowers are small, creamy white to greenish white, and grow in showy plume-like, branched clusters from leaf axils near the ends of the stems. Flower clusters are generally about the same length as the subtending leaf, unlike the shorter flower clusters found on giant knotweed and the longer clusters found on Japanese knotweed. Leaf and flower characters are most reliable when looking near the middle of a branch. The fruit is 3-sided, black and shiny.
Current Distribution on the Refuge: Only known infestations are on the Dawley Unit.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat and control 100% of Bohemian knotweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knotweed and knotweed seedbank. Map and measure larger infestation patches using geographic information software and a global positioning system device. Treat patches to prevent increase in the infestation area.
d. Maintain healthy stands of native perennial plants

Control Options:
Knotweed is very difficult to eradicate once it has become established. It is, therefore, important to prevent new infestations and eradicate small patches before they spread. Mechanical and chemical control methods can be used on knotweed, often in conjunction with each other. If control is to be effective, the sites must be visited throughout several seasons to further control any new growth.

Removal of the above-ground tissue by mowing or hand-scything weakens the plant, but because of the extensive root system this method is ineffective as a control method especially on larger infestation.

The chemical treatment of Bohemian knotweed by injection with an appropriate herbicide provides relatively effective control. Currently, imazapyr (Arsenal), and glyphosate (Roundup™, Roundup

Pro™) would be the herbicides used to control Bohemian knotweed on the Refuge. Imazapyr is similar to glyphosate, has a very low toxicity to most animals, but does remain in the soil longer than glyphosate. Mixing two kinds of herbicides together often improves the effectiveness when compared with using each herbicide individually. By mixing the glyphosate and imazapyr together, we can reduce the total amount of herbicide used. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Glyphosate is a nonspecific herbicide and the use of it should be accompanied by seeding, planting, or use in areas where native vegetation is lacking. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Injection of the herbicide is best done at the end of summer August/September during flowering but prior to seed set.

G.8.7 Canada thistle

Priority: Low to Medium: The priority for controlling this species is dependent upon location. The State of Washington considers this species widespread and detrimental to agriculture. Canada thistle can form monocultures, crowding out desirable species. Extensive horizontal roots give rise to shoots. This species infests roadsides, pastures, cropland, disturbed areas, and riparian areas. The dense growth pattern and spiny leaves of Canada thistle deters passage and consumption by wildlife.

Description: Canada thistle is a colony-forming perennial forb. Stems reach 1 to 4 feet with branching tops. Flowers are purple with spineless bracts. The leaves are irregularly lobed and tipped with tiny spines. Flowering occurs July through August.

Current Distribution on the Refuge: Canada thistle is widely distributed on the Protection Island, Dawley Unit, and patchy on Dungeness found in various soil types and vegetation communities. This species tends to invade re-seeded restoration areas.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Canada thistle control applied to keep infestations to less than 1 acre in area and weedy species comprising 40% or less of live vegetation cover.
d. Maintain healthy stands of native perennial plants.

Control Options: The nature of the Canada thistle infestations on the Refuge makes it impossible to control with simple hand methods. The removal of shoots by mowing is a viable option. The continued removal of above ground photosynthetic tissue has been shown to weaken plants and limit their spread through carbohydrate starvation.

Biological control offers many insects and a few nematodes, and the American Goldfinch has been reported to feed on various parts of Canada thistle. Most of these do very little damage. Three insects from Europe have been studied for biological control: *Altica carduorum* Guer (flea beetle), a leaf

feeder, has not established itself well. Adults of the beetle *Ceutorhynchus litura* F. eat young thistle shoots, but do little damage. The fly, *Urophora cardui* L. is the most promising biological control agent. Eggs are laid in the terminal buds and galls develop which divert nutrients and stress the plant. Many microorganisms have been found associated with Canada thistle, but no potential biocontrol agents are known.

The chemical treatment of Canada thistle with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™, Rodeo®) and imazapic (Plateau ®) are the herbicides used to control Canada thistle on the Refuge. Aminopyralid is very selective, provides longer control, can be used at lower rates, and be applied near water. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Glyphosate is a nonspecific herbicide and the use of it should be accompanied by seeding, planting, or use in areas where native vegetation is prolific. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other herbicides that are shown to be effective on Canada thistle are picloram, clopyralid, and 2,4-D. The Refuge avoids the use of restricted use pesticides like picloram. Clopyralid is not recommended for use on leachable soils. 2,4-D would be used on the Refuge with its effectiveness monitored and the use expanded to possibly replace imazapic in some capacities. As with all herbicides, 2,4-D has been detected in groundwater although the sources of contamination are associated with inappropriate use and spillage. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Hand pulling or digging of plants in the rosette stage is effective for small infestations. Monthly mowing or scything of bolted plants in moist soil areas or areas with a high water table (riparian/wetlands) are effective in limiting spread.

The stem-and-shoot gadfly would be released in June through July for new and existing invaded wetland areas where chemical and mechanical controls are not feasible.

Chemical control would occur in spring and fall, 1-2 times per season (June-October), particularly in the fall when shoot to root translocation is highest. This species is sensitive to moisture content or drought stress. Application of pesticide should occur when moisture condition is higher.

G.8.8 Bull thistle

Priority: Low to Medium: The priority for controlling this species is dependent upon location. Bull thistle grows in moist to dry areas, particularly in loamy or clay soils. It is a rapidly proliferating transient species in disturbed, open sites. Native vegetation and wildlife habitat value are compromised by infestation.

Description: Bull thistle is a biennial forb with a rosette forming the first year. A short tap root supports a 2 to 5 foot many-branched stem during the second year. The leaves are pinnately lobed, prickly, with a cottony underside. The involucre of the light purple flower is covered with long spines. Flowering occurs from July through September.

Current Distribution on the Refuge: Bull thistle has not produced major infestations on the Refuge.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Control Bull thistle to reduce competition with native plants by preventing seed production and keeping infestations to less than 1 acre and less than 40% of live vegetation cover.
d. Maintain healthy stands of native perennial plants.

Control Options: Small stands of Bull thistle would be mowed, scythed, or hand cut to remove the bolted but not flowered stem. Hand cutting would include removing the stem and root crown.

The bull thistle seed head gall fly (*Urophora stylata*) is effective in reducing stand density. Control of seed production is effective where the population of gall flies is high. This control method is not recommended for small infestations.

The chemical treatment of Bull thistle with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™, Rodeo™) and imazapic (Plateau™) are the herbicides used to control Bull thistle on the Refuge. Aminopyralid is very selective, provides longer control, can be used at lower rates. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Mechanical and hand removal would occur during bolt but before flowering (late June - July). Late bolting plants need removal before flowering to prevent seed formation. Herbicides would be applied 1 -2 times during the growing season (April - November). Application would occur during the rosette stage or after mowing or scything.

G.8.9 Field bindweed

Priority: Low to Medium: Field bindweed is highly competitive species with prodigious powers of regeneration from roots and rhizomes. Bindweed can survive a wide range of environmental conditions, but disturbed soil is a necessity for invasion. Bindweed is a threat to the regeneration of native vegetation.

Description: Field bindweed is perennial forb growing as a climbing and prostrate vine that forms dense mats. The taproot is deep, forming an extensive root system. The leaves are sagittate; flowers are bell-shaped and pink to white. Blooming occurs from June until frost.

Current Distribution on the Refuge: Bindweed is widely spread on Protection Island and unknown in other areas of the Refuge.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Control field bindweed to reduce competition with native plants by keeping any infestation at less than 40% of live vegetation cover.
d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical and hand methods of control are impractical and ineffective due to the species' distribution and ability to regenerate from severed roots and rhizomes.

The chemical treatment of field bindweed with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) are the herbicides used to control field bindweed on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other herbicides indicated for field bindweed control are picloram, dicamba, and 2,4-D. The uses of restricted use pesticides like picloram are avoided at the Refuge. Dicamba has low wildlife toxicity but is not for use near water. Aquatic formulations of glyphosate and 2,4-D fill that niche. 2,4-D would be used at the Refuge. Its effectiveness would be monitored and the herbicide would be considered as a replacement for imazapic in some situations. As with all herbicides, 2,4-D has been detected in groundwater although the sources of contamination are associated with inappropriate use and spillage. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

The field bindweed moth and the field bindweed mite have not been used to control field bindweed at the Refuge. These agents have not established well in the Pacific Northwest.

Treatment Schedule: Herbicides would be applied one to two times during the growing season (June - November). The period of highest chemical effectiveness is in the early flowering stage. Invaded sites would be monitored to determine the local variation in conditions that lead to the plants' flowering time. Multiple year applications may be necessary.

The field bindweed moth and field bindweed mite would be released to heavily infested bindweed sites during the early growing season (June through August). The release of bioagents would be dependent on the insects' availability.

G.8.10 St. Johnswort

Priority: Low to medium: St. Johnswort invades disturbed sites along roadsides, over-grazed pastures and range, and waste places. It prefers dry, sandy to gravelly soil. St. Johnswort forms a

deep, laterally spreading root system that forms new plants vegetatively from root buds. Dense growth of these plants inhibits regeneration of native species.

Description: St. Johnswort is a perennial shrub-like forb. The stems produce numerous branches and reach 1 to 3 feet high. Leaves are up to one inch long, opposite, entire, and contain numerous transparent dots. Flowers are yellow arranged in open, flat-topped cymes.

Current Distribution on the Refuge: St. Johnswort has not been identified on any of the refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat 100% of St. Johnswort plants - targeting for elimination - to reduce competition with native plants and stop the spread of infestations.
d. Maintain healthy stands of native perennial plants.

Control Options: Small infestations of new plants can be pulled by hand or dug out.

Glyphosate (Roundup® and Roundup Pro®) is effective in controlling St. Johnswort. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Other herbicides indicated for effective St. Johnswort control are picloram and 2,4-D. The use of restricted use pesticides such as picloram is avoided on the Refuge. 2,4-D is planned for use on the Refuge to control various broadleaf noxious weeds and its use for St Johnswort control could be considered in the future. As with all herbicides, 2,4-D has been detected in groundwater although the sources of contamination are associated with inappropriate use and spillage. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Biological control of St. Johnswort with the Klamath weed beetle (*Chrysolina quadrigemina*) has been very effective in North America. Two foliage beetles, *Chrysolina hyperici* and *C. quadrigemina* were released in California from 1945 to 1946, and established within two years. A root-boring beetle *Agrilus hyperici* and a leaf bud gall-forming midge *Zeuxidiplosis giardi* were released in 1950 to help the Chrysolina spp. Recently released in the state and established is the moth *Aplocera plagiata.* Due to the success of these beetles in controlling St. Johnswort, their continued use for established and new infestations is the preferred method of control.

Treatment Schedule: Removal and disposal of plants would be done in early spring (before flower formation).

Spot spraying with glyphosate (Roundup® and Roundup Pro®) before flowering can be an effective control method if repeated applications are made. Bolting and flowering occur early and continue through late summer (June - September). Patches need to be monitored for newly sprouted plants throughout the summer.

The release of Klamath weed beetles would be made in July to new or non-beetle infested areas. Beetles (if available) established in an area on the Refuge would be harvested and used as colonizers.

G.8.11 Dalmatian toadflax

Priority: High: Dalmation toadflax is an aggressive, colony-forming invasive. This species is opportunistic in invading disturbed sites, but it can also press into established vegetation communities in good condition. Native communities and restored sites may be jeopardized by the creeping expansion of Dalmation toadflax adventitious root buds. Competition between natives and toadflax may make the community more vulnerable to other invasive species. Dalmation toadflax produces a toxic substance and is unpalatable to livestock and wildlife.

Description: Dalmation toadflax is a perennial forb reaching up to 3 feet in height. Reproduction is by seed and underground root stalks. Leaves are alternate and variable in shape - ovate to lanceolate. Leaves and stems are robust, glaborous with whitish or bluish cast. Flowers grow at the axils of the upper leaves. The spurred-flower is yellow with an orange center. Flowers bloom late June through October.

Current Distribution on the Refuge: Currently, no islands are known to have any infestation, but Dungeness Spit has a small patch located on Graveyard Spit. That site has been treated for several years by hand-pulling.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat 100% of Dalmation toadflax plants - targeting for elimination - to reduce competition with native plants.
d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling individual plants before seed set decreases seed production. Scything or mowing of stands before seed set is also effective. These methods do not kill the plant, but over time with repeated pulling, the population would be reduced.

The chemical treatment of Dalmation toadflax with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) are the herbicides used to control Dalmation toadflax on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments, but its broad specificity precludes broadcast applications. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Biological control using a defoliating moth is well-established in Washington and reportedly provides good control.

Treatment Schedule: The removal of above ground portions of the plant before seed set would be done in April through July. The seeds are long-lived; annual removal of plants for up to ten years is necessary to deplete the seed bank.

Applications of glyphosate and imazapic would be made one to two times per growing season (April-November). Fall applications are particularly effective in decreasing the available stored carbohydrates in the roots.

G.8.12 Yellow toadflax

Priority: High: Yellow toadflax is an aggressive, colony-forming invasive. This species is opportunistic in invading disturbed sites, but it can also press into established vegetation communities in good condition. Native communities and restored sites may be jeopardized by the creeping expansion of yellow toadflax adventitious root buds. Competition between natives and toadflax may make the community more vulnerable to other invasive species. Yellow toadflax produces a toxic substance and is unpalatable to livestock and wildlife.

Description: Yellow toadflax is a perennial forb, 1 to 2 feet, with pale green, alternate, linear leaves. The base of the branched stem is woody. Stems and leaves are pale green. Flowers are spurred and yellow with an orange center.

Current Distribution on the Refuge: No known infestations exist on refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat 100% of yellow toadflax plants - targeting for elimination - to reduce competition with native plants.
d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling individual plants before seed set decreases seed production. Scything or mowing of stands before seed set is also effective. These methods do not kill the plant.
The chemical treatment of yellow toadflax with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) are the herbicides used to control yellow toadflax on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments, but its broad specificity precludes broadcast applications. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: The removal of above ground portions of the plant before seed set would be done in April through July. The seeds are long-lived; annual removal of plants for up to ten years is necessary to deplete the seed bank.

Applications of glyphosate and imazapic would be made one to two times per growing season (April - November). Fall applications are particularly effective in decreasing the available stored carbohydrates in the roots.

G.8.13 Scotch thistle

Priority: Low to Medium: Scotch thistle aggressively invades disturbed and moist areas. This thistle, due to its size and spinous leaves, presents a passage barrier. Infestation decreases the value and area of wildlife habitat. Scotch thistle seeds have a water-soluble germination inhibitor that facilitates its own propagation and expansion along irrigation canals and other wet areas. Scotch thistle reproduces by seed.

Description: Scotch thistle is biennial forb that grows to 12 feet high. Leaves are large, green, and spiny. Fine hairs give the leaves a cottony appearance. First-year rosettes are 10 to 12 inches in diameter. Leaves of the mature plant may be two feet in length with a prominent white mid-rib. Flower heads are numerous and terminal. Flowers are 1 to 2 inches in diameter, pale purple to red in color.

Current Distribution on the Refuge: No known infestations exist on refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, other disturbed soil areas, and riparian and other moist areas.

Objectives:

a. Monitor known infestation sites, riparian and moist areas, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Control Scotch thistle to reduce competition with native plants by keeping infestations to less than 1 acre and less than 40% of live vegetation cover.
d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical treatment would include hand pulling or cutting of individual plants and small stands. The taproot would be cut 1-2 inches below the ground surface. Scything and mowing would be options for larger stands. The removal of the top material before flower production decreases the number of seeds available for spreading and propagation. Preventing flowering by mechanical means in conjunction with herbicide application for root killing is most effective in eliminating and controlling Scotch thistle.

The chemical treatment of Scotch thistle with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™), imazapic (Plateau™), and metsulfuron methyl (Escort®) are the herbicides used to control Scotch thistle on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is

appropriate for spot treatments, but its broad specificity precludes broadcast applications. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Metsulfuron methyl is very effective for thistle and mullein control and is the preferred treatment in restoration areas with a high infestation level. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Mechanical treatment would target plants before flowering (April to mid-June).

Herbicides would be applied before bolting in the spring (April to June), possibly in conjunction with mechanical control, or to rosettes in fall (September -November).

G.8.14 Common cordgrass

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control, particularly for preventing new infestations. Cordgrass is an aggressive species that regenerates from large rootstocks. Excessive proliferation of cordgrass can lower the groundwater level, reduce the amount of surface water, reduce habitat for wildlife dependent on open water, reduce bird use by as much as 50%, reduce and interfere with water flow through drainages.

Description: Cordgrass is a perennial grass with stems reaching 7 feet. The stems have a waxy coating. Leaves are flat, 1/4 to 3/4 inch wide. The leaves lack auricles and have ligules that consist of a fringe of hairs. The leaf blades, which may be flat or inrolled, are 5 to 12 mm broad and may be persistent or falling. The flowers occur in numerous, erect, contracted panicles, which consist of closely overlapping spikelets in two rows on one side of the rachis. Reproduction is by seed, rhizomes, tillering, and rhizome fragments. The panicle is 3 to 8 inches long, initially compact but opening upon maturity.

Current Distribution on the Refuge: The only known infestation of common cordgrass is on Graveyard Spit on Dungeness NWR.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants and established native communities in disturbed moist soil, riparian, and wetland environments.

Objectives:

a. Monitor known infestation sites - riparian, wetland, and moist areas for significant adverse effects on water flow and wildlife habitat.
b. Seed disturbed sites with native species.
c. Control common cordgrass to reduce competition with native plants and significantly altering the environment. Treatment applied to keep infestation to less than 40% of live vegetation cover and prevent infestations from increasing in area.
d. Maintain healthy stands of native perennial plants.

Control Options: Mowing infestations can contain growth, limit seed set, and eventually kill the plants. To be effective, clones must be mowed repeatedly, beginning with initial spring green-up and continued until fall die-back. For clones under 10 feet in diameter, one to three mowings during the

growing season may be effective. Larger clones need to be mowed nine to ten times over two seasons for eradication. In some cases, mowing would be required for a third or fourth year (Spartina Task Force 1994).

Chemical control with glyphosate (Rodeo®) would be used on the Refuge for effective control of common cordgrass. Glyphosate is soil binding, inexpensive, a low threat to groundwater quality, and used to target numerous weed species. This chemical formulation is approved for aquatic application. All chemicals would be used in accordance with label recommendations.

Treatment Schedule: Data from herbicide trials in Willapa Bay suggest chemical control is best performed when the plants carbohydrate stores are lowest. Treatment would be conducted 1 to 2 times per season - once in the summer (June - August) and/or once in the spring (May) (Norman and Patten 1995).

G.8.15 Himalayan blackberry and Evergreen blackberry

Priority: High: Although widespread in Washington and control in not required, these species are highly invasive and difficult to control. Therefore it is important to protect wilderness areas as well as areas being restored to native vegetation.

Description: A robust, thicket forming shrub with stout arching canes with large stiff thorns. They can grow up to 15 feet tall; canes to 40 feet long. They bloom in the spring and the flowers are small, white to pinkish with five petals and Himalayan blackberry leaves are palmately compound with large, rounded to oblong, toothed leaflets usually in groups of 5 on main stems, while Evergreen blackberry (also known as cut-leaf blackberry) has deeply incised leaflets. They can be distinguished from the native trailing blackberry (*Rubus ursinus*) by its tall, arching reddish-brown canes, much more robust plants, rounder leaflets (or deeply incised leaflets for evergreen blackberry), and larger fruits and flowers

Current Distribution on the Refuge: Known infestations exist on the Dawley Unit and Protection Island. Currently, it is unknown distribution or densities of either of these species on any of the other refuge islands.

Measurable Objectives and Goal: Prevent further spread into newly seeded native restoration sites, along other ditches or other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat 100% of blackberry plants - targeting for elimination - to reduce competition with native plants.
d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical control includes hand pulling of small infestations, mowing or herbicide larger patches.

The chemical treatment of blackberries with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™), would be used on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments. Metsulfuron methyl is very effective for thistle, mullein control and blackberry is the preferred treatment in restoration areas with a high infestation level. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Cultural control of blackberries is an important control method. The key to controlling spread is by decreasing seed production in established patches, and/or preventing the cane tips or nodes from touching the ground to produce "daughter" plants. Methods that assist in these control strategies are minimizing soil disturbance, maintaining healthy native vegetation, control seed formation with a combination of mechanical and chemical techniques.

Treatment Schedule: The pulling can be done anytime. Mowing or cutting midsummer allow plant to grow back 18 inches then treat with herbicide is the preferred method.

Chemical application would occur during the Fall (Sept Oct.).

G.8.16 English Ivy

Priority: Low: Although widespread in western Washington and control in not required, this specie is highly invasive but fortunately not too difficult to control. Therefore it is important to protect wilderness areas as well as areas being restored to native vegetation.

Description: Evergreen vine that can trail along the ground or grow vertically up trees, fences, walls and hillsides. Most common type of growth lacks flowers and has dull green, lobed leaves with light veins that grow alternately along trailing or climbing stems. Leaf shape and size varies between varieties from deeply to shallowly lobed and from small, narrow leaves to large, broadly shaped leaves. Mature form of growth has shiny, unlobed leaves that grow in dense, whorl-like clusters and produce umbrella-like groups of small yellow-green flowers in the fall, followed by dark purple-black berries in the late winter or early spring.

Current Distribution on the Refuge: Only known infestations exist on Matia Island and the Dawley Unit.

Measurable Objectives and Goal: Prevent further spread into newly seeded native restoration sites, along other ditches or other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat 100% of ivy plants - targeting for elimination - to reduce competition with native plants.
d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical control includes hand pulling and cutting of vines or herbicide larger patches.

The chemical treatment of ivy with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™), would be used on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments. Other chemicals would be added as needed and be approved at the required level. All chemicals would be used in accordance with label recommendations.

Cultural control of ivy is an important control method. The key to controlling spread is by decreasing seed production in established patches, and/or preventing the vegetative spreading of the plants. Methods that assist in these control strategies are minimizing soil disturbance, maintaining healthy native vegetation, control seed formation with a combination of mechanical and chemical techniques.

Treatment Schedule: The pulling can be done anytime. Mowing or cutting midsummer allow plant to grow back 18 inches then treat with herbicide is the preferred method. Cutting vines and treating stems with herbicide or foliar in spring are good alternatives.

Chemical application would occur during the spring or fall.

G.8.17 Scotch Broom

Priority: High: The State of Washington considers this species as a Class B Noxious weed, and control is recommended. Scotch broom infests disturbed areas, along roadsides, pastures, and open areas where it forms dense colonies. It reproduces by seeds, which can remain viable for up to 60 years. Populations enlarge by peripheral expansion of existing stands forming monocultures. Biodiversity, livestock and wildlife forage quality are reduced with infestations of scotch broom. Seed are toxic to livestock and horses.

Description: Scotch broom is a perennial evergreen shrub with a deep taproot. Plants reach 3 to 10 feet tall with many branched stems. There are relatively few leaves that are simple in the upper part of the plant and the lower parts are 3 leaflets and deciduous. Flowers are primarily yellow, but may be tinged with red or purple. They are an irregular shaped pea-like flower about ¾ of an inch long. Flowering occurs from April to June.

Current Distribution on the Refuge: Only known infestation is at the Dawley Unit of the Refuge Complex.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., restoration areas, wildfire areas) depleted of native perennial plants.
b. Seed disturbed sites with native species.
c. Treat and control 100% of scotch broom plants - targeting for elimination - to reduce competition with native plants and prevent establishment of Scotch broom or its seed bank.

d. Map and measure larger infestation patches using geographic information software and a global positioning system device. Treat patches to prevent increase in the infestation area.
e. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling or digging using a weed wrench is a feasible control of small infestations and individual plants. The taproot would be removed to at least 2 inches below the ground surface. Entire plants would be removed from the site to limit the source of available seeds or removed prior to seed set.

Biological control of scotch broom is limited with a few domestic animals browsing the young stems. Two introduced insects; the twig-mining moth and the seed weevil eat only Scotch broom. They have been released in western Clallam County but their effectiveness in controlling Scotch broom has not yet been established.

The chemical treatment of scotch broom with an appropriate herbicide provides relatively effective control. Currently, triclopyr (Garlon ™), or glyphosate (Roundup™, Roundup Pro™) would be the herbicides used to control Scotch broom on the Refuge.

Treatment Schedule: Hand removal would be conducted 2 to 3 times during the growing season, the first removal occurring early in the season (March) well before flowering. Established areas too large to practically control by hand, or in areas where injury to surrounding vegetation prohibits broad scale application with chemical control, a cut and stump treatment would be used.

Selected biological control insect(s) would be, if used, released during the optimal time for both insect and plant to provide the greatest effectiveness for controlling Scotch broom.

Triclopyr or glyphosate would be applied once before the flowering season (April-June). Annual treatment is necessary as long as there is a viable seed source.

G.8.18 Other Future species

Oxeye Daisy, Tansy Ragwort, and Spurge Laurel
These are species currently not known to occur on the Refuge but do occur in surrounding areas. These include Purple Loosestrife, Russian knapweed, Garlic Mustard, Japanese Knotweed, and Lawnweed. Others may be added as information becomes available and new species are documented.

Table G-5. Summary of invasive plant species and possible control methods to be used, Washington Maritime National Wildlife Refuge Complex

Species	Priority	Mechanical	Biological	Chemical	Cultural
Blackberries	Low-Medium	X		X	
Bull thistle	Low-Medium	X		X	
Canada thistle	Low-Medium	X	Stem-and-shoot gallfly (*Urophora cardui*)	X	
Cheatgrass	Medium	X		X	X
Dalmatian and yellow toadflax	High	X		X	

Species	Priority	Mechanical	Biological	Chemical	Cultural
Diffuse, spotted, Russian, and meadow knapweed	High	X	Broad-nosed seedhead weevil, Sulfur knapweed moth, Knapweed weevil, Knapweed flowerhead weevil	X	
Field bindweed	Low-Medium		Field bindweed moth, Field bindweed mite	X	
Scotch Broom	High	X		X	
Leafy spurge	High		Brown-legged spurge flea beetle, Amber spurge flea beetle	X	
Musk thistle	Medium	X	Seed head weevil, Musk thistle weevil	X	
Common cordgrass	Medium-High	X		X	
Russian knapweed	High	X		X	
Scotch thistle	Medium-High	X		X	
St. Johnswort	Medium-High		Klamath weed beetle		

G.9 Non-native Mammal Control

The animals referred to under this category are the non-native predators (rats, red fox, dogs, and cats) and the herbivore (European rabbit). All of these can be controlled using one or more methods. Currently, only rabbits are known to exist on a limited number of islands and in low numbers, but expanding. For initial population control traps would be the preferred method followed by shooting then poison bait. Any method used would be to eradicate the population in the quickest, most humane, and least impact to other potential non-target animals.

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Appendix H. Sign Inventory and Maintenance Plan

H.1 General Information

Dungeness National Wildlife Refuge was set aside by Executive Order 2123 in 1915 as a refuge, preserve, and breeding ground for native birds. Located in the northwest corner of Washington State on the Strait of Juan de Fuca, the Refuge offers a diversity of habitats including sand beaches, protected bay waters, eelgrass beds, mudflats, and forested and grass uplands. Dungeness NWR consists of the Dungeness Unit, which includes the Graveyard Spit Research Natural Area (RNA), and the Dawley Unit.

Originally the Dungeness Unit (including the Dungeness Spit) was part of a lighthouse reservation, on which the New Dungeness Light Station was built in 1857. Dungeness Spit is the longest natural sand spit in North America. Extending five and a half miles into the Strait of Juan de Fuca, it provides habitat for a great variety of migratory shorebirds, waterfowl, marine mammals, and other marine life within its protective reach. The tranquil waters of Dungeness Bay, with its eelgrass beds, mudflats, and tidelands provide food, shelter, and breeding grounds to support a whole ecosystem teeming with life.

Large numbers of brant, wigeon, pintail, mallard, and bufflehead winter there. Dungeness crab, surf smelt, herring, and others breed within the bay and salmon frequent the waters surrounding the Refuge. Rare northern elephant seals haul out on the spit each year. Graveyard Spit supports some of the best remaining strand habitat within the Salish Sea. While Graveyard Spit is closed to the public, tidelands to the east and west are open seasonally. The Dungeness Spit is open to the public on the Strait side from the base of the spit to the lighthouse year-round and on the bay side for the first half mile seasonally. The west beach and forest trails are open to the public year-round.

The Dawley Unit, located along Sequim Bay, was established as a wildlife sanctuary in 1973. The residential area was heavily developed with the construction of aviaries, ponds, and gardens while the forested tract was altered by logging over the years. The forested area does have an established logging road system, but due to the topography, some areas were protected from further alterations and are considered good second growth forest habitat. The entire unit is closed to the public.

H.2 Purpose of this Plan

The general purpose of the sign inventory and maintenance plan is to identify and quantify the signs in use while documenting their condition and assessing and prioritizing repair and replacement needs. Furthermore, the plan seeks to accomplish four additional goals. First, refuge signs are intended to convey important general information to visitors such as where the Refuge is located and where they should and should not go or what they should not do with the overall goal of reducing impact to wildlife and their habitat. Second, refuge signs intend to facilitate a better understanding of the importance of the Refuge to wildlife while instilling in our visitors a sense of value for wildlife and habitat conservation. Signs should help to illuminate the Refuge's unique history and how it is part of a larger cultural and natural perspective. Third, refuge signs intend to increase visitor safety and reduce injuries by providing important warnings. And finally, they are intended to accomplish these tasks with as little disruption to the aesthetic beauty of the Refuge as possible.

H.3 Use and Visitation

The Dawley Unit is closed to the public. While it is primarily set aside as wildlife habitat, the Service continues to use some of the structures on a limited basis. Only regulatory signs are utilized on the unit making sign criteria and maintenance fairly straight-forward. In contrast, the Dungeness Unit is the busiest unit with the Washington Maritime National Wildlife Refuge Complex. It is estimated that more than 80,000 people visit each year. An extensive array of regulatory, information, and interpretive signs are utilized in this unit which requires an aggressive sign program. Due to the nature of beaches and the general marine environment, maintaining signs in the Dungeness Unit is challenging.

H.4 Sign Inventory

See Table H-1 for an abbreviated sign inventory for Dungeness NWR. In addition there are approximately 300 standard Service closed area and refuge boundary signs and approximately 10 government property (no trespassing) and sensitive wildlife habitat signs in use. Examples of each are provided. See Figure H-1, Standard Service Signs.

Figure H-1. Standard Service Signs in use on Dungeness NWR. Size: 11" X 14"

Table H-1. Dungeness NWR Sign Inventory

Sign		Location	Type	Condition	Date
General Information Signs					
1	Park Entrance	Voice of Am. Rd. & Lotzgesell Rd.	Info	Good	N/A
2	Ref. Entrance	Voice of Am. Rd	Info	New	11/2011
3	Entrance St. Welcome	Entrance station plaza	Info	New	8/2011
4	Bluff Trail, Welcome	West end of bluff trail	Info	New	8/2011
5	Main Tr. Info and map	Main trailhead entrance	Info/Reg	New	8/2011
6	Refuge Closes at: (time)	Main and primitive trailheads, hill	Info	Poor	N/A
7	Trail Arrow	Kiosk, right post	Info	New	8/2011
8	Office Arrow	Fee station, right post	Info	New	8/2011
9	Headquarters doors	Office entrance	Info	New	8/2011
10	Trash Recycle (3)	Right side of kiosk	Info	New	8/2011
11	Trash Recycle (3)	Left side of dumpster enclosure	Info	New	8/2011
12	Fee Station	Fee station structure	Info	New	8/2011
13	Fee Can Decals (2)	Fee canister @ main and primitive tr.	Info	New/Poor	N/A

Sign			Location	Type	Condition	Date
14	Restrooms w/ arrow (2)		RR sidewalk & fence	Info	Good	N/A
15	Lighthouse Information		Fence left of main trailhead	Info	Good	N/A
16	Parking Area Full		Overflow lot entrance	Info	Poor	N/A
17	Distance to Spit 1		Near County Park kiosk	Info	Good	N/A
18	Distance to Spit 2		West end of parking lots	Info	Fair	N/A
19	Distance to Spit 3		Middle of parking lots	Info	Poor	N/A
20	Primitive Trail Fee Sign		Primitive Trail Fee Station	Info/Reg	Fair	N/A
21	Primitive Arrow Symbol		Base of spit @ bottom of main tr.	Info	Poor	N/A
22	Hiker w/ Arrow		Base of spit @ bottom of main tr.	Info	Poor	N/A
23	No Jogging Past .5 mile		Near ½ mile marker	Info	Poor	N/A
24	Hiker & Arrow Symbol		Lighthouse access rd.	Info	Good	N/A
25	Map Panels (Porcelain on steel)	a	Primitive Trail Kiosk	Info/Reg	Fair	N/A
		b	Lighthouse boat landing area	Info/Reg	Poor	N/A
		c	County Park Kiosk	Info/Reg	Good	N/A
		d	Cline Spit (planned)	Info/Reg	--------	
		e	Dungeness Landing (planned)	Info/Reg	--------	
26	Fee Dollars at Work		Entrance to upper overlook	Info	Fair	N/A
27	Harbor Overlook		Entrance to upper overlook	Info	Poor	N/A
28	a Hiker Arrow Symbol		Intersection of main & primitive trails	Info	Poor	N/A
	b Primitive Arrow Symbol		Intersection of main & primitive trails	Info	Poor	N/A
29	Amnesty Bucket		Entrance to upper overlook	Info	New	11/2011
30	Maintenance Area		Mellus Cabin Gate	Info	Poor	N/A
31	Mile Markers	a	½ Mile	Info	Poor	N/A
		b	1 Mile	Info	Good	N/A
		c	2 Mile	Info	Poor	N/A
		d	3 Mile	Info	Good	N/A
		e	4 Mile	Info	Good	N/A
Interpretive Signs						
34	Kiosk Interp. Panels (3)		Kiosk	Interp	New	8/2011
35	Main Trail Interp. (2)		Lower main trail	Interp	New	8/2011
36	Dungeness Spit Interp.		Steep hill to beach	Interp	New	8/2011
37	Spit Map		Steep hill to beach	Interp	New	8/2011
38	Plant Identification		Main trail (series)	Interp	Good/Fair	N/A
39	Bird Pictorial Guide		At entrance to upper viewing deck	Interp	New	11/2011
Regulatory Signs						
40	Entrance Regulations		Overflow parking entrance	Reg	Fair	N/A
41	Main Trail, symbols		Main trailhead	Reg	Fair	N/A
42	Stop, Did You Pay		Main trailhead	Reg	Poor	N/A
43	Stop, Did You Pay		Primitive trailhead	Reg	Poor	N/A

Sign		Location		Type	Condition	Date
44	No Pets	Main trailhead		Reg	Fair	N/A
45	No RVs or Trailers	Overflow lot entrance		Reg	Poor	N/A
46	Primitive Tr. symbols (6)	Entrance to primitive trail		Reg	Good/Poor	N/A
47	No Horses on path	Paver path to HQ @ overflow lot		Reg	Good	N/A
48	Caretaker Parking	Overflow lot		Reg	Very good	2011
49	Volunteer Parking	Overflow lot		Reg	Very good	2011
50	Disabled Parking	Overflow lot		Reg	Very good	N/A
51	Disabled Parking (2)	Main lot & restroom, 1st spaces		Reg	Poor	N/A
52	15 minute parking	Restroom, 2nd space		Reg	Poor	N/A
53	Reserved Parking	Restroom maintenance access		Reg	Poor	N/A
54	Main Tr. “Gate” barrier	Main trailhead		Reg	Fair	N/A
55	Crosswalk	Restroom crosswalk		Reg	Very good	N/A
56	Boating Regulations	a	Cline Spit	Reg	Poor	N/A
		b	Dungeness Landing	Reg	Poor	N/A
57	Boating Regs., Pylons	Dungeness Harbor and Bay		Reg	Very good	N/A
58	Large Format Buffer	Graveyard (3) Dungeness end (1)		Reg	Good	N/A
59	Boat Landing Zone	Lighthouse boat landing area		Reg	Poor	N/A
60	Boat Visitors to LH	Lighthouse boat landing area		Reg	Poor	N/A
61	Firearms Prohibited	Headquarters doors, front & back		Reg	New	N/A
62	Area Closed Signs	Various: bluffs, .5 mile, etc.		Reg	New/Poor	N/A
63	Refuge Boundary	Boundaries; Dungeness/ Dawley		Reg	New/Poor	N/A
64	Unauthorized Entry	Boundaries; Dungeness/ Dawley		Reg	New/Good	N/A
65	No Parking	Refuge parking lots		Reg	Good/Fair	N/A
66	Bank Rest., Keep Off	Lower main tr. @ lower overlook		Reg	Fair	N/A
67	No Climbing symbol	Along lower main trail and bluffs		Reg	Fair/Poor	N/A
68	Sensitive wildlife habitat	5 mile closure, Strait side of spit		Reg	New/Good	4/2012
69	Wildlife Sanctuary Closed	a	5.5 mile, End of Spit	Reg	Fair	N/A
		b	South End of Graveyard Spit	Reg	Fair	N/A
		c	West side of Graveyard Spit	Reg	Fair	N/A
County Road Signs (Not Refuge Maintained)						
70	HWY 101	Highway 101		Info	Good	N/A
71	Kitchen Dick Rd	Kitchen Dick Rd @ Woodcock		Info	Good	N/A
72	Old Olympic Hwy	Old Olympic Hwy @		Info	Good	N/A

Sign		Location	Type	Condition	Date
		Kitchen Dick Rd			
73	Lotzsgesell Rd	Lotzsgesell Rd @ Park Entr.	Info	Good	N/A
74	Cays Rd	Cays Rd @ Lotzsgesell Rd	Info	Good	N/A
75	Voice of America Rd	Voice of Am. Rd @ Picnic area	Info	Good	N/A
76	West Anderson Rd	West Anderson Rd, east of Cays Rd	Info	Good	N/A
77	Anderson and Cays	NW Corner of Anderson & Cays	Info	Good	N/A

Sign Types: Info= Informational, Reg= Regulatory, Interp= Interpretive

H.5 Sign Specification and Placement Criteria

Signs will meet the specifications set forth in the USFWS Sign Manual. Signs posted in the Refuge will be constructed of high quality durable materials including steel, marine density overlay (MDO) ¾ inch plywood, poly metal, and plastic laminates and will have steel or wooden posts and supports. Large signs should be planted in cement. All mounting hardware should be corrosion-resistant stainless steel, such as Society of Automotive Engineers (SAE) grade 316, with locking nuts. The use of temporary and/or handmade signs is discouraged.

Except as otherwise indicated, sign background color will be brown or white and lettering will be white, black, or, in the case of standard USFWS signs, dark blue. Text font will be Helvetica Medium. Reflective materials will be employed where vehicles (including boats) may encounter signs in dark conditions.

Protected shoreline areas will utilize large format signs which can be read from the water at least 100 yards offshore. These signs may also include the Service shield. Large format signs are at least 5 feet wide and 4 feet high. These signs should be well supported to protect against high winds common in the area.

Standard USFWS closed area signs will be utilized to demarcate areas not open to the public as determined by the refuge manager. These signs will be posted on standard steel or wood posts. Standard USFWS refuge boundary signs should be posted along terrestrial boundary lines and sensitive habitat signs should be utilized as needed. See Figure H-1 for examples of standard Service signs.

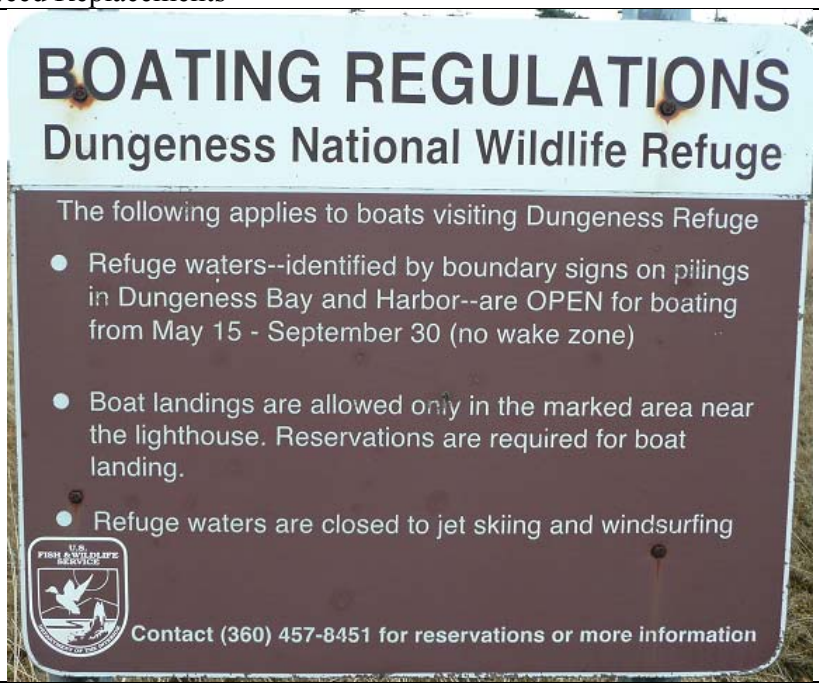
H.5.1 Large Special Purpose (Regulatory) Signs

Due to the somewhat complicated nature of the Dungeness Unit, it is necessary to maintain a variety of large custom signs. In marine environments where wildlife disturbance is an issue, signs that can be read at distances up to 100 yards are necessary. The Refuge utilizes a variety of large format signs to inform visitors about refuge regulations including area closures. These signs are described below.

Sign Number(s): 40	
Description:	Visitor Information - Entrance
Material:	MDO plywood White and brown with white and brown lettering
Text:	Dungeness National Wildlife Refuge, Visitor Information • Dungeness Spit Trailhead • Entrance Fee Required • Refuge Closes at Sunset • Pets, Bicycles, Fires, and Camping Prohibited
Dimensions:	66” X 48”
Location:	Voice of America Road at refuge overflow parking entrance

Sign Number(s): 42 and 43	
Description:	Entrance fee stop sign
Material:	MDO plywood Reflective brown with white lettering and red “stop sign” symbol
Text:	Did You Pay Entrance Fee? Failure to comply with entrance fee requirement is a violation subject to penalties prescribed in 50 CFR 28.31
Dimensions:	38” X 16”
Location:	Main and Primitive Trailheads
Note:	Need Replacements

Sign Number(s): 56a and 56b	
Description:	Boating Regulations
Material:	Metal White and brown with white and brown lettering
Text:	BOATING REGULATIONS Dungeness National Wildlife Refuge The following applies to boats visiting Dungeness Refuge • Refuge waters - identified by boundary signs on pilings in Dungeness Bay and harbor – are OPEN for boating from May 15 – September 30 (no wake zone) • Boat landings are allowed only in the marked area near the lighthouse. Reservations are required for boat landing. • Refuge waters are closed to jet skiing and windsurfing. • Contact (360) 457-8451 for reservations or more information
Dimensions:	26” X 24”
Location:	Cline Spit and Dungeness Landing boat launches
Note:	Need Replacements



Sign Number(s): 57a and 57b	
Description:	Tidelands seasonal closure
Material:	Heavy plastic on MDO plywood Reflective white or white and blue with black or white and blue lettering
Text:	WILDLIFE REFUGE AREA CLOSED EXCEPT MAY 15 – SEPT. 30 BOATING (no wake zone) AND SHELLFISHING ALLOWED UP TO 100 YARD BUFFER FROM SHORE. SHORE AND UPLAND REMAIN CLOSED. Windsurfing & Jet Skis Not Allowed
Dimensions:	24” X 42”
Location:	Refuge tidelands boundary pilings east and west of Graveyard Spit (Dungeness Bay and Harbor)

Sign Number(s): 59	
Description:	Lighthouse boat landing zone, reservation required
Material:	MDO plywood Reflective white or white and blue with black or white and blue lettering
Text:	BOAT LANDING ZONE, By Reservation Only, Between yellow posts For Information Contact Dungeness National Wildlife Refuge (360) 457-8451
Dimensions:	60” X 42”
Location:	Lighthouse boat landing zone
Note:	Needs Replacement

Sign Number(s): 60	
Description:	Lighthouse boat landing closed areas
Material:	MDO plywood Brown with white lettering and a red and yellow map
Text:	ATTENTION VISITORS, The tip of Dungeness Spit, including all beaches, tidelands, and uplands, is closed to public access to provide a sanctuary for wildlife.
Dimensions:	44” X 20”
Location:	Lighthouse boat landing zone
Note:	Needs Replacement

Sign Number(s): 69a, b, and c	
Description:	Wildlife sanctuary closures; end of Dungeness Spit, all of Graveyard Spit
Material:	MDO plywood White with black lettering
Text:	Wildlife Sanctuary Area Closed Refuge Boundary Posted on Pilings in Bay
Dimensions:	66” X 48”
Location:	Tip of Dungeness Spit, Tip and West Side of Graveyard Spit (2)

H.5.2 Posting Closed Areas on Dungeness Spit

Bluffs: Some of the most hazardous areas in the Refuge are the west bluffs which are permanently closed to the public. Constantly eroding, the bluffs are known to shed large amounts of material without warning. At least one visitor has been seriously injured while trespassing in the closed area and attempting to climb the bluffs. Posting signs in this dynamic environment poses a constant challenge. Wave action at the base of the bluffs can quickly undermine sign posts on the beach resulting in regular loss of signs and posts. Refuge staff has experimented with different posting methods including posting signs directly on the bluffs but none have proven fully successful.

Currently, the best approach is to continuously post signs on the beach approximately 10 feet away from the bluffs to create a safety buffer and allow for eroded material to collect. It is best to post in locations that present the most “inviting” avenues of access such as gullies and dirt piles. Signs should be posted approximately every 25 feet initially from the base of the Spit for the first hundred feet, 5 signs, and then every 75 to 100 feet thereafter to the western refuge boundary. Signs should be inspected daily and replaced as needed.

Dungeness Spit: Although somewhat less dynamic than the west beach area, the “Spit” also presents a challenge for maintaining signs. Installing posts on the driftwood “spine” of the spit can be extremely difficult due to buried logs and rocks. Winter storms regularly dislodge and destroy signs

making it difficult to keep closed areas adequately posted. Signs along the entire "Spit" should be inspected monthly and replaced as needed. Each spring a team of staff and volunteers should conduct a comprehensive sign "replenishment" campaign.

The first ½ mile of the Spit is closed seasonally from October 1 through May 14. While closed signs are removed during the open season, posts should left in place. In late September missing sign posts should be replaced in preparation for posting closure signs. Signs at the base of the spit should be placed no more than 25 feet apart on the service road and the first 150 feet of the spit. Additionally, a rope should span this area from post to post to provide a visual barrier and aid in enforcement. Signs after that should be posted every 75 to 100 feet to the ½ mile marker. Signs demarcating the ½ mile closure line on the inside of the spit should be no more than 25 feet apart extending from the driftwood spine into the harbor. These signs should be removed seasonally to reduce visitor confusion but the posts should be left in place. This area experiences a high level of trespass and should be well defined.

The second ½ mile should be well posted with signs every 100 to 150 feet. After the first mile marker signs can be up to 200 feet apart except that they should be more numerous in the 4.5-5 mile section near the lighthouse where the spit is narrow and visitors are more tempted to cross over to the Bay side. Wash-over areas are often clear of driftwood and present inviting paths for trespassers. For that reason they are good places to post signs, however, they are also more likely places for signs to be lost to wave action. When posting in these areas signs should be placed on higher ground near the wash-over "path."

The Wildlife Sanctuary, 5 mile closure: Another area that experiences regular trespass is the "wildlife sanctuary" at the end of the "Spit." At low tide beach walkers may inadvertently wander into this area. Because it is difficult to maintain signs on the beach, a clear line of signs should be visible on the upland area from the rip rap edge across the spit to the Bay. These signs, particularly the ones at the ends of the line, should be inspected weekly and replaced as needed. The inclusion of standard Service "Sensitive Wildlife Habitat" signs should help deter trespass.

H.6 Sign Inspection and Maintenance

The refuge caretaker in conjunction with staff will be responsible for routine inspections and maintenance of signs. A sign inspection form should be maintained for each non-standard sign. See Figure H-2. Inspection forms are not necessary for standard Service signs which should be visually inspected and replaced as needed. In addition, caretakers and staff will assess for sign damage as soon after high wind and water events as possible to insure signs have not been lost or damaged. Any sign damage that is not immediately remedied will be reported to the refuge manager or deputy manager. Materials necessary to repair signs will be stored in the maintenance building. These materials will include replacement USFWS shields, posts, cribbing, tools, and bolts. Due to their size and expense most large replacement signs will be stored at the Refuge Complex Headquarters at 715 Holgerson Rd. in Sequim, Washington, or made to order as needed. A supply of standard Service signs will be maintained in the storage shed at the Caretaker's cabin. A review of this sign plan will occur every 5 years unless conditions necessitate an earlier review.

Figure H-2. Sign Inspection Form.

Washington Maritime NWRC
Sign Inspection Checklist

Name of Inspector: _____

Refuge: _____ Unit: _____

Date: ____/_____/_____ Time: _____

Sign Inventory ID: ☐

Sign Location: _____ Description: _____

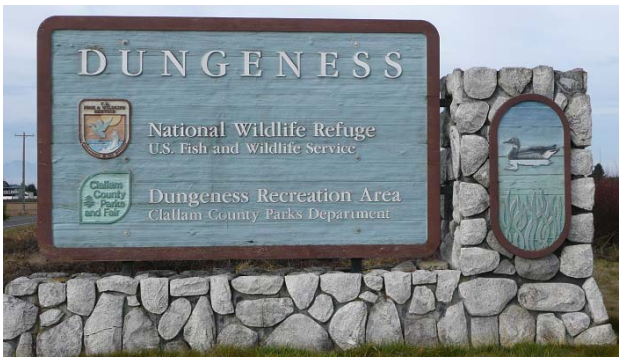
Problem	Substrate	Face (overlay & lettering)	Finish (Paint)	Sign supports	Hardware	Comments
Missing						
Blistering						
Corroded						
Cracking						
Dirty						
Damaged						
Decal faded/damaged						
Faded/readable						
Faded/unreadable						
Hanging or fallen						
Ply Separation						
Rotting						
Scratching or Tearing						
Unstable						

Recommendations						
Clean						
Cut vegetation						
On-site repair						
Shop repair						
Remove						
Replace decal						
Replace sign						
Replace hardware/post(s)						

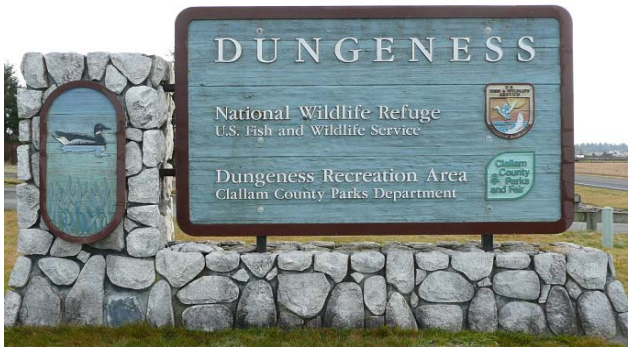
H.7 References

U.S. Fish and Wildlife Service (USFWS). 1992. U.S. Fish and Wildlife Service sign manual, director's memorandum signed by Acting Assistant Regional Director Carolyn Bohan, May 15, 1992. U.S. Department of Interior, Fish and Wildlife Service, Region 1. Portland, OR.

Dungeness NWR Sign Reference Photos: Information (Sign #1 – 32)



1a. County Park Entrance (east side)



1b. County Park Entrance (west side)

2. Voice of America Rd

3a. Refuge Kiosk (front)

3b. Refuge Kiosk (back)

4. Bluff Trail

5a. Main Trailhead

5b. Main Trailhead (Left)

5c. Main Trailhead (Right)

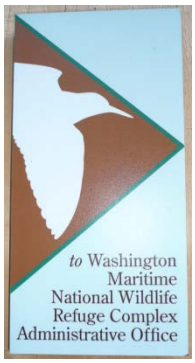
5d. Main Trailhead (Back)

6a. Main Trailhead

6b. Primitive Trailhead

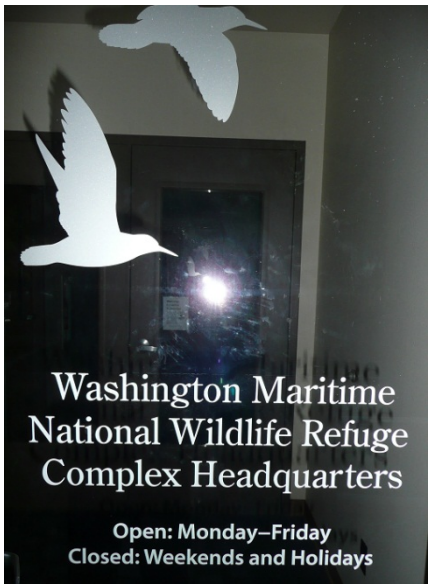
6c. Top of Hill to Spit

7. Kiosk



8. Fee Station

9a. Headquarters Entrance (left)



9b. Headquarters Entrance (right)

9c. HQ (left and right)

10. Kiosk

11. Main Parking Lot

12. Fee Station

13a. Main Trail

13b. Primitive Trail

14a. Entrance Station Crosswalk

14b. Parking Lot Fence

15. Main Trailhead (Maintained by NDLSA)

16. Overflow Parking Lot Entrance

17. Near County Kiosk

18. West End of Parking Lot

19. Middle of Parking Lot

20a. Primitive Trail Fee Station

20b. Primitive Trail Fee Station

21. Spit Service Rd


22. Spit Service Rd

23. 1/2 Mile Marker 24. Lighthouse Service Rd

25a. Primitive Trailhead


25b. Lighthouse Landing Area

25c. County Park Kiosk

26. Upper Overlook

27. Upper Overlook

28a and b. Main Trail Junction (Horseback riding sign will be removed)

29. Caretaker's Cabin

30. Caretaker's Cabin Gate

31a. Spit

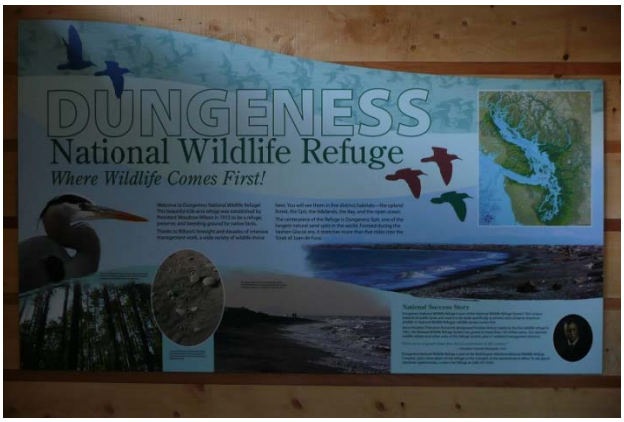
31b. Spit

31c. Spit

31d. Spit

31e. Spit

Dungeness NWR Sign Reference Photos: Interpretive (Sign #34 – 39)



34a. Kiosk (left)

34b. Kiosk (center)

34c. Kiosk (right)

35a. Lower Main Trail (front)

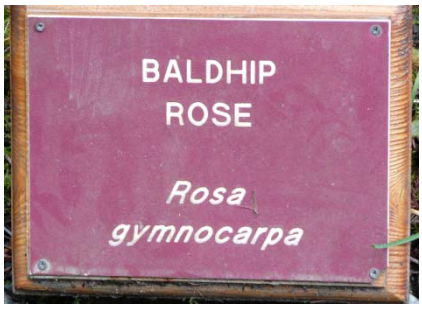
35b. Lower Main Trail (back)

36. Lower Main Trail, Hill

37. Lower Main Trail, Hill

38a. Main Trail

38b. Main Trail



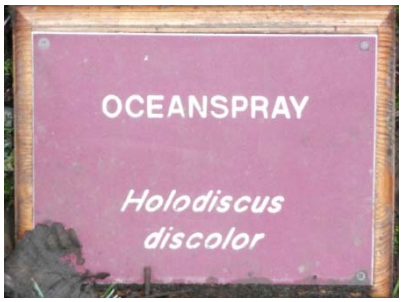
38c. Main Trail

38d. Main Trail

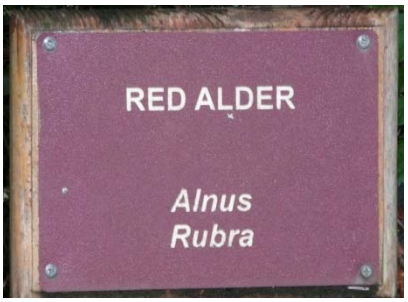
38e. Main Trail

38f. Main Trail

38g. Main Trail



38h. Main Trail

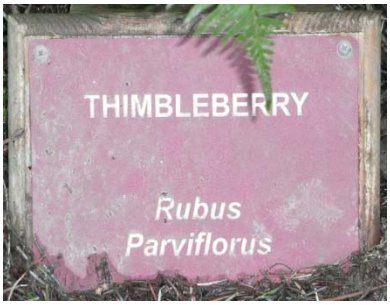


38i. Main Trail

38j. Main Trail

38k. Main Trail

38l. Main Trail



38m. Main Trail

38n. Main Trail

38o. Main Trail

38p. Main Trail

39. Main Trail, Top of Hill

Dungeness NWR Sign Reference Photos: Regulatory (Sign #40 – 69)

40. Voice of America Rd at Refuge Entrance

41. Main Trailhead

42. Main Trail

43. Primitive Trail

44. Main Trailhead

45. Overflow Parking Lot

46a. Primitive Trail Gate

46b 

46c 

47. Path to Headquarters

48. Overflow Lot

49. Overflow Lot

50. Overflow Lot

51. Main Parking Lot

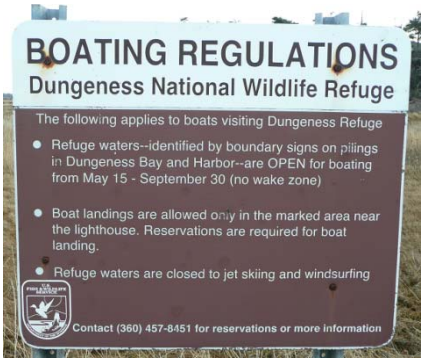
52. Restroom Parking

53. Restroom

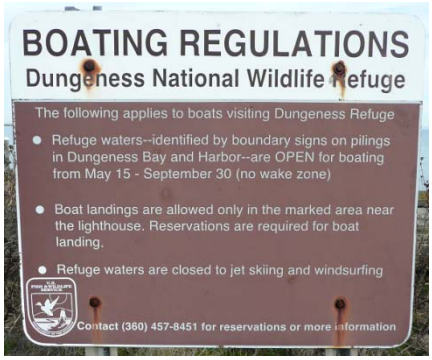
54a. Main Trail “Gate” (front)

54b. Main Trail “Gate” (back)

55. Restroom Crosswalk



56a. Cline Spit



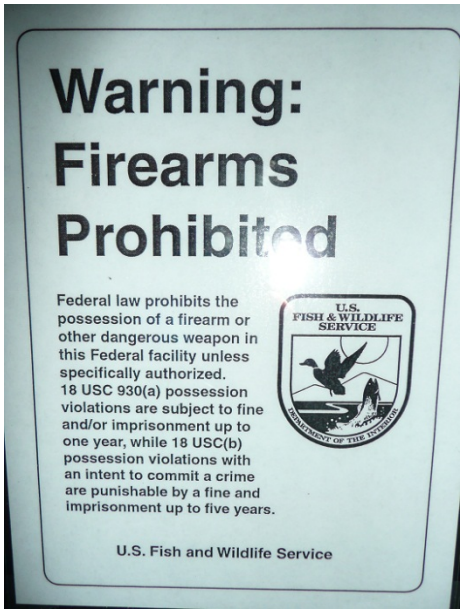
56b. Dungeness Landing

57a. Harbor/Bay Pilings

57b. Harbor/Bay Pilings

60. Lighthouse Boat Landing Area

61. Lighthouse Boat Landing Area



62. Headquarters Entrance

62 – 65: Standard USFWS Signs (See Figure H-1, Standard Service Signs in use on Dungeness NWR)

66. Main Tr Hill


67. Bluffs

68. LH Beach

69a, b, and c. Graveyard Spit and End of Dungeness Spit

Dungeness NWR Sign Reference Photos: County (Sign #70 – 77)

70. Highway 101

71. Kitchen Dick Rd at Woodcock Rd

72. Old Olympic Highway at Kitchen Dick Rd

73. Lotzsgesell Rd at County Park Entrance

74. Cays Rd

75. Voice of America Rd

76. East Anderson Dr at Cays Rd

77. West Anderson Dr and Cays Rd

Document continues on next page.

Appendix I. Acronyms, Glossary and Scientific Names

I.1 Acronyms

ABA	Architectural Barriers Act
ABC	American Bird Conservancy
ADA	Americans with Disabilities Act
ARPA	Archaeological Resources Protection Act
ATSDR	Agency for Toxic Substances and Disease Registry
Audubon	National Audubon Society
BBS	Breeding Bird Survey
BCC	Birds of Conservation Concern
BIDEH	Biological Integrity, Diversity, and Environmental Health
BLM	Bureau of Land Management
BMC	Birds of Management Concern
BMPs	Best Management Practices
BOR	Bureau of Reclamation
BP	Before Present
CCP	Comprehensive Conservation Plan
CD	Compatibility Determination
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CIG	Climate Impacts Group
COASST	Coastal Observation and Seabird Survey Team
Complex	Washington Maritime National Wildlife Refuge Complex
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWA	Clean Water Act
DAHP	Washington State Department of Archaeology and Historic Preservation
DAWACT	Dungeness Area Watershed Analysis Cooperative Team
DBH	Diameter at Breast Height
Director	Director of the U.S. Fish and Wildlife Service
DOE	U.S. Department of Energy
DRA	Dungeness Recreation Area
DWD	Downed Woody Debris
EA	Environmental Assessment
EDPU	Elwha-Dungeness Planning Unit
EE	Environmental Education
EIS	Environmental Impact Statement
ENSO	El Niño/Southern Oscillation
EO	Executive Order
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FIRFA	Federal Insecticide, Fungicide, and Rodenticide Act
FMP	Fire Management Plan
FR	Federal Register
FWA	Fish and Wildlife Act of 1956
FWS	U.S. Fish and Wildlife Service (also, Service, USFWS)

FY	Fiscal Year
GAO	Government Accountability Office
GHG	Greenhouse Gases
GIS	Geographic Information System
GPS	Global Positioning System
HMP	Habitat Management Plan
IAC	Interagency Committee for Outdoor Recreation
IBA	Important Bird Areas
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
LCC	Land Conservation Cooperative
LE	Law Enforcement
LWCF	Land and Water Conservation Fund
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSL	Mean Sea Level
MTL	Mean Tide Level
NAGPRA	Native American Graves Repatriation Act
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NAVD88	North American Vertical Datum 1988
NAWMP	North American Waterfowl Management Plan
NCDC	National Climatic Data Center
NDLSA	New Dungeness Light Station Association
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRC	Natural Resource Consultants
NRHP	National Register of Historic Places
NSRE	National Survey on Recreation and the Environment
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
OCBP	Ocean Carbon and Biogeochemistry Program
OCNMS	Olympic Coast National Marine Sanctuary
OFM	State of Washington's Office of Financial Management
OMB	Office of Management and Budget
ONF	Olympic National Forest (also Olympic NF)
ONP	Olympic National Park (also Olympic NP)
OPAS	Olympic Peninsula Audubon Society
PDO	Pacific Decadal Oscillation
PFT	Permanent full time

PIF	Partners in Flight
PLO	Public Land Order
PP	Presidential Proclamation
PRBO	Point Reyes Bird Observatory
PRPA	Paleontological Resources Protection Act
PSAT	Puget Sound Action Team
PSNERP	Puget Sound Nearshore Ecosystem Restoration Project
PSWQAT	Puget Sound Water Quality Action Team)
PTC	Peninsula Trails Coalition
PUP	Pesticide Use Proposal
R1	Region 1 of the FWS (WA, OR, HI, ID)
RC&DC	North Olympic Peninsula Resource Conservation & Development Council
RCO	Washington State Recreation and Conservation Office
RNA	Research Natural Area
ROC	Resource of Concern
SAMMS	Service Asset Management System
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SDTF 2003	Spray Drift Task Force 2003
SHPO	State Historic Preservation Office
SLAMM	Sea Level Affecting Marshes Model
SO	Secretarial Order
SUP	Special Use Permit
T & E	Threatened or Endangered Species
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
U.S.C.	United States Code
USC&GS	U.S. Coastal and Geodetic Survey
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDC	U.S. Department of Commerce
USDI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency (also, EPA)
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
USHCN	U.S. Historical Climatology Network
WDEQ	Washington Department of Environmental Quality
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOE	Washington Department of Energy
WRCC	Western Regional Climate Center
WSDA	Washington Department of Agriculture

I.2 Glossary

Adaptive Management. Refers to a process in which policy decisions are implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in a management plan. Analysis of results help managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Alternative. 1. A reasonable way to fix the identified problem or satisfy the stated need (40 CFR 1500.2). 2. Alternatives are different means of accomplishing refuge purposes and goals and contributing to the System mission (Service Manual 602 FW 1.6).

Anadromous. A fish that hatches in freshwater, migrates to the ocean to live and grow, and returns to freshwater to spawn.

BIDEH. Biological integrity, diversity and environmental health represented by native fish, wildlife, plants and their habitats as well as those ecological processes that support them.

Biological Diversity. The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Service Manual 052 FW 1.12B). The System's focus is on indigenous species, biotic communities, and ecological processes. Also referred to as Biodiversity.

Compatible Use. A proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the national wildlife refuge (Service Manual 603 FW 2.6). A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

Comprehensive Conservation Plan (CCP). A document that describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge; helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; and meets other mandates. (Service Manual 602 FW 1.6).

Concern. See definition of issue.

Cover Type. The type of vegetation in an area. Often referred to as percent cover or the % of ground covered by vegetation type (e.g. 20% shrub cover).

Cultural Resources. The remains of sites, structures, or objects used by people in the past.

Cultural Resource Inventory. A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including a background literature search, a comprehensive field examination to identify all exposed physical manifestations of cultural resources, or a sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).

Demography. The study of life-history parameters such as adult survival, fledgling success, and the number of broods raised per year.

Disturbance. Significant alteration of wildlife behavior or habitat structure and composition. May be natural (e.g., fire) or human-caused events (e.g., aircraft over flight).

Ecosystem. A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.

Ecosystem Management. Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely.

Endangered Species (Federal). A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species (State). A plant or animal species in danger of becoming extinct or extirpated in Washington within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.

Environmental Assessment (EA). A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

Finding of No Significant Impact (FONSI). A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Fire Regime. A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning.

Focal Resources. Plant and animal species that are most representative of refuge purposes, BIDEH and other FWS and ecosystem priorities. Conservation and management of these species will guide refuge management in the future. See Priority Resources of Concern and Other Benefiting Species.

Forb. A broad-leaved, herbaceous plant; for example, a columbine.

Goal. A descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose, but does not define measurable units (Service Manual 602 FW 1.6).

Habitat. Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Habitat Type. See Vegetation Type.

Habitat Restoration. Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

Invasive Species. A non-native species whose introduction causes or is likely to cause economic or environmental harm. Also referred to as exotic or non-native species.

Inventory. A survey that documents the presence, relative abundance, status and/or distribution of abiotic resources, species, habitats, or ecological communities at a particular time. Often referred to as baseline inventory.

Issue. Any unsettled matter that requires a management decision (e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition) (Service Manual 602 FW 1.6).

Management Alternative. See Alternative.

Migration. The seasonal movement from one area to another and back.

Mission Statement. Succinct statement of a unit's purpose and reason for being.

Monitoring. A survey repeated through time to determine changes in the status and/or demographics of abiotic resources, wildlife or plants, habitat, or ecological communities.

National Environmental Policy Act of 1969 (NEPA). Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (40 CFR 1500).

National Wildlife Refuge. A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System.

National Wildlife Refuge System. All lands, waters and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish and wildlife, including those that are threatened with extinction.

National Wildlife Refuge System Mission. The mission is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

Native Species. Species that normally live and thrive in a particular ecosystem.

Noxious species. Any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment. Control of these species is mandated by law.

Objective. An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (Service Manual 602 FW 1.6).

Obligate Species. Species that require a specific habitat type or plant species for their existence.

Ocean Acidification. The ongoing decrease in the pH of the Earth's oceans, caused by their uptake of anthropogenic carbon dioxide from the atmosphere.

Other Benefiting Species. Native species, other than priority resources of concern and focal resources, that will benefit from management actions.

Paleontology. The study of prehistoric life, including organisms' evolution and interactions with each other and their environments.

Passerine. See songbird

Pinniped. A suborder of carnivores that are marine mammals, have flippers, and eat mostly fish and marine invertebrates (e.g., sea lions, seals).

Plant Association. A classification of plant communities based on the similarity in dominance of all layers of vascular species in a climax community.

Plant Community. An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community (e.g., Sitka spruce).

Preferred Alternative. This is the alternative determined (by the decision maker) to best: achieve a refuge's purpose(s), vision, and goals; contributes to the Refuge System mission; addresses the significant issues; and is consistent with principles of sound fish and wildlife management.

Priority Resources of Concern. Habitats that are most representative of refuge BIDEH, as well as other FWS and ecosystem priorities that were chosen as resources that will guide refuge management in the future. See Focal Resources.

Priority Species. Fish and wildlife species that the Washington Department of Fish and Wildlife believe require protective measures and/or management guidelines to ensure their perpetuation. Priority species include the following: (1) state listed and candidate species; (2) species or groups of animals susceptible to significant population declines within a specific area or statewide by virtue of their inclination to aggregate (e.g., seabird colonies); and (3) species of recreational, commercial, and/or Tribal importance.

Public. Individuals, organizations, and groups; officials of Federal, state, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Purpose(s) of the Refuge. The purpose of a refuge is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit (Service Manual 602 FW 1.6).

Refuge Goal. See Goal.

Refuge Purposes. See Purposes of the Refuge.

Salish Sea. A single estuarine ecosystem that extends from the north end of the Strait of Georgia to the west end of the Strait of Juan de Fuca and south to the southern extent of Puget Sound. It encompasses the inland marine waters of Southern British Columbia, Canada and northern Washington, USA (Freelan 2009).

Seabird. A group of birds that obtain at least some food from the ocean by traveling some distance over its surface. They also typically breed on islands and along coastal areas. Seabirds include: gulls, alcids, penguins, albatrosses, storm-petrels, and cormorants, among others.

Songbirds. (Also Passerines) A category of birds that are medium to small, perching land birds. Most are territorial singers and migratory.

Step-down Management Plans. Step-down management plans provide the details necessary to implement management strategies identified in the Comprehensive Conservation Plan (Service Manual 602 FW 1.6).

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 602 FW 1.6).

Succession. The observed process of change in the species structure of an ecological

T-sheet. A historic type of topographic map produced by the U.S. Coast and Geodetic Survey.

Threatened Species (Federal). Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Threatened Species (State). A plant or animal species likely to become endangered in Washington within the near future if factors contributing to population decline or habitat degradation or loss continue.

Tidelands. Submerged lands and beaches that are located between ordinary high tide and extreme low tide.

Vegetation Type, Habitat Type, Forest Cover Type. A land classification system based upon the concept of distinct plant associations.

Vision Statement. A concise statement of the desired future condition of the planning unit, based primarily upon the System mission, specific refuge purposes, and other relevant mandates (Service Manual 602 FW 1.6).

I.3 Scientific Names

The following tables contain the common and scientific names of plants and animals that are mentioned in this CCP.

I-1. Common and Scientific Names of Plants Mentioned in this CCP

Common Name	Scientific Name
American dunegrass	*Elymus mollis*
American glasswort	*Salicornia virginica*
Bigleaf maple	*Acer macrophyllum*
Black knotweed	*Polygonum paronychia*
Bohemian knotweed	*Polygonum bohemicum*
Bull thistle	*Cirsium vulgare*
Canada thistle	*Cirsium arvense*
Cattail	*Typha latifolia*
Caulerpa	*Caulerpa* ssp.
Cheatgrass	*Bromus tectorum*
Common cordgrass	*Spartina angelica*
Common eelgrass	*Zostera marina*
Dalmatian toadflax	*Linaria dalmatica*
Diffuse knapweed	*Centaurea diffusa*
Douglas-fir	*Pseudotsuga menziesii* ssp. *menziesii*
Dull Oregon grape	*Mahonia nervosa*
Dwarf mistletoe	*Arceuthobium campylopodum*
English holly	*Ilex aquifolium*
English ivy	*Hedera helix*
Evergreen blackberry	*Rubus laciniatus*
False lily-of-the-valley	*Maianthemum dilatatum*
Field bindweed	*Convolvulus arvensis*
Garlic mustard	*Alliaria petiolata*
Grand fir	*Abies grandis*
Herb Robert	*Geranium robertianum*
Himalayan blackberry	*Rubus armeniacus*
Japanese eelgrass	*Zostera japonica*
Japanese knotweed	*Polygonum cuspidatum*
Large-headed sedge	*Carex macrocephala*
Lawnweed	*Soliva sessilis*
Meadow knapweed	*Centaurea jacea x nigra*
Musk thistle	*Carduus nutans*
Oceanspray	*Holodiscus discolor*
Oxeye daisy	*Leucanthemum vulgare*
Pacific madrone	*Arbutus menziesii*
Pacific rhododendron	*Rhododendron macrophyllum*
Poison hemlock	*Conium maculatum*
Purple loosestrife	*Lythrum salicaria*
Red alder	*Alnus rubra*

Common Name	Scientific Name
Red elderberry	*Sambucus racemosa* ssp. *pubens*
Red fescue	*Festuca rubra*
Russian knapweed	*Centaurea repens*
Salal	*Gaultheria shallon*
Salmonberry	*Rubus spectabilis*
Sargassum	*Sargassum* ssp.
Scotch broom	*Cytisus scoparius*
Scotch thistle	*Onopordum ancanthium*
Sea lettuce	*Ulva spp*
Seashore saltgrass	*Distichlis spicata* var. *spicata*
Seaside plantain	*Plantago maritima* ssp. juncoides
Silver burweed	*Ambrosia chamissonis*
Slough sedge	*Carex obnupta*
Spotted knapweed	*Centaurea maculosa*
Spurge laurel	*Daphne laureola*
St. Johns wort	*Hypericum perforatum*
Sword fern	*Polystichum munitum*
Tansy Ragwort	*Senecio jacobea*
Western hemlock	*Tsuga heterophylla*
Western redcedar	*Thuja plicata*
Yellow sand-verbena	*Abronia latifolia*
Yellow toadflax	*Linaria vulgaris*

I-2. Common and Scientific Names of Mammals Mentioned in this CCP

Common Name	Scientific Name
American black bear	*Ursus americanus*
Beaver	*Castor canadensis*
Black-tailed deer	*Odocoileus hemionus*
Bobcat	*Lynx rufus*
Domestic cat	*Felis catus*
Domestic dog	*Canis familiaris*
Elk	*Cervus elaphus*
Keen's myotis	*Myotis keenii*
Long-eared myotis	*Myotis evotis*
Long-legged myotis	*Myotis volans*
Northern elephant seal	*Mirounga angustirostris*
Nutria	*Myocastor coypus*
Pacific harbor seal	*Phoca vitulina*
Short-tailed weasel	*Mustela erminea*
Silver-haired bat	*Lasionycteris noctivagans*
Townsend's big-eared bat	*Corynorhinus townsendii*

I-3. Common and Scientific Names of Birds Mentioned in this CCP

Common Name	Scientific Name
American crow	*Corvus brachyrhynchos*
American wigeon	*Anas americana*

Common Name	Scientific Name
Bald eagle	*Haliaeetus leucocephalus*
Band-tailed pigeon	*Patagioenas fasciata*
Barrow's goldeneye	*Bucephala islandica*
Belted kingfisher	*Megaceryle alcyon*
Bewick's wren	*Thryomanes bewickii*
Black oystercatcher	*Haematopus bachmani*
Black scoter	*Melanitta nigra*
Black-bellied plover	*Pluvialis squatarola*
Brant	*Branta bernicla*
Bufflehead	*Bucephala albeola*
Bullock's oriole	*Icterus bullockii*
Canada goose	*Branta Canadensis*
Caspian tern	*Hydroprogne caspia*
Chestnut-backed chickadee	*Poecile rufescens*
Common goldeneye	*Bucephala clangula*
Cooper's hawk	*Accipiter cooperii*
Double-crested cormorant	*Phalacrocorax auritus*
Downy woodpecker	*Picoides pubescens*
Dunlin	*Calidris alpina*
Glaucous-winged gull	*Larus glaucescens*
Golden-crowned kinglet	*Regulus satrapa*
Great blue heron	*Ardea herodias*
Greater scaup	*Aythya marila*
Green-winged teal	*Anas carolinensis*
Hairy woodpecker	*Picoides villosus*
Harlequin duck	*Histrionicus histrionicus*
Heermann's gull	*Larus heermanni*
Hutton's vireo	*Vireo huttoni*
Least sandpiper	*Calidris minutilla*
Lesser scaup	*Aythya affinis*
Mallard	*Anas platyrhynchos*
Marbled murrelet	*Brachyramphus marmoratus*
Merlin	*Falco columbarius*
Mew gull	*Larus canus*
Northern harrier	*Circus cyaneus*
Northern pintail	*Anas acuta*
Northern saw-whet owl	*Aegolius acadicus*
Northern shoveler	*Anas clypeata*
Northwestern crow	*Corvus caurinus*
Orange-crowned warbler	*Oreothlypis celata*
Pacific-slope flycatcher	*Empidonax difficilis*
Pelagic cormorant	*Phalacrocorax pelagicus*
Peregrine falcon	*Falco peregrinus*
Pigeon guillemot	*Cepphus columba*
Pileated woodpeckers	*Dryocopus pileatus*
Pine siskin	*Carduelis pinus*

Common Name	Scientific Name
Red-breasted sapsucker	*Sphyrapicus ruber*
Rufus hummingbird	*Selasphorus rufus*
Sanderling	*Calidris alba*
Sharp-shinned hawk	*Accipiter striatus*
Short-eared owl	*Asio flammeus*
Snowy owl	*Bubo scandiacus*
Spotted towhee	*Pipilo maculatus*
Steller's jay	*Cyanocitta stelleri*
Surf scoter	*Melanitta perspicillata*
Townsend's warbler	*Dendroica townsendi*
Varied thrush	*Ixoreus naevius*
Western gull	*Larus occidentalis*
Western sandpiper	*Calidris mauri*
Western snowy plover	*Charadrius alexandrinus nivosus*
Whimbrel	*Numenius phaeopus*
White-winged scoter	*Melanitta fusca*
Wood duck	*Aix sponsa*

I-4. Common and Scientific Names of Amphibians Mentioned in this CCP

Common Name	Scientific Name
American bullfrog	*Rana catesbeiana*
Cascades frog	*Rana cascadae*
Coastal tailed frog	*Ascaphus truei*
Cope's giant salamander	*Dicamptodon copei*
Ensatina	*Ensatina eschscholtzii*
Long-toed salamander	*Ambystoma macrodactylum*
Northwestern salamander	*Ambystoma gracile*
Olympic torrent salamander	*Rhyacotriton olympicus*
Pacific chorus frog	*Pseudacris regilla*
Red-legged frog	*Rana aurora*
Rough-skinned newt	*Taricha granulosa*
Western red-backed salamander	*Plethodon vehiculum*
Western toad	*Bufo boreas*

I-5. Common and Scientific Names of Insects Mentioned in this CCP

Common Name	Scientific Name
Amber spurge flea beetle	*Apthona flava*
Broad-nosed seed head weevil	*Bangasternus fausti*
Brown-legged spurge flea beetle	*Apthona lacertosa*
Bull thistle seed head gall fly	*Urophora stylata*
Carpenter ant	*Camponotus* spp.
Field bindweed moth	*Tyta luctuosa*
Field bindweed mite	*Aceria malherbae*
Foliage beetle	*Chrysolina hyperici*
Klamath weed beetle	*Chrysolina quadrigemina*
Knapweed flower head weevil	*Larinus minutus*

Common Name	Scientific Name
Knapweed seed head fly	*Urophora affinis*
Knapweed seed head gall fly	*Urophora quadrifasciata*
Knapweed weevil	*Cyphocleonus achates*
Leaf bud gall-forming midge	*Zeuxidiplosis giardi*
Leaf-feeding flea beetle	*Altica carduorum* Guer
Musk thistle seed head weevil	*Rhinocyllus conicus*
Musk thistle rosette weevil	*Trichosirocalus horridus*
Root-boring beetle	*Agrilus hyperici*
Root-boring/gall beetle	*Sphenoptera jugoslavica*
Sand-verbena moth	*Copablepharon fuscum*
Scotch broom seed weevil	*Apion fuscirostre*
Stem-mining weevil	*Ceutorhynchus litura* F
St. Johnswort inchworm	*Aplocera plagiata*
Sulphur knapweed moth	*Agapeta zoegana*
Taylor's checkerspot	*Euphydryas editha taylori*
Thistle gall fly	*Urophora cardui* L
Toadflax defoliating moth	*Calophasia lunula*
Twig-mining moth	*Leucoptera spartifoliella*

I-6. Common and Scientific Names of Fish and Shellfish Mentioned in this CCP

Common Name	Scientific Name
Bull trout	*Salvelinus confluentus*
Coho salmon	*Oncorhynchus kisutch*
Chinook salmon	*Oncorhynchus tshawytscha*
Chum salmon	*Oncorhynchus keta*
Cutthroat trout	*Oncorhynchus clarkii*
Dungeness crab	*Metacarcinus magister*
European green crab	*Carcinus maenas*
Littleneck clam	*Protothaca staminea*
Pacific herring	*Clupea pallasii*
Pacific sand lance	*Ammodytes hexapterus*
Pink salmon	*Oncorhynchus gorbuscha*
Steelhead trout	*Oncorhynchus mykiss*
Surf smelt	*Hypomesus pretiosus*

Document continues on next page.

Appendix J. CCP Team Members

The CCP was developed and prepared primarily by a core team comprised of refuge and regional office staff. There was some turnover of regional office staff core team members during the planning process. The core team sought technical expertise and review from other professionals both within and outside of the Fish and Wildlife Service throughout the CCP process. Extended team members provided critical input during wildlife and habitat review early in the process and continued to provide review and comment as the document evolved. The List of Preparers below includes the core team members as well as other persons responsible for writing specific portions of the plan. Many others provided assistance in developing and reviewing the CCP and associated products and in providing advice throughout the planning process. These people are captured in the List of Reviewers and Advisors.

Table J-1. List of Preparers

Name and Title	Organization	CCP Contributions
Kevin Ryan, Project Leader (Retired in 12/2012)	Washington Maritime National Wildlife Refuge Complex, USFWS	Supervision; decision-making; responsible for overall coordination and development of the CCP; public involvement; writer/reviewer; research/ analysis: communication plan; appropriateness findings and compatibility determinations; compliance with NEPA, ESA, NHPA, etc.; Federal and State agency, and Tribal coordination.
Lorenz Sollmann, Deputy Project Leader Acting Project Leader starting in 1/2013.	Washington Maritime National Wildlife Refuge Complex, USFWS	Writer/reviewer: wildlife & habitat goals and objectives, affected environment and environmental consequences, contaminants, integrated pest management plan; research/analysis: invasive species, fire management, and habitats; public involvement: communication plan, wildlife & habitat review, and public meetings.
Sue Thomas, Refuge Biologist	Washington Maritime National Wildlife Refuge Complex, USFWS	Writer/reviewer: wildlife & habitat goals and objectives, affected environment and environmental consequences; research/analysis: priority resources of concern, habitats, wildlife, biological integrity, diversity, and environmental health; public involvement: communication plan, wildlife & habitat review, and public meetings.
Dave Falzetti, Refuge Law Enforcement Officer and Visitor Services Manager	Washington Maritime National Wildlife Refuge Complex, USFWS	Writer/reviewer: visitor services goals and objectives, refuge facilities, sign inventory and maintenance plans, regional recreation opportunities and forecasts, illegal uses, refuge visitation, and environmental consequences; public involvement: communication plan and public meetings.
Sue Mayo, Administrative Assistant	Washington Maritime National Wildlife Refuge Complex, USFWS	Researcher/writer: refuge vision; list of common and scientific species names, abbreviations and glossary; public involvement: CCP mailing list and public meetings.

Name and Title	Organization	CCP Contributions
Jane Bardolf, Conservation Planner	(formerly) Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	CCP Lead Planner (through 8/2011) responsible for regional office coordination, and process and policy guidance for development of the CCP; CCP schedule and status reports; team meeting facilitator; document layout, management, and review; planning record; public involvement: communications plan.
Khemarith So, Geographer and Conservation Planner	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	CCP Lead Planner (starting 10/2011) responsible for regional office coordination, and process and policy guidance for development of the CCP; CCP schedule and status reports; team meeting facilitator; document layout, management, and review; planning record; public involvement: public meetings, scoping comments compilation, scoping report. Development of working, public involvement, and document maps; GIS data gathering and analysis; researcher/ writer: physical environment, climate change, environmental consequences, wilderness review.
Virginia Parks, Archaeologist	Division of Natural and Cultural Resources, Region 1, USFWS	Researcher/writer: cultural resources objectives, affected environment, and environmental consequences.
Erin Carver, Economist	Division of Economics, Washington Office	Researcher/writer: socioeconomics, environmental consequences.
David Patte, Climate Change Coordinator	Science Applications, Region 1, USFWS	Researcher/writer/reviewer: climate change.
Staci McCorkle, Natural Resources Scientist	SWCA Environmental Consultants	Writer/editor: wildlife & habitat and visitor services goals and objectives, refuge public uses.
Nicole Garner, Writer/Editor	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	Technical edit review of CCP document and Federal Register Notices; design and edit of planning updates.
Kay Kier-Haggenjos, Writer/Editor	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	Technical edit review of CCP document and Federal Register Notices; design and edit of planning updates.
Lara Bjork, Technical Editor	SWCA Environmental Consultants	Technical edit review of CCP document.
Pat Stark, Visual Information Specialist	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	CCP cover design and print management.

Table J-2. List of Reviewers and Advisors

Name and Title	Organization	CCP Contributions
Robyn Thorson, Regional Director	Region 1, USFWS	Final decision-maker, CCP/EA and Federal Register notice approvals.
Robin West, Regional Chief of Refuges	National Wildlife Refuges, Region 1, USFWS	Major decisions on CCP direction, CCP/EA and Federal Register notice approvals.
Ben Harrison, Assistant Regional Chief of Refuges	National Wildlife Refuges, Region 1, USFWS	CCP Advisor: policy, appropriateness findings, compatibility determinations, environmental consequences review.
Bob Flores, Refuge Supervisor	National Wildlife Refuges, Region 1, USFWS	Refuge workload assistance; reviewer; decision-maker.
Bob Peyton, Assistant Refuge Supervisor	National Wildlife Refuges, Region 1, USFWS	Refuge workload assistance; reviewer; decision-maker.
Chuck Houghten, Division Chief of Planning, Visitor Services, and Transportation	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	CCP Advisor for planning policy and guidance; reviewer; coordination with other divisions and Washington Office.
Scott McCarthy, Branch Chief of Planning	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	CCP Advisor for planning policy and guidance; reviewer; planning workload priorities; coordination with other divisions.
Mike Marxen, Branch Chief of Visitor Services and Communication	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	Visitor Services review and guidance design, public use goals and objectives; public involvement assistance.
Kevin O'Hara, Conservation Planning	Division of Planning, Visitor Services, and Transportation, Region 1, USFWS	Review of environmental effects analysis.
Joe Engler, Assistant Regional Refuge Biologist	Division of Natural and Cultural Resources, Region 1, USFWS	Development and review of biological goals and objectives and biological integrity, diversity, and environmental health analysis.
Bridgette Flanders-Wanner, Assistant Regional Refuge Biologist	Division of Natural and Cultural Resources, Region 1, USFWS	Development and review of biological goals and objectives and biological integrity, diversity, and environmental health analysis.
Brian Root, Zone Inventory and Monitoring Biologist	Nisqually National Wildlife Refuge Complex, USFWS	Wildlife and habitat review.
Bill Ritchie, Refuge Biologist	Willapa National Wildlife Refuge Complex, USFWS	Habitat assessment of Dawley Unit for suitability for marbled murrelet.

Name and Title	Organization	CCP Contributions
Cathy Sheppard, Division Chief, Realty and Refuge Information (retired)	Division of Realty and Refuge Information, Region 1, USFWS	Advice on realty issues; CCP review.
Wayne Hill, Branch Chief, Realty	Division of Realty and Refuge Information, Region 1, USFWS	Advice on realty issues; CCP review.
Joan Jewett, External Affairs	External Affairs, Region 1, USFWS	News release review and distribution.
Greg Hagedorn, Fire Management Officer	Region 1, USFWS	Advice on fire management.
Pat Gonzales-Rogers, Tribal Liaison	External Affairs, Region 1, USFWS	Identification of and coordination with Indian Tribes.
Anita McMillan, Biologist	WDFW	WDFW contact for CCP coordination (local).
Mick Cope, Regional Wildlife Program Manager	WDFW	WDFW contact for CCP coordination (Region 6).
Greg Schirato	WDFW	WDFW contact for CCP coordination and comment (Headquarters office).
Don Kraege	WDFW	WDFW contact for CCP coordination and comment (Headquarters office).
Shelly Ament, Wildlife Biologist	WDFW	WDFW contact for CCP coordination (local).
Peter Dunwiddie, Botanist	University of Washington	Wildlife and habitat review.
Susan Piper, Wildlife Supervisor	Olympic National Forest, USFS	Wildlife and habitat review.
Chris Dowling, Silviculturalist	Olympic National Forest, USFS	Wildlife and habitat review.
Curtis Tanner, Fish and Wildlife Biologist	Western Washington Fish and Wildlife Office, USFWS	Advice on wildlife and habitat.
Scott Chitwood, Natural Resources Director	Jamestown S'Klallam Tribe	Tribal consultation.
Ron Thom, Ecologist	Battelle National Laboratory	Advice on eelgrass.
Roger Peters, Fisheries Biologist	Western Washington Fisheries Office, USFWS	Preliminary assessment of refuge reach of Dean Creek for salmonids.
Brian Turner, District Manager	WDNR	Advice on forest management.
Hugh Shipman, Coastal Geologist	WDOE	Advice on bluff and beach management.

Appendix K. Public Involvement

Public involvement was sought throughout the development of the CCP, starting in April 2011 with the preparation of a Communications Plan. Public involvement strategies included face-to-face meetings or phone conversations with community organizations, local, state and federal agencies, elected officials (or their aides), Tribal representatives, and local refuge users. For the broader public, the Refuge also held open houses and provided planning updates intended to inform, invite discussion and solicit feedback. The Refuge also maintains a website where CCP information can be found and where the public could print out comment forms or submit emails during the scoping phase, preliminary draft alternatives, or draft CCP/EA comment period.

A mailing list of approximately 512 persons and organizations is maintained at the Refuge and was used to distribute planning updates and public meeting announcements. Below is a brief summary of the events, meetings, and outreach tools that were used in our public involvement efforts.

Meetings with Elected Officials and/or their Aides:

- December 12, 2011. Met with Judith Morris, legislative aide for Congressman Norm Dicks, 6th District.
- November 9, 2012. Met with Alex Fastle, legislative aide for Senator Patty Murray.
- December 12, 2012. Met with State Representative Kevin Van De Wege, 24th Legislative District.

Meetings with Federal Agency Representatives:

- April 14, 2011. Met with William Ritchie, USFWS Wildlife Biologist, Willapa NWR to assess habitat suitability in the Dawley Unit for marbled murrelet.
- July 18, 2011. Met with Roger Peters, USFWS Fisheries Biologist, Western Washington Fish and Wildlife Office to preliminary assess Dean Creek for salmonids and schedule formal assessment.
- December 12, 2011. Met with Karen Gustin, Superintendent, Olympic National Park.

Meetings with Tribal Representatives:

- December 8, 2011. Met with Jamestown S'Klallam Tribe. 6 participants.

Meetings/Contacts with State Agency Representatives:

- May 10, 2011. CCP Coordination Meeting with Don Kraege and Greg Schirato, Washington Department of Fish and Wildlife.
- November 9, 2011. Phone conversation with Brian Turner, Washington Department of Natural Resources. Discussed CCP and planning process with emphasis on Dawley Unit forest and adjacent WDNR forest habitats.
- March 30, 2012. Personal communication with follow-up e-mail with Hugh Shipman, Coastal Geologist with Washington Department of Ecology. Sandy bluffs, barrier beach and inventory and monitoring goals and objectives were reviewed from a coastal geological perspective. January 24, 2012. E-mail from Anita McMillan, WDFW, regarding review of preliminary goals and objectives.

Meetings with Multiple Agency Workgroups or Committees:

- January 11, 2012. Made a public announcement at the Dungeness River Management Team monthly meeting about the upcoming public meeting on the draft alternatives. There were 33 participants, including representatives from North Olympic Land Trust, Jamestown S'Klallam Tribe, Dungeness Beach Association, Clallam County, Sports Fisheries, Clallam Conservation District, Protect the Peninsula's Future, City of Sequim, Riverside Property Owners, WDOE, USFS, Water Users Association, PUD#1, WDFW, StreamKeepers, OPAS, Clallam County Environmental Health, Olympic Park Associates, Sequim Gazette, Dungeness River Audubon Center staff, and people from general public.
- January 25, 2012. Sent a follow-up email message to all on the Dungeness River Management Team general email list about the rescheduled public meeting for the draft alternatives. This was necessary as the original meeting had a very low turnout due to a snow storm.
- March 1, 2012. Made an announcement to the Clean Water Working Group members concerning the draft CCP/EA and that the Refuge would appreciate if they could review this document when it comes out in the spring. There were 9 participants, including representatives from Clallam county, Jamestown S'Klallam Tribe, Clallam Conservation District, and private citizens.

Meetings with Non-government Organizations:

- October 31, 2011. Met with Olympic Peninsula Audubon Society. 9 participants.

Notice to Refuge Volunteers:

- April 8, 2011. New and returning Dungeness NWR Volunteers were given a presentation on the CCP process, alternatives being considered, and how they could get involved and offer input. 97 participants.
- Prior to the public open houses, all refuge volunteers were provided with the Preliminary Draft Alternatives and invited to the public meetings. 130 people.

Workshops / Field Review:

- February 7-8, 2011. Wildlife and Habitat Management Field Review on the Refuge. 11 participants, including representatives from the Washington Department of Fish and Wildlife, U.S. Forest Service, and University of Washington.

Public Open Houses/Scoping Sessions:

- January 19, 2012. Public Preliminary Draft Alternatives meetings at the Sequim Prairie Grange Hall, Sequim, WA.
  Purpose and format: To provide information on CCP process and preliminary draft alternatives. The public meeting was in an open-house format. At the open house, refuge staff explained the CCP process and progress to date; refuge purposes, and management; preliminary draft alternatives; and future opportunities for public input. The public was invited to submit comments either in writing or verbally. The attendees then had the opportunity to visit tables staffed by refuge staff and the lead planner. Each table had a scribe to record verbal comments.
  Attendance: A total of 5 private citizens and representatives from various organizations attended the open houses, providing comments on the issues and opportunities presented.
- February 2, 2012. Public Preliminary Draft Alternatives meetings at the Dungeness Schoolhouse, Sequim, WA.

Purpose and format: To provide information on CCP process and preliminary draft alternatives. The public meeting was in an open-house format. At the open house, refuge staff explained the CCP process and progress to date; refuge purposes, and management; preliminary draft alternatives; and future opportunities for public input. The public was invited to submit comments either in writing or verbally. The attendees then had the opportunity to visit tables staffed by refuge staff and the lead planner. Each table had a scribe to record verbal comments.
Attendance: A total of 28 private citizens and representatives from various organizations attended the open houses, providing comments on the issues and opportunities presented.

U.S. Fish and Wildlife Service Coordination:
The core planning team coordinates frequently within the agency during the planning process. The core team also relies on specialists from various Service programs for their expertise. Additional coordination occurs with the Regional Office Management at key phases in the process including:

R1, Pacific Regional Office Management Reviews
- Preplanning Briefing meeting – April 14, 2011
- Alternative Briefing meeting – November 1, 2011
- Administrative Draft Briefing meeting – May 10, 2012

Planning Updates:
- October 2011. Hardcopies of Planning Update 1 mailed to approximately 320 persons, organizations, and officials on the mailing list and additional updates were hand delivered to R1 FWS staff. Throughout scoping, Planning Update 1 was provided to refuge office visitors and partners and mailed to interested parties. Planning Update 1 included background information on the Refuge, refuge purposes, preliminary issues, vision, goals, land status map, and a mail-in comment form with the following questions:
  - What do you see as the primary issues that need to be addressed in the Comprehensive Conservation Plan?
  - What are your thoughts on the visions and goals for Dungeness National Wildlife Refuge?
  - Do you have additional comments at this time?
- January 2012. Hardcopies of Planning Update 2 mailed to approximately 350 persons, organizations, and officials on the mailing list and additional updates were hand delivered to R1 FWS staff. Planning Update 2 was also provided to refuge office visitors, partners, and attendees of the January 19, 2012 and February 2, 2012 public meetings. Planning Update 2 included a summary of public scoping comments, a summary of Preliminary Draft Alternatives, information on the open house meetings, and contact information.
- November 2012. Hardcopies of Planning Update 3 mailed to approximately 372 persons, organizations, and officials on the mailing list and additional updates were hand delivered to R1 FWS staff. Planning Update 3 was also made available at the refuge office for visitors and partners. This update announced the availability of draft CCP/EA for public review and comment, provided information on how and where to comment, and detailed the different draft management alternatives.
- Planning Update 4, announcing the completion of the final CCP, will be released concurrently with this document. This planning update will summarize comments received on the draft CCP/EA, detail the Refuge's management direction, and provide information on how and where to obtain copies of the final plan.

Press Coverage:

- Fall 2011. Refuge staff sent a news release to local media and made follow up contacts. Various notices of CCP scoping period were printed in the Peninsula Daily News, News Tribune, Bellingham Herald, and Port Angeles Daily News.
- Winter 2012. Refuge staff sent a news release to local media and made follow up contacts. Various articles and notices of preliminary draft alternatives were printed in the Sequim Gazette.
- November 28, 2012. Refuge staff sent a news release to local media announcing the availability of the draft CCP/EA for public review and comment. The news release resulted in articles in the following media. This list is not inclusive:
    - November 28, 2012 Sequim Gazette (No more running, riding near spit?)
    - November 30, 2012 Peninsula Daily News (Proposal would ban horses, jogging on Dungeness Spit)
- December 7, 2012. Refuge staff sent a news release to local media announcing the extension of the draft CCP/EA public comment period to January 28, 2013. The news release resulted in articles in the following media. This list is not inclusive:
    - December 12, 2012 Sequim Gazette (Comment period extended for Dungeness Wildlife Refuge plan)
- January 14, 2013. Refuge staff sent a news release to local media announcing the extension of the draft CCP/EA public comment period to February 28, 2013, providing a total of 90 days for public review and comment.
- Other press coverage related to the Dungeness NWR draft CCP/EA included the following:
    - December 25, 2012 Peninsula Daily News (Sequim lawmaker fights to keep horses in wildlife refuge)
    - December 26, 2012 Sequim Gazette (Van De Wege says state may reclaim spit)
    - January 2, 2013 The Port Townsend Leader (Van De Wege works for access to Dungeness Spit)
    - January 20, 2013 Peninsula Daily News (Lawmaker, Audubon forge proposed deal to keep some jogging, horses at Dungeness refuge)
    - January 27, 2013 Peninsula Daily News (Dungeness Spit deal sought)
    - February 8, 2013 Peninsula Daily News (Record number listens to phone-in town hall forum)

Other Tools:

- Website at http://www.fws.gov/pacific/planning/main/docs/WA/Dungeness/ featuring CCP information and scoping forms.

***Federal Register* Notices:**

- October 4, 2011. *Federal Register* published Notice of Intent to prepare a comprehensive conservation plan and environmental assessment, and included background information on the Refuge and preliminary issues with request for scoping comments.
- November 19, 2012. *Federal Register* published Notice of Availability of the Draft Comprehensive Conservation Plan and Environmental Assessment; and request for comments.
- Federal Register Notice of Availability of the Final Comprehensive Conservation Plan and Finding of No Significant Impact for Environmental Assessment published concurrently with release of this document.

Appendix L. Public Comments and Service Responses

L.1 Introduction

The U.S. Fish and Wildlife Service (USFWS or Service) received comments from 183 entities during the 90-day public comment period held November 28, 2012 through February 28, 2013 for the Dungeness National Wildlife Refuge (NWR or Refuge) Draft Comprehensive Conservation Plan and Environmental Assessment (CCP/EA). All written comments were reviewed, analyzed, and addressed. A summary of the comments and our response is presented in this appendix.

Each original piece of correspondence was identified with the commenter's last name and first initial and a number. Note that for simplicity's sake, we use the word "letter" to refer to any comment or reference document we received, whether by letter, phone call, or e-mail. Multiple correspondences from a commenter are counted as one comment letter.

To help us analyze the comments, a number of themes and subthemes were identified within the letters, and similar comments were grouped together under a theme. Our responses apply to the comments grouped under a theme. Comments that fell outside the scope of the CCP were also considered and responded to as appropriate.

L.2 Changes Made to the Final CCP

The CCP planning team reviewed and evaluated all of the comments we received during the Draft CCP/EA comment period. In some cases, the management direction was either modified or clarified based on the comments. Table L-1 shows the major changes between the draft and final CCPs. For additional information, see Chapter 2 and Figure 2-1 in the CCP.

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
HABITAT MANAGEMENT		
Mixed-coniferous Forest		
Forest management within Dungeness Unit	- Invasive species removal. - Use fire suppression techniques to prevent catastrophic wildfire. - Clear downed or overhanging branches across the public use trails that are hazards. - Enhance the effectiveness of the main trail firebreak by removing dead and downed materials within 10 feet of either side of the trail; keep live and large woody debris >21 inches DBH and snags.	No change from draft plan.
Forest management within Dawley Unit	- Continue invasive species removal and fire suppression. - Conduct forest assessment. - Develop step-down forest management plan by 2018. - Use various techniques such as, but not limited to snag creation, thinning, and prescribed fire to enhance forest structure within core 40-acre area. - Remove small dump site.	No change from draft plan.

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
Roads within Dawley Unit	- Conduct road inventory and condition assessment by 2016. - Maintain main road for regular vehicles up to turnaround (0.95 mile), beyond that maintain for ATV only. - Slide stabilization, where needed. - Rehabilitate unneeded logging spur roads (0.58 mile) outside of 40-acre core area.	No change from draft plan.
Nearshore Habitats		
Multiple habitats Oil spill and contaminants	- Rapid response in accordance with the Strait of Juan de Fuca Geographic Response Plan. - Collect and maintain information needed by the response team for resource protection. - Periodically review/update Geographic Response Plan. - Increase staff participation in deployment drills. - Work with partners (WA Dept. of Ecology, oil spill response groups) on validating deployment locations and techniques within Refuge lands.	No change from draft plan.
Sandy bluff habitat	- Maintain public use closure. - Use IPM to control invasive species. - Coordinate with partners (e.g., State, County, and Tribes) to prevent or reduce shoreline armoring, especially to the west of Dungeness NWR. - Restrict further development within 150 feet of the bluff on Refuge lands.	No change from draft plan.
Barrier beach habitat	- Seasonal public use closures. - Regular removal of marine debris. - Prohibition of driftwood collection - Fire suppression. - Rapid response in accordance with the Strait of Juan de Fuca Geographic Response Plan. - IPM for invasive species control. - Work with partners to remove marine debris and creosote-covered logs in adjacent marine areas, off-Refuge, and increase removal in closed areas. - Monitor environmental changes caused by climate change stressors (e.g., accelerated erosion due to sea level rise and/or increased frequency and severity of storm events, driftwood recruitment and retention).	No change from draft plan.
Mudflat and barrier lagoon	- Monitor and if found, remove invasive species (e.g., *Spartina*) using IPM techniques. - Monitor for European green crab. - Seasonal public use closures. - Coordinate with partners (e.g., Clean Water Working Group) to monitor and address water quality issues within Dungeness Bay and Harbor. - Rapid response in accordance with the Strait of Juan de Fuca Geographic Response Plan. - Removal of marine debris. - Monitor environmental factors that are climate change related stressors (e.g., sedimentation, ocean acidification, salinity). - Remove abandoned USCG road access dike located at base of spit if determined to be on Refuge lands.	No change from draft plan.

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
Eelgrass Beds	- Coordinate with partners (e.g., Clean Water Working Group) to monitor and address water quality issues within Dungeness Bay and Harbor. - Coordinate with oil spill response team. - Monitor for European green crab. - Monitor environmental factors that are known stressors. - Work with partners to determine adaptive management techniques to address stressors (e.g., climate change, sedimentation, excessive nutrients).	No change from draft plan.
Salt marsh	- Monitor and if found, remove invasive species (e.g., *Spartina*) using IPM techniques. - Public use closure. - Fire suppression. - Rapid response in accordance with the Strait of Juan de Fuca Geographic Response Plan. - Removal of marine debris and creosote-covered logs. - Monitor environmental factors that are known stressors (e.g., sedimentation, ocean acidification, salinity, vegetation community, driftwood recruitment and removal).	No change from draft plan.
Freshwater Wetlands		
Seasonal freshwater wetlands on the Dawley and Dungeness units	- Conduct wetland inventory and hydrological assessment by 2015. - Conduct migratory bird, amphibian, and bat surveys. - Use IPM to control invasive species.	Same as Draft CCP/EA but with the following clarification: Conduct amphibian and bat surveys.
Instream and riparian habitat	- Slope stabilization of main road. - Partner with upstream land owners to improve and protect water quality. - Conduct hydrological assessment by 2015. - Conduct survey and assess habitat suitability for anadromous and resident fish. - Use IPM to control invasive species.	No change from draft plan.
Freshwater impoundment on Dawley Unit	- Maintain water delivery system to impoundment. - Maintain water level for use in fire suppression. - Clear woody vegetation from dike. - Conduct hydrological assessment of relationship between impoundment and domestic water source. - Map bathymetry of impoundment. - Conduct amphibian and bat surveys. - Install new water control structure and water gage. - Maintain minimum water levels and manage for optimum water levels/benthic layer characteristics for amphibians. - Manage vegetation and downed woody debris along waterline. - Use IPM to control invasive species (e.g., bullfrogs and nonnative fish).	No change from draft plan.
Monitoring and Research		
Status monitoring (Surveys)	- Continue or expand bird counts (Christmas Bird Count, FeederWatch, Mid-winter Waterfowl Survey) and monitoring for invasive plants, European green crab, marine debris. - Conduct Breeding Bird Survey (BBS). - Determine frequency and monitor the distribution and densities of common eelgrass on the Refuge.	Same as Draft CCP/EA with the following clarifications: - Continue or expand bird counts (Christmas Bird Count, Mid-winter Waterfowl Survey) and

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
		monitoring for invasive plants, European green crab, marine debris. - Conduct breeding bird surveys.
Research	- Caspian tern colony productivity. - Sediment dynamics at the base of Dungeness Spit. - Large woody debris monitoring in the Elwha nearshore. - Assess the value of salt marsh habitat on Graveyard Spit as a nursery area for crab, salmon, etc. - Assess driftwood recruitment and removal rates within the barrier beach and salt marsh habitats. - Plot and monitor microhabitat characteristics (e.g., species, percent cover) to track changes in distribution and diversity of plant species in the Graveyard Spit RNA. - Assess climate change impacts on natural spit habitats such as Dungeness Spit.	No change from draft plan.
Effectiveness Monitoring	- Monitor CCP and other step down plan objectives.	No change from draft plan.
Scientific Assessments	- Conduct amphibian and bat surveys. - Follow-up assessment of the distribution and abundance of Lepidopterans on Graveyard and Dungeness spits. - Assess the number of breeding pairs of gull colony at the tip of Graveyard Spit. - Conduct survey and assess habitat suitability for anadromous and resident fish. - Conduct wetlands inventory (Dawley Unit) and hydrological assessment (Dawley and Dungeness units) by 2015. - Conduct road inventory and condition assessment (Dawley Unit) by 2016.	No change from draft plan.
PUBLIC USE		
Human-caused Wildlife Disturbance		
Aircraft disturbance	- Federal Aviation Administration 2,000 foot Above Ground Level flight recommendation over national wildlife refuges.	No change from draft plan.
Refuge Foot Access – Open and Closed Areas		
Open areas: upland trails, strait-side of Dungeness Spit from west Refuge boundary to lighthouse (Zones 1, 2, and 3).	- Foot access only, sunrise to sunset.	No change from draft plan.
Seasonal open areas: uplands and tidelands in the first ½ mile of the Spit's harbor side (Zone 2).	- Foot access only May 15-September 30, sunrise to sunset.	No change from draft plan.
Temporary Closures	- Close portions of high use areas when seal pups present.	No change from draft plan.
Closed areas: upland forest	- Closed to public use.	No change from draft plan.

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
(except on established trails), bluffs, Graveyard Spit (Zone 4), end of Dungeness Spit (Zone 4), and bay- and harbor- side of Dungeness Spit (Zone 4), and Dawley Unit		
Refuge Motorized and Nonmotorized Boat Access – Open and Closed Areas		
Boat access – landings	- Allowed by advance reservation at designated lighthouse boat landing zone only. - Limited to 20 boat landings per day. - Boat landing limited to 9am-5pm.	No change from draft plan.
Boat access – Refuge waters (tideland areas east and west of Graveyard Spit in Zone 5)	- Open to boating May 15-September 30, sunrise to sunset. - No wake zone in all Refuge waters. - Boats must stay 100 yards from the mean high tide line. - Refuge waters closed to personal watercraft, windsurfing, and para-surfing/sailing.	No change from draft plan.
Boat buffers, non-Refuge waters	- Boaters are encouraged to stay at least 100 yards from the mean high tide line.	No change from draft plan.
Visitor Orientation		
Staff and volunteer time devoted to making visitor contacts on the Refuge	- Increase staff time to 520 hours per year and volunteer time to 1,200 hours per year.	No change from draft plan.
Orientation materials	- Tear sheet maps available at main and primitive trail entrances. Panel maps located at county park kiosk, entrance station, primitive trail entrance, base of main trail, and lighthouse boat landing area. - Add information and map panels at Cline Spit boat launch and Dungeness Landing boat launch - Develop trail etiquette materials including brochure and signage	Same as Draft CCP/EA but with the following clarification: Tear sheet maps available at main trail entrance. Panel maps located at entrance station, base of main trail, and lighthouse boat landing area.
Regulation Signs	- Signs at closed areas (permanent): bluffs; bay-side of spit at ½ mile to lighthouse; across end of spit at lighthouse; north side of trail adjacent to parking lot. - Signs at closed areas (seasonal): harbor-side of spit to ½ mile; boundary pilings in bay. - International symbol signage at: main and primitive trail entrance stations; bluffs - Additional signs at lighthouse, lighthouse boat landing area, and end of Dungeness Spit.	No change from draft plan.
Wildlife-dependent Uses		
Wildlife Observation and Photography	- Unstructured opportunities to observe and photograph wildlife along approximately 1 mile of trails (including main, primitive and bluff trails) and on approximately 5.5 miles of beach (Zones 1, 2, and 3). - Offer at least 5 guided wildlife walks and/or programs.	No change from draft plan.

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
Fishing	- Permitted on Strait-side of spit and seasonally in boat access areas (Zones 1, 2, 3, and 5). - Install map/regulations panel at Cline Spit and Dungeness Landing. - Partner with WDFW to include Refuge-specific information in State sport fishing rules pamphlet.	No change from draft plan.
Shell-fishing	- Permitted seasonally on Refuge tidelands in Dungeness Harbor and Bay up to 100 yards from the mean high tide line in zone 5 and in all foot access tideland areas (first ½ mile of Spit, zone 2). - Install map and regulations panel at Cline Spit and Dungeness Landing. - Partner with WDFW to include Refuge-specific information in State sport fishing rules pamphlet.	No change from draft plan.
Interpretation – biological	- Maintain kiosk panel, trail panel, and overlook panels (6 panels) and Refuge brochures. - Use volunteers and subject-matter experts for interpretive programs. - Present 1 interpretive program per year. - Provide 2 guided plant walks and/or programs annually. - Improve wildlife interpretive displays at lighthouse. - Incorporate Refuge-specific climate change information into at least 1 interpretive product.	No change from draft plan.
Interpretation – geological	- Kiosk panel, trail panel, overlook panel (1 panel). - Use trained and expert volunteers to provide interpretive information. - Present 1 interpretive program per year. - Provide 1 guided geology program annually.	No change from draft plan.
Environmental Education	- Continue to allow the Refuge to be used by others as an outdoor classroom. - Hire education specialist and offer programs to primary and secondary level school groups on and off the Refuge. - Increase partnerships.	No change from draft plan.
Other General Public Uses		
Beach use	- Recreational beach use allowed from west Refuge boundary to the first ½ mile of the spit (Zone 1 and Strait-side of Zone 2).	No change from draft plan.
Horseback riding	- Not appropriate, therefore not allowed. See Appendix A, Appropriate Use Findings.	- Allowed on west beach (Zone 1) with stipulations, if an alternate access route is developed. - Daily, October 1-March 31; and weekdays, April 1-September 30. - No horseback riding on Memorial Day, the Fourth of July, and Labor Day. - Horses must walk (no trotting, cantering, or galloping). - Party size is limited to no more than 4 horses. - Pedestrians have right-of-way.

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
Jogging	- Not appropriate, therefore not allowed. See Appendix A, Appropriate Use Findings.	- Allowed on west beach (Zone 1) and trail adjacent to the parking lot only. Not allowed on Dungeness Spit (Zones 2 and 3) and upland trails. - Monitor for repeated patterns of violations. If found, then will reevaluate compatibility.
Cultural Resources Interpretation and Education		
Interpretation – New Dungeness Light Station and maritime history	- Continue to partner with NDLSA to provide interpretation. - Continue to allow motorized access for keeper exchanges and facility maintenance. - Maintain human history panel in Refuge entrance kiosk. - Acquire New Dungeness Light Station properties when excessed by the U.S. Coast Guard and enter into formal agreement with NDLSA on management.	Same as Draft CCP/EA but with the following clarification: - Continue to partner with USCG and NDLSA to provide interpretation.
Interpretation – Native American history and culture	- Maintain human history interpretive panel in Refuge entrance kiosk and displays in lighthouse. - Provide at least 1 interpretive product or program per year. - Partner with Tribe(s) to provide at least 1 Native American cultural program per year.	No change from draft plan.
Cultural Resources Protection,Preservation, and Evaluation		
Preservation - cultural resources	- Identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects. - Conduct systematic documentation and evaluation of historic buildings. - Evaluate threatened and impacted sites and structures for eligibility to the National Register of Historic Places. - Develop a GIS layer for cultural resources that can be used with other GIS layers for the Refuge, yet contains appropriate locks to protect sensitive information. - Develop partnerships with the Tribes for cultural resources inventory, evaluation, and project monitoring, consistent with the regulations of the National Historic Preservation Act.	Same as Draft CCP/EA but also: - Continue to coordinate with USCG to allow Aids to Navigation maintenance personnel motorized access for lighthouse servicing and repair.
Native American Graves Protection and Repatriation Act (NAGPRA)	- Identify Native American Tribes, Groups, and direct lineal descendants that may be affiliated with Refuge lands. - Open consultation process with affiliated Tribes, Groups, and direct lineal descendants. - Develop procedures to follow for intentional and inadvertent discoveries. - Identify persons to contact for the purposes of NAGPRA compliance.	No change from draft plan.
Community Outreach		
Festivals and other public events	- Attend at least 3 events per year.	No change from draft plan.
Community presentations	- Deliver at least 5 presentations per year about the Service and Washington Maritime NWRC.	No change from draft plan.
Refuge website	- Routinely upgrade and improve content. Add links to partners' and other resources.	No change from draft plan.

Table L-1. Summary of Changes to Management Direction between the Draft and Final CCPs

Key Theme/issue	Alternative B in Draft CCP	Management Direction in Final CCP
Media outreach	- Increased coordination with media sources to improve the accuracy and content of Refuge-related articles. - Publish at least 2 local articles per year. - Target select media articles toward boating and aviation communities.	No change from draft plan.
Volunteer Program	- Continue to work with Friends group. - Conduct 7 beach clean-ups per year. - Provide up to 4 full-time volunteer hosts. - Provide additional volunteer trainings.	No change from draft plan.
Illegal Uses		
Pets, bicycles, resource collecting, fires, discharging firearms, after hours trespass including camping, kite flying, ball playing, fireworks and Frisbees.	- Maintain and increase law enforcement patrols. - Maintain regulation information panels and signage. - Continue to use staff, volunteers, and trail rovers to inform visitors. - Replace regulatory and guidance signage at lighthouse boat landing zone and end of Dungeness Spit.	No change from draft plan.

L.3 Summary of Comments Received and Service Responses

Wildlife and Habitat Management

1. **Comment:** Implement projects to maintain and/or restore the ecological integrity of the Refuge, through integrated management techniques guided by sound science such as those proposed for the forested habitats.

   Response: We appreciate the support for the proposed monitoring and management strategies. We agree that an integrated management approach is the most scientifically sound way to manage the Refuge, particularly in forested habitats. These habitats, on the edge of the nearshore environment, serve as a buffer from floodwaters, provide nutrient enrichment of aquatic environments in the outflow, and increase the biodiversity of the Refuge and nearshore environment as a whole.

2. **Comment:** Ban fire suppression techniques on the Refuge.

   Response: The overall objectives for fire management on the Refuge Complex, as described in the Fire Management Plan completed in 2004 (USFWS 2004), are to promote a program that provides for firefighter and public safety, reduces the occurrence of human-caused fires, and ensures an appropriate suppression response capability to meet expected wildland fire complexity. Fire suppression techniques used on the Refuge are intended to prevent catastrophic wildfire and to promote the retention of driftwood and vegetation on the barrier beaches. Suppression tactics and strategies to be implemented are intended to minimize long-term impacts of suppression actions.

Within the Refuge's forested habitats, the Service recognizes that historically natural disturbance regimes, including fire, wind throw, and flooding, helped to maintain a mosaic of mature to old-growth habitat with variable age classes of appropriately sized snags. Under the CCP, we will promote the development of old-growth forest characteristics. Strategies that could help return stands to historical densities and provide gaps in the canopy for accelerating the growth of the remaining trees include thinning and prescribed fire. A step-down forest management plan to be completed by 2018 will provide additional details on the use of silviculture practices. Fire suppression techniques will be used to prevent a stand replacement fire that would return the area to an early successional stage.

Within the barrier beaches on Refuge lands, driftwood serves an important role in stabilizing the upper portion of the beach by holding sediments in place, particularly during storm events that coincide with high tides. Native strand plants act in the same manner as driftwood within the more protected strand portion of this habitat type. Fire suppression techniques are important for retaining these key structural components.

3. **Comment:** The Refuge should not engage in invasive species removal.

Response: Throughout the CCP, the terms *pest* and *invasive species* are used interchangeably because both can prevent/impede achievement of Refuge wildlife and habitat objectives and/or degrade environmental quality. Service policy (569 FW 1) defines *pests* as "invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." Department of the Interior policy (517 DM 1) defines an *invasive species* as "a species that is nonnative to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health."

Introduced invasive plants (e.g., common cordgrass, Dalmatian toadflax, cheatgrass, etc.) are an issue within some of the nearshore habitats. Major invasive weeds that have invaded Refuge upland habitats include Bohemian knotweed, English holly, spurge laurel, Canada thistle, Scotch broom, and English ivy. More recently, Herb Robert has been found in several small patches of the Dawley Unit, along the upper most reaches of the main road (<1/4 acre). Many of these invasive plant species can directly out-compete native plant species by reducing light at the ground level and aggressively capturing water and nutrients. They also have the potential to affect food webs and alter ecosystem processes. Invasive marine invertebrates with high reproductive capacity and wide environmental tolerances are also threats to Refuge resources. For example, European green crabs prey on native Dungeness crabs, reduce populations of native clams, and outcompete native invertebrates for food resources where they have become established.

The control of nonnative and invasive species on the Refuge is proactive and receives high management priority. The targets for control on the Refuge have primarily been plants (e.g. English ivy, English holly, and Dalmatian toadflax) although the Refuge's integrated pest management (IPM) program also applies to animal species.

Decisions to use particular tools and techniques, and the criteria for their use to control invasive species, are based on numerous factors and considerations (e.g., the particular species being targeted, associated natural history characteristics, proximity to sensitive resources and nontarget species, etc.). While the CCP provides overall direction and priority

for the control of invasive species, naming specific treatments for the variety of possible problems would be premature. IPM is an interdisciplinary approach, utilizing various methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on Refuge lands and waters to achieve wildlife and habitat management goals and objectives. Considering refuge objectives and the ecology of pest species, once a pest species population reaches a threshold, one or more methods would be selected that are feasible, efficacious, and most protective of non-target resources, including native species (fish, wildlife, and plants), Service personnel, Service-authorized agents, volunteers, and the public.

4. **Comment:** Continue current inventory and monitoring programs. Data developed from these programs should be released or made accessible in a timely manner.

   Response: The Service acknowledges the support for continuing current Refuge inventory and monitoring programs. We are committed to using sound science in decision-making and providing the public with information of the highest quality possible. Under Goal 4, we will emphasize continuing and expanding our efforts to conduct high-priority inventories, surveys, research, and assessments. Funding, staffing, and the Refuge Complex's information needs priorities will dictate which surveys can be accomplished in any given year. Upon completion of survey efforts and data analysis, summary results will be available on the Refuge's website, currently under development. Data collected by Refuge staff in support of larger projects (e.g., Christmas Bird Count and Birdathon) are sent immediately to compilers after the survey is completed.

   The Service is instituting data standards to improve the quality and compatibility of its data. This approach will increase opportunities to share data and reduce incidents of redundant data development. Federal agencies are required to publish guidelines for ensuring the quality, objectivity, utility, and integrity of the information we use and disseminate, and to provide mechanisms for allowing the public to seek correction of that information. In order to ensure the quality and credibility of the scientific information the Refuge uses to make decisions, the Service has implemented a formal "peer review" process for influential scientific documents following the Office of Management and Budget's memorandum "Final Information Quality Bulletin for Peer Review" (available online at www.whitehouse.gov/sites/default/files/omb/memoranda/fy2005/m05-03.pdf).

5. **Comment:** Provide access to the Dawley Unit and publicly accessible areas of Dungeness Spit for volunteer surveys of biological resources.

   Response: The Refuge staff receives periodic requests from non-Service entities (e.g., universities, state or territorial agencies, other Federal agencies, nongovernmental organizations) to conduct research, scientific collecting, and surveys on Refuge lands. Access to the Refuge, including the Dawley Unit, for biological surveys is provided for under a special use permit if the use is appropriate and compatible. For more information on stipulations, see the appropriate use finding (Appendix A) and compatibility determination (Appendix B) for research, scientific collecting, and surveys.

   As discussed in Chapter 2, Objective 7.2, we will continue to engage Refuge volunteers in survey activities, including the Olympic Peninsula Audubon Society Christmas Bird Count and others, which occur in part on the Dawley Unit.

General Public Use Management

6. **Comment:** The Refuge should embrace a more user-friendly welcoming and multiple use philosophy.

   Response: Dungeness NWR is managed as part of the National Wildlife Refuge System within a framework provided by legal and policy guidelines. The needs of wildlife and their habitats come first on Refuges, in contrast to other public lands that are managed for multiple uses. With few exceptions, lands and waters within the Refuge System are different from multiple-use public lands in that they are closed to all public access and use unless specifically and legally opened. No Refuge use may be allowed or continued unless it is determined to be appropriate and compatible. Generally, an appropriate use contributes to fulfilling the refuge's purposes, the Refuge System mission, or goals and objectives described in a refuge management plan. A compatible use is a use that in the sound professional judgment of the refuge manager will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge. Further, each individual refuge must evaluate appropriateness and compatibility as it applies to their lands. For more information on appropriateness and compatibility, see Appendices A and B. For more information on the various Federal laws, executive orders, international treaties, Service policies, and refuge purposes that guide Dungeness NWR management, see Chapter 1.

   Public use activities determined to be appropriate and compatible on the Refuge include saltwater fishing, shell-fishing (clams and crabs), wildlife observation, wildlife photography, hiking, no-wake boating, jogging, horseback riding (should alternative access be obtained per compatibility determination), beach use (wading, picnicking, sunbathing, other recreational beach uses), environmental education, and environmental interpretation. In providing these public uses, the Refuge staff and volunteers strive to make visitors feel welcomed and oriented. The objectives and strategies under Goals 5 through 7, in particular, were developed to enhance the visitor experience.

7. **Comment:** The Dawley Unit should be opened to wildlife observation.

   Response: To protect wildlife resources, the Dawley Unit is closed to public uses. No public facilities exist or are planned. The Olympic Discovery Trail is adjacent to the northern portion of the unit. The southern forested portion has no trail connectivity and does not provide a unique visitor experience from other publicly accessible lands within the area.

Wildlife Observation, Photography, Environmental Education, and Interpretation

8. **Comment:** Expand and enrich wildlife observation, photography, environmental education, and interpretation programs. Increasing Refuge staff, including hiring an education and outreach coordinator and increasing volunteer time, should be a priority.

   Response: The Service acknowledges the support for the Refuge's proposed goals, objectives, and strategies to provide high quality wildlife observation, photography, environmental education, and interpretation opportunities.

Boat Landing Access

9. **Comment:** Boat landing hours at the designated zone directly south of the New Dungeness Light Station should be available from sunrise to sunset.

   Response: The designated boat landing area on the beach directly south of the New Dungeness Light Station is intended to facilitate visitation of the lighthouse; it is not intended to be an entry point to the Refuge. Areas adjacent to the landing are closed to reduce wildlife disturbance. The lighthouse is open to visitation from 9am to 5pm daily; consequently, boat landings at the designated landing area are limited to the same times. This restriction is not intended to apply to the U.S. Coast Guard (USCG) or others during emergencies or other coordinated activities. For more information see Chapter 2, Objective 5.2 and Chapter 5, Section 5.5.2.

10. **Comment:** Develop additional clarifications (e.g., maps, signs) regarding the regulations for boat landing access, including the reservation system.

    Response: Strategies under Objectives 5.1, 5.2, and 5.3 include replacing existing signage at the Cline Spit and Dungeness Landing boat launches with new Refuge maps and regulations panels. New regulatory and guidance signage will be also installed at the lighthouse boat landing area. Additionally, under Objective 7.1, Refuge staff will specifically conduct outreach to the boating community in order to improve communication and promote understanding and awareness of Refuge resources and regulations.

Vehicle Use

11. **Comment:** Prohibit the use of vehicles on Dungeness Spit; it causes more wildlife disturbance than other public uses.

    Response: In comparison with other public uses, some research has suggested that certain wildlife species are less likely to be flushed or swim away from slow moving vehicles than from pedestrians (e.g., Klein 1993, Holmes et al. 1993, Pease et al. 2005). Nevertheless, the Service recognizes the potential for vehicle use on Dungeness Spit to disturb wildlife and wildlife-dependent recreation.

    At Dungeness NWR, the extent of impacts from vehicle use of the beach varies by season. During the daylight summer months, seal pups on the beach may be trampled, and resting shorebirds and gulls displaced. Compatible wildlife-dependent activities such as wildlife watching, photography, and environmental education may be negatively affected because of the expected responses by wildlife to vehicles approaching or passing by. When wildlife react by moving away from vehicles or alter behavior by hiding, they are less likely to be observed (Bennett and Zuelke 1999). During the winter season when vehicle use on the beach occurs at night to coincide with winter low tide events, impacts to Refuge wildlife resources will be minimized but will include resting shorebird and gull displacement. Impacts to marine mammals will be minimal and might affect molting elephant seals. Impacts to Refuge visitors will be negligible as the Refuge is open only during daylight hours.

    The use of vehicles is necessary, however, to accomplish management objectives, including but not limited to removing marine debris, maintenance of signage, inventory and

monitoring, and emergency and law enforcement response. Often these activities require the use of a vehicle (e.g. removal of marine debris, emergency response) or are restricted to a particular tidal range (e.g. shorebird surveys) which necessitates use of a vehicle to complete the activity during daylight or working hours. Additionally, vehicles are used by the New Dungeness Light Station Association (NDLSA) to perform lighthouse keeper exchanges and to transport work parties when maintenance needs dictate.

In order to reduce potential disturbances to wildlife or wildlife-dependent public use, the Service strives to minimize vehicle use on Dungeness Spit. The stipulations necessary to ensure the compatibility of allowing the NDLSA to use vehicles on the beach are also instituted as Refuge best management practices. Refuge staff members and NDLSA volunteers will adhere to practices, such as a speed limit, to minimize impacts to wildlife and Refuge visitors. Furthermore, for research, scientific collecting, and survey activities on the Refuge, vehicles will be thoroughly cleaned to prevent the introduction and spread of pests. See Appendix B for compatibility determinations for research, scientific collecting, surveys, and vehicle access to the New Dungeness Light Station.

12. **Comment:** Consider boat access to provision the lighthouse, instead of driving a vehicle along the spit.

    Response: The safe movement of people and supplies necessary to maintain and interpret the New Dungeness Light Station is best accomplished by allowing vehicle access via the beach at low tides. Weather patterns in the Strait of Juan de Fuca often result in strong westerly winds, and rough water, making access by boat unpredictable and hazardous. Disturbance and other impacts to wildlife and Refuge visitors from allowing vehicle access will be negligible, with the stipulations identified in the Compatibility Determination in Appendix B.

Horseback Riding

13. **Comment:** The Service received comments in favor of no longer allowing horseback riding on the Refuge, and in favor of continuing horseback riding on the Refuge. Comments in favor of continuing to allow horseback riding follow.
    - The Service falsely concluded that horseback riding is an inappropriate use of the Refuge.
    - The CCP failed to identify and consider all reasonable alternatives, which is a violation of the National Environmental Policy Act.
    - The perceived safety risks created by potential user conflicts between horseback riders and pedestrians can be reduced to acceptable levels.

    Response: Horseback riding is not one of the six priority wildlife-dependent public uses identified in the National Wildlife Refuge System Administration Act as amended. In order for horseback riding to be allowed on the Refuge, it must first be determined to be appropriate in accordance with the Service's Appropriate Refuge Uses Policy (603 FW 1) and then compatible per the Compatibility Policy (603 FW 2). In the Draft CCP/EA, the Service preliminarily determined that horseback riding was an inappropriate use of the Refuge and should not be allowed due to safety concerns and user conflicts.

    The Service is obligated to review serious incidents in the interest of providing safe Refuge access. In May 2012 a serious injury accident occurred involving a pedestrian and a horse and its rider on a section of steep trail—approximately 500 linear feet—leading to the Spit.

Investigators determined that there is an unacceptable level of risk involved in continuing to allow pedestrians and horseback riding on that steep section of trail in its current configuration. The situation is complicated by high and unpredictable levels of pedestrian use, and the absence of places for pedestrians to step off the trail when horses are encountered mid-trail. The average trail slope is approximately 8 percent, with a minimum trail slope of 5.4 percent and maximum of 10 percent. The average cross-slope (i.e., slope perpendicular to the trail) is approximately 3.5 percent with a minimum of 0.4 percent and a maximum of 5.9 percent. The trail width ranges from 8 feet to 10 feet. On one side of the trail, there is a steep drop-off down a bluff. On the other side, there is a steep incline. From May through September, the main trail receives approximately 50,000 visitors. It is not unusual to have 600 visitors per day during the summer, and more than 900 visitors on very busy days (USFWS 2012b).

The National Environmental Policy Act (NEPA) directs the Service to analyze a range of reasonable alternatives. The Council for Environmental Quality (CEQ) has defined reasonable alternatives as those that are economically and technically feasible, and that show evidence of common sense. Alternatives that cannot resolve the need for action and fulfill the stated purpose in taking action to a large degree, are eliminated as unreasonable. Unreasonable alternatives may be those that are unreasonably expensive; that cannot be implemented for technical or logistic reasons; that do not meet mandates; or that are inconsistent with Refuge purposes or management objectives.

The Service evaluated all of the comments and suggestions received on our proposal to discontinue horseback riding for feasibility and consistency with Refuge management objectives. This reevaluation resulted in the revision of the appropriate use finding, compatibility determination, and management direction for horseback riding. The Service has determined that horseback riding is an appropriate and compatible use of the Refuge, when conducted in certain locations and in accordance with specific stipulations. The locations follow; for additional information on the stipulations, see Appendix B.

- The Service will allow horseback riding on the beach west of the point where the main trail meets Dungeness Spit (Zone 1), if a safe and legal alternate access route can be obtained from the west or from the east.
- If an alternate access route is obtained from the east then horseback riding on the administrative road will be allowed, from the gate between Refuge lands and private lands to the beach.

Under one possible scenario for implementing the stipulations, individuals or groups could work with private landowners and seek their own safe and legal access route to the Refuge. Alternatively, the Service would need to acquire additional Refuge lands through fee or easement acquisitions or cooperative agreements. Service policy for adding land to a refuge is to work with landowners within a refuge's approved boundary who are willing participants in such acquisitions and agreements. The Service would work with partners to assess land conservation priorities within the area, and identify possible additions to the approved refuge boundary.

The Service also reviewed the following suggestions submitted during the Draft CCP/EA comment period regarding changes to the trail or changes to the use of the trail.

- Build a separate trail.
- Install railings in various configurations.

- Require riders to dismount and walk horses.
- Require self-registration.
- Install traffic guides, signals, or sight mirrors.
- Install signs and institute protocols.
- Use volunteer flaggers.
- Separate the hours of trail operation for pedestrians and equestrians.
- Provide both pedestrian and equestrian uses in separate areas.

The Service thoroughly evaluated each of the suggestions above. Modifications to the current trail (e.g., widening), or the construction of a bypass for the steep hill section, or the construction of a separate equestrian trail for beach access via refuge lands are considered impractical due to technical and logistical challenges. As such, the costs to construct and maintain such options would be prohibitive. The Service does not currently own other lands where a separate equestrian trail could be feasible. Installing railings would not adequately resolve safety issues associated with horse and pedestrians using the same trail or would prove impractical due to trail width limitations. Unsafe conditions persist whether riders dismount and walk horses or ride their horses when co-mingling with pedestrians. Regarding self-registration, should alternate access to the Refuge for horses be developed, the Service intends to streamline the reservation and permit process based on the specific access location and may install a horse-only fee station or require all riders to obtain a permit by phone or in person. Other suggestions would not achieve the desired result or ensure compliance, or would require substantial amounts of staff time to implement and thus would be infeasible to implement with the limited number of staff at the Refuge. Since each of the above suggestions was either not feasible to implement or would not achieve the desired result, none of the above suggestions were included as part of the program for allowing horseback riding on the Refuge.

14. **Comment:** Horseback riding has no or very little impact to wildlife compared to impacts from other user groups.

    Response: Many public uses, including horseback riding, cause some disturbance to wildlife that varies by season. The 150 foot approach distance offered by Owen (1973) is consistent with observations suggesting that riders observing wildlife can approach wildlife at closer distances than through other forms of travel. However, any form of approach is expected to cause some disturbance, which will vary according to the species affected, the season and time of day, and the type, level, frequency and duration of the disturbance. The extent of impacts from horseback riding on the west beach (Zone 1) would vary by season. During the summer months seal pups on the beach and bluff-nesting guillemots may be disturbed, and resting shorebirds and gulls displaced. During the winter months gulls and shorebirds may be disturbed and displaced. However, overall, disturbances on the beach to the west of where the main trail meets the spit are expected to result in minor impacts to resident wildlife and other Refuge users, due to the low volume and seasons of use. More information on the potential impacts to wildlife from horseback riding is available in Appendix B.

15. **Comment:** Horseback riding should be allowed to facilitate accessibility to the Refuge.

    Response: When necessary and when compatible with resource management objectives, we may make exceptions to general access restrictions for visitors with disabilities to facilitate

their experience. However, public safety concerns along a 500-linear-foot section of trail to the beach preclude horseback access via this route.

Jogging

16. **Comment:** Comments regarding jogging and wildlife disturbance follow.
    - Jogging causes wildlife disturbance on the Refuge.
    - Jogging does not appear to be as much of a threat to wildlife compared to other public uses.
    - Disturbance to wildlife from jogging has not been observed by some visitors.

    Response: In general, responses by wildlife to recreational activity can range from behavioral changes including nest abandonment and food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995). The long-term effects are more difficult to assess but may include altered behavior, vigor, productivity, or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions. Knight and Cole (1991) found that wildlife responses to human disturbance include avoidance, habituation, and attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the habitat type, time of day, time of year, and weather; the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991, Gabrielsen and Smith 1995). For more information on the general impacts of recreation on wildlife see Appendix B.

    Jogging, more specifically, can impact normal wildlife behavioral activities, including feeding, reproducing, and social behaviors. Studies have shown that waterfowl and shorebirds are sensitive to jogging activity (Burger 1981, Burger 1986). Rapid movement by joggers is more disturbing to wildlife, than slower moving hikers (Bennett and Zuelke 1999, Burger 1981). Because wildlife use the same areas as joggers for feeding and resting, it is likely that joggers would be moving directly toward wildlife. This type of activity would cause an increase in disturbance since research has shown that a direct approach is more disturbing to wildlife than movement away from or at an oblique angle (Knight and Cole 1991).

    Although the impacts of jogging, as conducted on Dungeness NWR, have not been studied in detail, impacts have been reported from Refuge staff, volunteers and visitors including wildlife disturbance on the forested trail and beach, and conflicts between user groups. Jogging can impact marine mammal, passerine, shorebird, waterfowl and other migratory bird populations feeding and resting on the beach, bluff, or near trails. The extent of impacts from jogging to Refuge wildlife would vary by season. For example, during the summer months seal pups on the beach may be disturbed and resting shorebirds and gulls displaced.

17. **Comment:** We received comments regarding allowing or not allowing jogging on the Refuge. Comments supported Alternative A, the no action alternative, and Alternative B, as described in the Draft CCP/EA. Additionally, suggestions for modified jogging alternatives included but were not limited to the following.
    - Allow jogging along the trail parallel to the parking lot.
    - Close jogging on Dungeness Spit and on the upland trails, and continue to allow jogging along the west beach (Zone 1) below the bluffs.

- Continue to allow jogging on the upland trails.
- Identify seasonal jogging closures or time restrictions.

Response: The comments and suggestions received by the Service on the Draft CCP/EA related to discontinuing jogging resulted in a reevaluation and subsequent revision of the appropriate use finding, compatibility determination, and management direction for jogging.

The studies cited for jogging (Appendix B) show that public use activities can and do disturb wildlife. Based on the circumstances described in the scientific literature as well as reports from staff, volunteers and visitors, similar effects are occurring on Dungeness NWR. A primary concern in allowing any public use on Dungeness NWR is to maintain adverse impacts within acceptable limits. Korschgen and Dahlgren (1992) and Fox and Madison (1997) state the importance of providing disturbance-free food reserves and areas, as a management alternative to minimize human disturbances. The Refuge has several areas which are removed from human activity and support high use by aquatic birds and marine mammals including Graveyard Spit and the tip of Dungeness Spit.

Although jogging is not a wildlife-dependent use of the Refuge as defined by statute (16 U.S.C. 668dd et seq.), it is likely that some joggers observe and enjoy wildlife while on the Refuge. Therefore, jogging will be allowed during daylight hours, on the trail adjacent to the parking lot and on the west beach only (Zone 1). These areas receive less overall wildlife use compared to other sections of the Refuge, and conflicts with other visitors, primarily engaged in wildlife-dependent activities, will be limited. Therefore, we anticipate the impacts on wildlife and wildlife-dependent public use from jogging in these areas to be minor.

The west beach area is immediately adjacent to cliffs, bluffs, and open water, and receives less wildlife use compared to Dungeness Spit, in part, because the spit is adjacent to intertidal flats, eelgrass beds, salt marsh, and open water. The composition and spatial arrangement of habitats surrounding the spit make it more valuable to wildlife and more vulnerable to impacts from human disturbance.

Jogging will not be allowed on the forested trails leading down to the beach because the higher speed of joggers, combined with short sight distances on confined wooded trails, creates unsafe conditions for both joggers and other Refuge visitors. Special running events and team training will not be allowed because group size increases wildlife response to disturbance (Geist et al. 2005, Yosef 2000), and group events can cause conflicts with other visitors on confined wooded trails. Restricting group size to a maximum of 3joggers and educating the public on the effects of recreation on wildlife and habitat, will further reduce impacts to wildlife and conflicts with other Refuge visitors. There are public lands nearby, including Clallam County's Dungeness Recreation Area adjacent to the Refuge, that provides an extensive trail system appropriate for this activity.

18. **Comment:** How will the Service define jogging and enforce restrictions on that activity? How is walking fast and running different from jogging?

Response: In general, jogging is aerobic running and is defined as an activity designed to increase physical fitness. Typically, joggers run for an extended period and distance with their primary purpose being exercise. Jogging differs from walking or hiking in speed even when the intention is physical exercise.

The Service views the management direction for jogging described in this CCP as a relatively minor change to what is currently allowed on the Refuge and intends to gain voluntary compliance through public education. The Service does not intend to single out this activity for additional enforcement beyond current levels. We will work with the jogging community to achieve compliance. Nonetheless, engaging in the activity outside of the areas identified in the CCP and compatibility determination would be a violation of Refuge regulations as defined in Chapter 50 of the Code of Federal Regulations, Part 26, and would be considered a misdemeanor offense. Violators may be subject to revocation of their Refuge entry permit, or issuance of a warning notice or a federal notice of violation.

Enforcement of regulations and imposed fines may minimize visitor disturbance to wildlife (Knight and Gutzwiller 1995). If a pattern of violation is demonstrated which results in jogging becoming a noncompatible activity (i.e. wildlife disturbance or impacts on wildlife-dependent public use) it will be reevaluated and may be eliminated.

Law Enforcement

19. **Comment:** Violators, including joggers and bike riders, may not be aware that they are breaking the law. The Service should improve and add additional signage that includes information on the usage rules, explanations on why certain activities are not allowed, and penalties for noncompliance.

    Response: One of the primary goals of public education is the achievement of voluntary compliance with Refuge regulations which are designed to minimize wildlife disturbance and promote visitor safety. This goal will be achieved by utilizing a variety of techniques including but not limited to signage, publications, personal contact, education and interpretation presentations, internet based information sites, and media outlets. Strategies identified in Objective 5.3 utilize many of the above techniques and range from improved signage to increased volunteer and staff commitments to expanded outreach. The Service remains committed to continuously evaluating, replacing, and improving signage. For more information on the implementation of sign changes and improvements, see Appendix H, Sign Inventory and Maintenance Plan.

    The Service is careful not to overwhelm visitors with excessive regulatory signage; therefore, we utilize a variety of information tools including personal contact from staff and volunteers, a website, and publications. Despite these efforts, we are aware that some visitors will inadvertently or purposefully miss such information. It is incumbent upon Refuge users to obtain the required entrance permit and to comply with Refuge regulations. Failure to comply with Refuge regulations defined in Chapter 50 of the Code of Federal Regulations can subject violators to revocation of their Refuge entry permit and/or issuance of a warning notice or a federal notice of violation. Extreme violations can result in arrest and imprisonment.

Volunteer Program

20. **Comment:** Expand opportunities for citizen science volunteers to engage in Refuge programs and increase their value to the Refuge as identified in Alternative B.

    Response: The Service recognizes the importance of working with volunteers to carry out some of the tasks associated with Refuge management (e.g., inventory and monitoring,

invasive species control, and interpretation). The work of citizen scientists is particularly valued as evidenced by the many citizen science projects supported by Refuge staff including: Christmas Bird Count, Birdathon, COASST, Project FeederWatch, PTMSC Plastics Project, Purple Martin nest box project, amphibian surveys, pigeon guillemot burrow counts, and green crab surveys. Under Objective 7.2, the Service plans to continue to recruit, train, retain, and utilize volunteers for these and other projects.

Outreach

21. **Comment:** Outreach to local organizations and media should be a central part of the Refuge's education and interpretation programs.

    Response: Much has been done in recent years to improve interpretive programs and signage on the Refuge; however, the Service recognizes that much more can be done to educate Refuge visitors and the public about the value of the National Wildlife Refuge System and the specific resources found on Dungeness Refuge. The strategies under Objective 7.1 are intended to guide increased media and local community outreach.

22. **Comment:** In cooperation with partner agencies, the Refuge should create comprehensive maps showing recreational opportunities on all public lands in the vicinity of the Refuge.

    Response: The CCP includes comprehensive public use maps for Refuge lands (Figure 2-2); however, we agree that a comprehensive area map of recreational opportunities would be a valuable tool. We would offer our input to other agencies, organizations, or individuals if such an effort occurs, but a larger role is not feasible due to staffing and funding limitations.

Staffing

23. **Comment:** Additional permanent staffing for the Refuge is needed.

    Response: The Service appreciates the support for additional staffing (i.e., Environmental Education/Visitor Services Specialist) to implement the programs detailed within the CCP. Because Refuge staff and funding resources are limited, the Refuge will also partner with other organizations to enhance education and recreation opportunities.

Dawley Unit Management

24. **Comment:** In order to free up management capacity to focus on other efforts at the Refuge, the Dawley Unit should be transferred to another agency (e.g., Washington State Parks).

    Response: As referenced in Chapter 2, the Service plans to work with other agencies or conservation organizations to pursue cooperative management of the Dawley Unit. However, the ability of other agencies or conservation organizations to commit towards cooperative management is likely contingent upon budget availability.

New Dungeness Light Station

25. Comment: The Service should coordinate directly with the U.S. Coast Guard (USCG) regarding potential acquisition of the lighthouse property, the proposal to remove the road access dike at the base of Dungeness Spit, preservation of cultural resources, and signage.

Response: The USCG District 13 has been on the Service's CCP distribution list since the beginning of the CCP process. Additional USCG points of contact were added upon request. During implementation of the CCP, we will continue to coordinate with the USCG on issues of mutual interest including but not limited to those mentioned above. Further language and clarifications have been added to the CCP in Chapters 2 and 5, to reflect this intent.

26. Comment: Figure 1-3 should show USCG withdrawal jurisdiction over the New Dungeness Light Station. The lighthouse property is not within the Service fee title area as the Service only has an overlapping withdrawal, not full administrative jurisdiction.

Response: Figure 1-3 within the final CCP has been edited to include the USCG withdrawal jurisdiction over the New Dungeness Light Station.

27. Comment: The Service should continue to allow the USCG motorized access to the lighthouse as appropriate (e.g., site cleanup, large-scale historic preservation, emergency, or aids to navigation servicing and repair projects).

Response: The restrictions on boat landing access on the Refuge within Objective 5.2 are intended for the general public and do not apply to the USCG or others during emergencies or other coordinated activities. Further language and clarifications have been added to the CCP in Chapter 2, in order to reflect this intent.

Planning Process

28. Comment: The Service should extend the public comment period for the Draft CCP/EA.

Response: Originally, the Service released the Draft CCP/EA for a 30-day public review and comment period starting on November 28, 2012 and ending December 27, 2012. On December 7, 2012, the Service announced an extension of the comment period to January 28, 2013. On January 14, 2013, the Service extended comment period to February 28, 2013, providing a total of 90 days for public review and comment.

29. Comment: The Service should hold public meetings on the Draft CCP/EA.

Response: Public involvement has been encouraged throughout CCP development. Public involvement strategies included face-to-face meetings or phone conversations with community organizations; local, state, and federal agencies; elected officials or their aides; Tribal representatives; and local Refuge users. For the broader public, we held open houses and provided planning updates to inform, invite discussion, and solicit feedback. We held four public open house meetings in Sequim, Washington, on January 19 and February 2, 2012, to inform the public about our preliminary draft alternatives, which included proposals to prohibit jogging, and stipulations for horseback riding on the Refuge. Following the release of the Draft CCP/EA, the public comment period was extended to 90 days to give the

public more opportunities to review and comment. Summaries of the events, meetings, and outreach tools used in our public involvement efforts are provided in Appendix K.

Outside of the Scope of the CCP

30. Comment: Many comments were submitted regarding camping, hunting, and other uses occurring on the adjacent Dungeness Recreation Area.

Response: The 216-acre Dungeness Recreation Area (DRA), located to the south of the Refuge, is owned by Clallam County and managed by its Parks, Fair, and Facilities Department. Since the DRA is not part of Dungeness NWR, issues and concerns related to DRA management are outside of the scope of this CCP. The Service will continue to coordinate with Clallam County regarding the trailhead parking lot and public restroom lease as well as other areas of mutual interest such as invasive species management.

The DRA and the Refuge have different purposes and mandates. Public uses and amenities offered at the DRA include: picnic sites, year-round camping, hiking, biking, horseback riding, and other recreation opportunities. Pets on leash are allowed in the park (Clallam County Parks 2012a). Hunting has been discontinued as of January 2013.

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