U.S. Fish & Wildlife Service

Grays Harbor National Wildlife Refuge and the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Assessment

A Vision of Conservation

Grays Harbor NWR

The Refuge is recognized internationally for its significance to shorebirds as part of the Grays Harbor Western Hemisphere Shorebird Reserve Network. Each year, shorebirds make a seemingly impossible journey along the Pacific coast, traveling thousands of miles southward in the fall to reach their wintering areas as distant as South America. The following spring they return to their nesting grounds in Alaska and Canada.

To achieve this feat, thousands of shorebirds require key rest areas. Grays Harbor National Wildlife Refuge plays an important role in this respect: twice a day the tides recede, providing a vast expanse of mudflat habitat where migrating birds forage and rest during their long journey. This spectacular natural phenomenon provides visitors and students alike an opportunity to observe, photograph, and learn about these shorebirds and other local wildlife in their native habitats.

The Refuge works in partnership with others to protect and enhance the biological integrity and natural functions of the estuary for migratory birds and other native fish and wildlife, using adaptive management to respond to changing environmental and climatic conditions. Located in a gateway community of the Olympic Peninsula, the Refuge provides opportunities for adults and children to enjoy the outdoors, observe wildlife, and foster a lifelong connection with nature.

Black River Unit of Billy Frank Jr. Nisqually NWR

The waters of the Black River flow almost imperceptibly from Black Lake south to the Chehalis River. Meandering through a complex mosaic of wetlands, riparian forest, shrub swamp, and bogs, this area is considered the most intact low-lying river system remaining in western Washington. The Unit protects some of the most expansive and remote wetlands, sustaining a truly wild place.

The Unit provides a diverse community of fish and wildlife, large populations of once rare species such as the Oregon spotted frog, salmon, and unique bog, plants, and animals now flourish in the healthy wetland habitats.

Unit visitors will explore the quiet waterway, paddling canoes through the narrow river channel to fish and observe wildlife. Exploration of the native habitats offers opportunities to catch a glimpse of secretive wading birds, river otter, beaver, Roosevelt elk, and other wildlife, providing visitors with a sense of stewardship for the Unit.

Together, community members and partners, in concert with the Unit, protect and enhance the Black River, promoting biodiversity and natural ecological functions to benefit native fish, wildlife, and plant communities in wetland and upland habitats.

The Unit continues to build strong partnerships to protect and maintain the solitude, wild character, and health of the Black River so future generations can experience being a part of this very special place.

Visitors along the Sandpiper Trail boardwalk. ©Ceridwen

Grays Harbor National Wildlife Refuge

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Assessment

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USFWS

Chapter 1 Introduction and Background

Chapter 1. Introduction and Background

1.1 Introduction

Grays Harbor National Wildlife Refuge (Refuge, NWR) and the Black River Unit (Unit) of Billy Frank Jr. Nisqually National Wildlife Refuge were established in the Chehalis River watershed in Washington State to protect fragile and unique natural habitats and their wildlife resources. Grays Harbor Refuge lies at the end of the Chehalis River watershed within the Grays Harbor estuary and was set aside to protect globally important shorebird habitat and conserve fish and wildlife populations at the estuary. The Black River Unit was set aside to protect, conserve, and manage fish and wildlife resources. Grays Harbor Refuge and the Black River Unit are part of Nisqually National Wildlife Refuge Complex (Refuge Complex) in Olympia, Washington (see Map 1).

This document is a comprehensive conservation plan (CCP), a management plan for the next 15 years or until it is revised; it will guide management and project development for the Refuge and the Unit as funding is made available. The planning team has carefully considered the critical resources, public use issues, and public input to design a plan that can best meet the resource conservation and visitor services challenges of the coming years.

Nisqually National Wildlife Refuge was redesignated as Billy Frank Jr. Nisqually National Wildlife Refuge (Refuge) in December 2015. A CCP for the then-named Nisqually National Wildlife Refuge was completed in 2005; this CCP addresses management of the Black River Unit but not Billy Frank Jr. Nisqually National Wildlife Refuge.

1.2 Significance of the Refuges

1.2.1 Grays Harbor National Wildlife Refuge

The freshwater of the Chehalis, Humptulips, Hoquiam, Elk, and Johns Rivers combine with the saltwater of the Pacific Ocean to create the Grays Harbor estuary. The estuary's 94 square miles of open water, saltmarshes, and mudflats provide crucial habitat for a variety of wildlife and aquatic species, including hundreds of thousands of shorebirds during spring migrations. The Refuge encompasses a small area of the estuary, located on the northeastern edge of Grays Harbor. Overall, the Refuge occupies only 2 percent of the estuary land base, yet has hosted up to 50 percent of the migrating shorebirds.

Grays Harbor estuary is one of four major staging areas for migrating shorebirds in North America and hosts one of the largest concentrations of shorebirds on the Pacific coast. In 1996, it was designated as a Western Hemisphere Shorebird Reserve Network Site of Hemispheric Significance and a Washington Important Bird Area (see Section 1.8). Within the greater Grays Harbor estuary, the mudflats of the Refuge are some of the last to flood at high tide, drawing high densities of foraging and resting shorebirds.

Shorebird species using the Refuge include large numbers of western sandpiper, dunlin, semi-palmated plover, black-bellied plover, least sandpiper, short- and long-billed dowitchers, and red knot. Common raptors include osprey, bald eagle, northern harrier, red-tailed hawk, peregrine falcon,

and merlin. In winter, a few thousand dunlin, some black-bellied plovers, and large concentrations of wintering waterfowl and waterbirds use the greater Grays Harbor estuary and Refuge. Neotropical songbirds use these areas on their north and south migrations while some are residents throughout the year. Estuarine conditions support dense populations of benthic invertebrates, macroinvertebrates, and many species of fish, including salmonids and federally threatened bull trout, green sturgeon, and eulachon (smelt).

Refuge habitats include tidal open water, intertidal mudflats, tidal salt and brackish marshes, and forest (see Map 2). The approved Refuge boundary encompasses 1,851 acres of estuary and uplands in Grays Harbor County, Washington; the Service owns approximately 1,408 acres and leases 64 acres from the Port of Grays Harbor (see Map 3).

1.2.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Unit is southwest of Olympia, Washington (see Map 4). The Black River is an important tributary of the Chehalis River, the second largest watershed in Washington State. The Unit boundary encompasses the northern portion of the Black River, the most intact lowland river system left in western Washington.

The Unit consists of a large, complex mosaic of wetland, riparian, and some upland habitats surrounding the low-lying river. The Unit's diverse habitats include river and tributary channels, bog, shrub swamp, riparian forest, emergent marsh, seasonally flooded nonnative grassland, dry nonnative grassland, and mixed forest (see Map 5). Bog habitat is considered locally rare.

Both the upper Black River and associated wetlands are some of the last remaining lowland wide floodplain systems in the Puget Sound Trough/Willamette Valley Ecoregion. The Unit contains spawning and rearing habitat and migration corridors for steelhead and cutthroat trout and Coho and Chinook salmon. At least 150 species of migratory birds, including waterfowl and neotropical songbirds, use the wetland and riparian habitats.

The Olympic mud minnow, a State-endemic and State species of concern, is found in the Unit. The Unit is one of only three sub-basins in Washington to support the federally threatened and State-listed as endangered Oregon spotted frog. The complex system of wetlands within the Unit supports two major areas of frog activity, and drainages into the river support other frog activity areas.

Management programs on the Unit are focused on protecting and enhancing the unique habitats for fish and wildlife, including rare or declining species, migratory birds, anadromous salmonids, amphibians, and other wildlife. Land areas within the Unit are closed to public access. The river bed is State-owned aquatic land managed by the Washington State Department of Natural Resources (WDNR). The river itself is open to the public by boat only, with boat access at one location on county land.

1.3 Proposed Action

We, the U.S. Fish and Wildlife Service (Service), manage national wildlife refuges as part of the National Wildlife Refuge System (Refuge System). We propose to adopt and implement a CCP for Grays Harbor National Wildlife Refuge and the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge. This document is the draft 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. 688dd–688ee, 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 the refuge(s);
- the fish, wildlife, and plant populations, their habitats, and the archaeological and cultural values found on the 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.

Refuge System planning policy (Service Manual Part 602, 602 FW3, June 21, 2000) states that the purpose of CCPs is to "describe the desired future conditions of a refuge and provide long-range guidance and management direction to achieve refuge purposes; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System; . . . and meet other mandates."

The proposed action in the draft CCP and environmental assessment (EA) is to implement Alternative 2, which is the Service's preferred alternative for the Refuge and the Unit. The Service has developed and examined two alternatives for the Refuge and two alternatives for the Unit. Chapter 6 describes anticipated effects for each alternative, pursuant to the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321–4347).

The preferred alternative may be modified between the draft and final documents depending upon comments received from the public or other agencies and organizations. The Service's Regional Director for the Pacific Region will decide which alternative will be implemented. For details on the specific components and actions comprising the range of alternatives, see Chapter 2.

1.4 Purpose and Need for Action

The purpose of developing the CCP is to provide the Refuge manager and the Unit 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, the Unit, and the Refuge System; help achieve the goals of the National Wilderness Preservation System; and meet other mandates. The CCP must be specific to the planning unit and identify the overarching wildlife, public use, or management needs for the Refuge and the Unit. The need for the CCP is derived from the overall Refuge System mission, goals, and policies, as described in or promulgated by the Refuge Administration Act (602 FW 3.4C1d).

1.5 Legal and Policy Guidance

1.5.1 The U.S. Fish and Wildlife Service

All national wildlife refuges are managed by the U.S. Fish and Wildlife Service, an agency within the Department of the Interior (DOI). 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 and wildlife and their habitats for the continuing benefit of the American people." National natural resources entrusted to the Service for conservation and protection include migratory birds, endangered and threatened species, inter-jurisdictional fish, wetlands, and certain marine mammals. The Service also manages national fish hatcheries, enforces Federal wildlife laws and international treaties on 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

Grays Harbor National Wildlife Refuge and the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge are part of the National Wildlife Refuge System, which is governed by a framework of 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.

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 the 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 as amended (16 U.S.C. 688dd–688ee) (Refuge Administration Act), the Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4), as amended, Title 50 of the Code of Federal Regulations (CFR), and the Fish and Wildlife Service Manual (FW). The Refuge Administration Act is implemented through regulations covering the Refuge System, published in Title 50, subchapter C, of the CFR. These regulations govern general administration of units of the Refuge System.

1.5.3 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 the mission goals and purposes policy (601 FW 1) are:

- conserve a diversity of fish, wildlife, 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 inter-connectedness of fish, wildlife, plants and their habitats.

1.5.4 National Wildlife Refuge System Administration Act

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 (Improvement Act) amended the Refuge System Administration Act in 1997 (USFWS 1997) by including a unifying mission for all national wildlife refuges as a system, a new process for determining compatible uses on refuges, and a requirement that each refuge be managed under a comprehensive conservation plan, developed in an open, public process.

The Refuge Administration Act states that the Secretary of the Interior shall provide for the conservation of fish, wildlife, plants, and their habitats within the Refuge System as well as ensure that the biological integrity, diversity, and environmental health (BIDEH) of the Refuge System 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.’’ BIDEH are critical components of wildlife conservation. As later made clear in the Biological Integrity, Diversity and Environmental Health Policy (601 FW 3) “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.”

Under the Refuge Administration Act, each refuge must be managed to fulfill the Refuge System mission as well as the specific purposes for which the refuge was established. The Refuge Administration Act requires the Service to monitor the status and trends of fish, wildlife, and plants in each refuge.

Additionally, the Refuge Administration Act identifies six priority wildlife-dependent recreational uses for the Refuge System. These uses are hunting, fishing, wildlife observation and photography, and environmental education and interpretation. Under the Refuge Administration Act, the Service is to grant these six wildlife-dependent public uses special consideration in the planning for, management of, and establishment and expansion of units of the Refuge System. The overarching goal of wildlife-dependent public use programs is to enhance opportunities and access to quality wildlife-dependent visitor experiences on refuges while managing refuges to conserve fish, wildlife, plants, and their habitats. When determined compatible on a refuge-specific basis, these six uses

assume priority status among all uses of the refuge. The Service is to make extra efforts to facilitate priority wildlife-dependent public use opportunities.

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) proposed or occurring on a refuge for appropriateness and compatibility. 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 purposes, 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. Updated appropriate use and compatibility determinations for existing and proposed uses for the Refuge and the Unit can be found in Appendices A and B.

The Refuge Administration Act also requires that in addition to formally established guidance, the CCP must be developed with the participation of the public. Issues and concerns identified by the public help prepare alternatives considered during the development of the CCP, and together with the formal guidance, form the basis for selection of the preferred alternative. It is Service policy that CCPs are developed in an open, public process, and we are committed to securing public input throughout the CCP process. Public involvement details can be found in Appendix J.

1.5.5 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 (MBTA), Refuge Recreation Act of 1962, National Historic Preservation Act of 1966 (NHPA), and the Endangered Species Act of 1973 (ESA). For additional information on laws and other mandates, a list and brief description of Federal laws pertinent to the Service can be found in the laws digest at http://www.fws.gov/laws/Lawsdigest.html.

In addition, we have 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(s).

1.6 Refuge Establishment and Purposes

1.6.1 Legal Significance of the Refuge Purpose

The purpose(s) for which a refuge was established or acquired is of key importance in refuge planning. Purposes must form the foundation for management decisions. The refuge 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 proposed refuge uses.

The purpose(s) 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 Refuge System mission.

1.6.2 Grays Harbor National Wildlife Refuge Purposes and History

Purposes for Establishing Grays Harbor National Wildlife Refuge in 1990:

- conserve fish and wildlife populations and their habitats, including those of western sandpiper, dunlin, red knot, long-billed dowitcher, short-billed dowitcher, other shorebirds, and other migratory birds, including birds of prey;
- fulfill international treaty obligations of the United States with regard to fish and wildlife and their habitats;
- conserve those species known to be threatened with extinction;
- provide an opportunity, consistent with the purposes set forth in paragraphs (1), (2), and (3), for wildlife-oriented recreation, education, and research. 102 Stat. 1041 (Act to establish the Grays Harbor National Wildlife Refuge);
- "... 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).

Supporting Documentation for Establishing Grays Harbor National Wildlife Refuge:

The first evidence of interest in protecting the mudflat habitat in Bowerman Basin came in 1985 at the International Association of Fish and Wildlife Agencies Conference. There was a proposal to establish a Western Hemisphere Sister Reserve System to Protect Shorebird Populations. The concept was developed to identify essential migratory shorebird habitats in the western hemisphere supporting 48 species with an estimated population of 10 to 20 million birds. Bowerman Basin at Grays Harbor, Washington, was among the sites proposed for inclusion in the Sister Reserve System.

At that time, Bowerman Basin was administered by the Port of Grays Harbor, which was developing a Grays Harbor Estuary Management Plan that included measures to protect wildlife habitat. In a consolidated grassroots effort, private citizens working together developed and pursued the vision to create the Refuge. With strong congressional support, Bill S.1979 was introduced to the Senate in December 1987. After passing both houses, it was presented to the President for signature. On August 19, 1988, President Ronald Reagan signed Public Law 100-406: the Grays Harbor National Wildlife Refuge Act, which authorized the establishment of Grays Harbor National Wildlife Refuge. The Act provides clear management priorities and guidance for the Refuge. The Refuge was established with the first parcel included in the Refuge in 1990 (see Table 1-2).

1.6.3 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge Purposes and History

Purposes for Establishing the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge in 1998:

- for use as an inviolate sanctuary, or for any other management purpose, for migratory birds. 16 U.S.C. § 715d (Migratory Bird Conservation Act);
- "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f (a)(4) (Fish and Wildlife Act of 1956);
- "... 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).

Supporting Documentation for Establishing the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge:

In 1980 a Service wetland inventory program identified the Black River wetland system as an important habitat in Washington State (USFWS 1980). Though little was known at the time, this intact low-lying river system retained unique wetland bogs in a mosaic of natural wetland habitats. Thurston County identified and designated this area as "natural" in the Shoreline Management Plan.

Identified in the Service's Black River Swamp Preserve Design (Caicco 1992), a clear description of the habitats describes the unique, relatively wild character and natural features of the wetlands south of the Black Lake. The document begins the discussion of habitat protection and management opportunities for the area. In an early land acquisition effort to protect the river corridor and surrounding floodplain wetlands, The Nature Conservancy (TNC) acquired 320 acres in 1993 to manage the land as a nature preserve. The following year, the Pacific Coast Joint Venture (PCJV,

now known as the Pacific Birds Habitat Joint Venture) identified portions of the Black River in need of protection in their annual Strategic Plan. Members of the public and nongovernmental organizations (NGOs), such as TNC and PCJV, advocated for the establishment of a refuge. A preliminary project proposal (USFWS 1993) was developed by the Service outlining habitat protection options and proposing an acquisition boundary. The Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge was authorized in 1996 (USFWS 1996) and the Unit was established with the purchase of the first parcel of land in 1998 (see Table 1-3). Community outreach efforts with landowners and willing sellers in the area continue today.

1.6.4 Refuge and Unit Ownership and Land Status

Tables 1-1, 1-2, 1-3, and Maps 3 and 4 show the lands associated with the Refuge and the Unit. The acreage figures for fee title properties are based on realty deeds. The approved Refuge and Unit boundaries indicate boundaries approved by the national or regional U.S. Fish and Wildlife Service Director for potential acquisition of lands by the Service.

Geographic information system (GIS) acres can vary by a certain amount from realty acres, which are based on survey or deed records. Realty acres should be viewed as the most accurate source. However, a variety of analyses (habitat acres, river miles) were conducted utilizing GIS mapping during the CCP process.

Quantitative analysis in the CCP is based on GIS estimates, which may slightly over- or underestimate actual acres or lengths.

Table 1-1. Land Ownership Status

	Approved Refuge Boundary Acres(1)	Acres Owned in Fee(2)	Acres in Easements, Agreement, or Lease(2)
Grays Harbor NWR	1,851 acres	1,408	64
Black River Unit	3,873 acres	1,566	11

(1) Acres generated from GIS, rounded to the nearest acre.
(2) Acres from realty data, rounded to the nearest acre (USFWS 2015)

Land acquisition using funding from the Land and Water Conservation Fund (LWCF) is under the acquisition authority of the Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a–742j). Acquisitions using funding from the Migratory Bird Conservation Fund (MBCF) are under the acquisition authority of the Migratory Bird Conservation Act of 1929.

Grays Harbor National Wildlife Refuge

Table 1-2. Grays Harbor NWR - Land Acquisition/Funding Authorities

Date	Legal Document	Direction
08/19/1988	Public Law 100-406 August 19,1988	100th Congress of the United States and signed by the President under the Authority: An Act, To establish the Grays Harbor National Wildlife Refuge Public Law 100-406, August 19, 1988

Date	Legal Document	Direction
08/29/1990	Lease	Tract 4LS-1, leased with LWCF funds
08/29/1990	Deed	Tracts 4a (5.80 acres) and 4 (63 acres) purchased with LWCF funds
09/17/1990	Lease	Tract 4LS-2, leased with LWCF funds (Note Deed signed 9/17/1990 improvement costs: expires 12/31/2043)
08/31/1994	Lease	Tract 5LS, (63.61 acres) purchased with LWCF funds
02/27/1995	Deed	Tract 5, (1,338.97 acres) purchased with LWCF funds

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Unit authority and management extends across all lands owned by the Unit, except that the aquatic bed of the river within that ownership (approximated by the area that is within "bank to bank" of the river) is under the jurisdiction of WDNR (see also Chapter 2.3.1 Features Common to All Alternatives).

Table 1-3. Black River Unit - Land Acquisition/Funding Authorities

Date	Legal Document	Direction
02/13/1998	Deed	Tracts 569, 569a, (31.6 acres) purchased with LWCF funds
09/02/1999	Easement	Tract 525R, donation of easement (.26 acres)
09/02/1999	Deed	Tract 525e, donation (25.46 acres)
12/15/1999	Easement	Tract 545R, purchased (wetlands) easement (.25 acres) with LWCF funds
12/15/1999	Deed	Tract 545, purchased (9.59 acres) with LWCF funds
03/20/2000	Deed	Tracts 525a, 525b, 525c, 525d, purchased (149.44 acres) with LWCF funds
03/20/2000	Easement	Tract 525R-1, donation of easement (3.21 acres)
06/06/2000	Deed	Tract 552, 552a, donation (73 acres)
08/31/2000	Deed	Tracts 547, 547a, 547b, purchased (41.91 acres) with LWCF funds
09/28/2000	Deed	Tracts 574, 574a, purchased (64.6 acres) with LWCF funds
11/09/2000	Deed	Tracts 575, 575a, 575b, purchased (29.1 acres) with LWCF funds
11/09/2000	Easement	Tract 575R-1, donation of easement (1.12 acres)
05/24/2001	Deed	Tract 553, purchased (23.73 acres) with LWCF funds
09/14/2001	Deed	Tract 525p, purchased (160 acres) with MBCF funds
09/24/2001	Deed	Tracts 525f, 525g, 525h, 525i, 525j, purchased (109.75 acres) with LWCF funds
10/05/2001	Deed	Tract 573, purchased (9.47 acres) with LWCF funds

Date	Legal Document	Direction
06/11/2002	Deed	Tract 546, 546a, donation (19.5 acres)
06/11/2002	Easement	Tract 546R, donation of (.30 acre) easement
09/03/2002	Deed	Tract 526c, purchased (89 acres) with LWCF funds
09/05/2002	Deed	Tract 525k, purchased (20 acres) with MBCF funds
09/30/2002	Deed	Tract 551, purchased (6.22 acres) with LWCF funds
12/19/2002	Deed	Tracts 584, 584a, purchased (5.07 acres) with LWCF funds
12/19/2002	Easement	Tracts 584R, 584M, donation (4 acres)
05/16/2003	Deed	Tract 525m, purchased (13.3 acres) with MBCF funds
08/15/2003	Deed	Tract 526a, purchased (21.09 acres) with LWCF funds
09/04/2003	Deed	Tract 548, purchased (80 acres) with LWCF funds
10/22/2004	Deed	Tract 514, purchased (10 acres) with LWCF funds
10/22/2004	Easement	Tract 514R, purchased easement (.16 acres) with LWCF funds
04/13/2005	Deed	Tract 525n, 525q, purchased (328 acres) with LWCF funds
10/04/2007	Deed	Tract 513c, purchased (34.50 acres) with LWCF funds
09/23/2009	Deed	Tract 541, purchased (19.77 acres) with LWCF funds
08/27/2010	Deed/Easement	Tract 571, 571R purchased (14.46 acres) with LWCF funds
08/18/2011	Deed	Tracts 567, 567a, 567b, 568, purchased (37.08 acres) with LWCF funds
08/18/2011	Easement	Tracts 567R, 568R, purchased easement (2.06 acres) with LWCF funds
11/03/2011	Deed	Tracts 544, 544a, purchased (19.65 acres) with LWCF funds
01/05/2012	Deed/Easement	Tracts 525r, 525R-2, purchased (65.83 acres) with LWCF funds
05/24/2012	Deed	Tract 523, purchased (38.68 acres) with LWCF funds
05/08/2015	Deed	Tracts 538c, 538d, purchased (16 acres) with LWCF funds

1.7 Relationship to Other Planning Efforts

When developing a CCP, we consider 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 to 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 Previous Refuge Plans

Grays Harbor National Wildlife Refuge

- Grays Harbor NWR Management and Development Plan (USFWS 1990)
- Wildland Fire Management Plan for Nisqually NWR Complex (USFWS 2003)
- Flight Safety Plan for Nisqually NWR Complex (USFWS 2016a)
- Safety Plan for Nisqually NWR Complex (Comprehensive) (USFWS 2012a)
- Draft Nisqually NWR Complex H5N1 Avian Influenza Disease Contingency Plan (USFWS 2007)

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

- Wildland Fire Management Plan for Nisqually NWR Complex (USFWS 2003)
- Flight Safety Plan for Nisqually NWR Complex (USFWS 2016a)
- Float Plan for Nisqually NWR Complex (USFWS 2016b)
- Safety Plan for Nisqually NWR Complex (Comprehensive) (USFWS 2012a)
- Draft Nisqually NWR Complex H5N1 Avian Influenza Disease Contingency Plan (USFWS 2007)

1.7.2 Future Planning

The CCP will be revised every 15 years or earlier if monitoring and evaluation determine that changes are needed to achieve the refuge purposes, vision, goals, or objectives. The CCP provides guidance in the form of goals, objectives, and strategies for refuge program areas but may lack some of the specifics needed for implementation. Step-down management plans will therefore be developed for individual program areas as needed, following completion of the CCP. Step-down plans may require additional NEPA compliance.

1.7.3 Migratory Bird Conservation and Plans

Birds of Management Concern (BMC)

BMC is a subset of all species protected by the MBTA (50 CFR 10.13) and includes those which pose special management challenges due to a variety of factors (e.g., too few, too many, conflicts with human interests, or societal demands) (USFWS 2012b). BMC comprises both game birds below their desired condition and nongame birds.

BMC species, subspecies, or populations are divided into four categories:

(a) birds listed as endangered or threatened under the ESA (USFWS 1973);
(b) nongame MBTA-protected birds that have been determined to be of conservation concern (as published in *Birds of Conservation Concern 2008;* 247 including all National, regional, and Bird Conservation Region species*)*;
(c) birds that are considered overabundant in part or all of their range and thus potentially damaging to natural ecosystems or human interests;
(d) high-priority migratory game birds, as determined by factors such as their population

status, their socio-economic value, and our ability to manage them based on sound information.

BMCs are also:

(a) protected by the MBTA (USFWS 1918);
(b) regularly found in the continental U.S., Hawaiian and U.S. Pacific Islands, Puerto Rico, or the U.S. Virgin Islands;
(c) regular breeders or winter residents in one of the above geographical areas;
(d) hunted species that are not currently hunted for sport under provisions established by the MBTA.

The Refuge and the Unit provide breeding, wintering, and stopover habitat for some birds identified as BMCs with primary importance in the region and includes those species that can usually be observed using Refuge and Unit habitats. Some of these species are greater white-fronted goose (Pacific population), cackling and Pacific populations of Canada goose, gadwall, American wigeon, mallard (western population), northern shoveler, northern pintail, American green-winged teal, greater and lesser scaup, surf scoter, double-crested cormorant, bald eagle, peregrine falcon, Virginia rail, red knot (roselaari), dunlin, short-billed dowitcher, Caspian tern, and rufous hummingbird. Uncommon or occasionally observed birds are dusky goose, Pacific black brant, common goldeneye, horned grebe, western grebe, pelagic cormorant, whimbrel, and marbled godwit (see Appendix E).

Focal Species of Birds

To better measure its success in achieving its bird conservation priorities and mandates, the Service's Migratory Bird Program initiated a focal species strategy for migratory birds (USFWS 2011, 2012c). The focal species strategy involves campaigns for selected species to provide explicit, strategic, and adaptive sets of conservation actions required to return the species to healthy and sustainable levels.

The goal of the focal species strategy is to measure the success in achieving bird conservation and to increase accountability. The Service remains committed to landscape-scale, integrated bird conservation for the full array of species of management concern. The focal species approach is just one component of the Migratory Bird Program and complements other work on migratory birds and their habitats.

To select focal species, the Service's Migratory Bird Program identifies species from the BMC that need investment because they (1) have high conservation need, (2) are representative of a broader group of species sharing the same or similar conservation needs, (3) act as a potential unifier for partnerships, or (4) have a high likelihood that factors affecting status can be realistically addressed.

Birds of Conservation Concern (BCC)

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the Service to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." The publication *Birds of Conservation Concern 2008* (BCC) is the most recent effort to carry out this mandate (USFWS 2008). BCC identifies the migratory and nonmigratory bird species, beyond those already designated as federally threatened or endangered, that represent the Service's highest conservation priorities. BCC species are a select group of birds appearing on the BMC list.

Grays Harbor Refuge

Eleven BCC species regularly occur at Grays Harbor Refuge: western grebe, bald eagle, northern harrier, peregrine falcon, whimbrel, red knot, dunlin, short-billed dowitcher, Caspian tern, rufous hummingbird, and willow flycatcher. Birds that occasionally are observed include dusky Canada goose, pelagic cormorant, lesser yellowlegs, long-billed curlew, and marbled godwit (see Appendix E).

Black River Unit

Four BCC species regularly occur on the Unit: mourning dove, rufous hummingbird, willow flycatcher, and purple finch. Birds that occasionally are seen or are thought to use Unit habitats include bald eagle, peregrine falcon, and solitary sandpiper.

Partners in Flight (PIF)

PIF is an international coalition of government agencies, conservation groups, academic institutions, private organizations, and citizens dedicated to the long-term maintenance of healthy populations of native landbirds. The goal of PIF's landbird conservation plans is to focus resources on improving inventory and monitoring, research, management, and education programs involving birds and their habitats. PIF's strategy is to stimulate cooperative public- and private-sector efforts in North America and the neotropics to meet these goals.

Grays Harbor Refuge

While most of the focus of the Refuge is on shorebirds and other water-associated birds, over 25 species of PIF-identified birds, including perching or landbirds, use Refuge habitats. These species generally use forest and salt or brackish marsh habitats.

Black River Unit

The Unit is important to perching birds and landbirds. The regional PIF plans applicable to the Unit include *The Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000) and *Conservation Strategy for Landbirds in Coniferous Forests of Western Oregon and Washington* (Altman and Alexander 2012). The lowlands and valleys plan identifies over 46 bird species and 2 priority habitats. Many forest conditions (seedlings to mature trees) identified in the coniferous forest plan are found within the Unit boundary. The 11 focal species of this plan include 4 species of warbler (orange-crowned, black-throated gray, Wilson's, and Townsend's), 3 species of flycatcher (olive-sided, Hammond's, and Pacific-slope), winter wren, varied thrush, brown creeper, and pileated woodpecker.

Northern Pacific Coast Regional Shorebird Management Plan (NPCRSMP)

This regional plan is part of the national U.S. Shorebird Conservation Plan, which is intended to provide an overview of the current status of shorebirds, the conservation challenges facing them, current opportunities for integrated conservation, broad goals for the conservation of shorebird species and subspecies, and specific programs necessary to meet the overall vision of restoring stable and self-sustaining populations of all shorebirds.

Grays Harbor Refuge

The NPCRSMP identifies the importance of Grays Harbor and the Refuge as a wintering area for shorebirds that breed in the arctic and temperate zones; it is also important during migration, particularly for arctic breeding species. There are also important breeding locations and breeding shorebird populations in the region. The plan includes several conservation priorities that are relevant to the Refuge because it provides approximately 497 acres of tidal mudflat habitat and 156 acres of estuarine salt marsh habitat in southwestern Washington. The plan's goals include restoring tidal flats and estuarine marshes to benefit shorebirds, enhancing tidal action in existing wetlands through the removal and maintenance of introduced cordgrass, managing a sufficient amount of shallow open water habitat to support shorebird populations, and limiting human disturbance to shorebirds in all seasons. The Refuge-specific recommendation is to reduce potentially deleterious silt that accumulates in marsh and mud flats.

Of the 20 species of highest concern for which coastal habitats in the Northern Pacific Coast Region are especially important, 10 species, including black-bellied plover, killdeer, greater yellowlegs, whimbrel, marbled godwit, red knot, sanderling, dunlin, short-billed dowitchers, and western sandpiper, are supported on this Refuge.

North American Waterbird Conservation Plan (NAWCP)

An independent partnership of individuals and organizations with a shared concern for waterbird conservation developed a plan to sustain or restore the distribution, diversity, and abundance of breeding, migratory, and nonbreeding waterbirds of North and Central America and the Caribbean regions (Kushlan et al. 2002). The primary goal of the partnership was to develop and facilitate implementation of the NAWCP. Completed in 2002, the NAWCP outlines a continental-scale strategy for conserving and managing over 200 aquatic bird species. The NAWCP identifies vulnerabilities and threats to species and their habitats. Habitat and site-based conservation actions throughout the Americas and the North Pacific are promoted by the NAWCP. Conservation priorities, information needs, resources, and infrastructure are identified at regional and local levels in a step-down process through regional working groups.

Grays Harbor Refuge

Waterbirds are those birds that depend on wetland conditions but do not include shorebirds or waterfowl. The Refuge provides habitat for over 15 of these species, including loon, grebe, pelican, heron; secretive birds such as sora, bittern, and rail; and gulls, terns, coots, and cranes.

Black River Unit

The Black River Unit is an important location for waterbirds; its extensive mosaic of wetlands provides habitats for approximately eight waterbird species, including pied-billed grebe, American coot, great blue and green heron, and secretive birds such as sora, bittern, and rail.

North American Waterfowl Management Plan (NAWMP)

This plan, first formulated in 1986, provides a strategy to protect North America's remaining wetlands and to conserve waterfowl populations through protecting, restoring, and enhancing habitat. The plan was updated in 2004 with an emphasis on strengthening the biological foundation, using a

landscape approach, and expanding partnerships (North American Waterfowl Management Plan Committee 2004).

Grays Harbor Refuge

The goals of the plan are to provide habitat for breeding and wintering waterfowl. The late fall season brings a large flush of waterfowl (ducks and geese) to the estuary, including the Refuge, as they begin to migrate from northern latitudes. Large numbers of many duck species stop, forage, and wait in the estuary for the seasonal rains to refill local land depressions with surface water. As more freshwater habitat becomes available with lowland flooding, many of the birds move out of the estuary to more wind-protected locations. Over 25 species of waterfowl are known to visit the Refuge.

Black River Unit

A small number of individual ducks or geese from approximately 11 species identified in the NAWMP have been observed using Black River habitat.

Pacific Flyway Management Plan (PFMP)

The Pacific Flyway Council is an administrative body that forges cooperation among public wildlife agencies for the purpose of protecting and conserving migratory game birds in western North America. The council is generally composed of one member from the public wildlife agency in each state and province in the western United States, Canada, and Mexico. Biologists from state, Federal, and provincial wildlife and land-management agencies, university students and faculty, and others develop management plans for the cooperative management of migratory game bird populations in the Pacific Flyway. Biologists from the Central Flyway, Canada, Mexico, and Russia contribute to these plans.

Grays Harbor Refuge

The PFMP addresses specific plans for many species of birds. Management plans for birds that regularly use Grays Harbor Refuge are for many subspecies of Canada geese, including cackling, dusky, Aleutian, lesser, Taverner's, and western geese, and double-crested cormorants. Management plans for birds that occasionally use the Refuge include greater white-fronted geese, black brant, and lesser snow geese.

Black River Unit

Management plans for birds that may use the Black River Unit include cackling geese and some subspecies of Canada geese, such as lesser, Taverner's, and western geese, as well as Pacific coast band-tailed pigeons and the western management unit population of mourning doves.

Seabird Conservation Plan (SCP)

The Pacific Coast supports some of the most diverse seabird populations in the United Sates, including 60 species that use the coastal waters around Grays Harbor. The Refuge's estuarine habitat supports the growth of potential food sources for these birds.

The purpose of the SCP is to identify priorities for managing seabirds, monitoring research, outreach, planning, and coordination with partners (USFWS 2005). The SCP provides guidance and recommendations for conservation actions for a prioritized group of species occurring at a regional scale.

Grays Harbor Refuge

Specific information on ecology, population, status, distribution, threats, and conservation needs is provided for species that may be found near Grays Harbor Refuge. The SCP addresses over seven species found on the Refuge, among them cormorants, gulls, and Caspian terns.

Although the Refuge does not manage seabird breeding habitats, many species of marine birds occur in the surrounding coastal waters.

1.7.4 State Plans

Washington Comprehensive Wildlife Conservation Strategy (CWCS)/Washington Wildlife Action Plan (WAP)

In response to two Federal programs—the Wildlife Conservation and Restoration Program and the State Wildlife Grant Program—the Washington Department of Fish and Wildlife (WDFW) prepared a number of important documents to help guide State resource management.

The driving force behind CWCS is the Washington Species of Greatest Conservation Need list. The list builds on current efforts to protect fish and wildlife species, including those listed on State and Federal endangered, threatened, and sensitive species lists, as well as species not yet listed but for which conservation actions or additional information is needed.

WAP is part of the CWCS (WDFW 2015). WAP includes information on the distribution and abundance of State priority wildlife and habitats, provides strategies for conserving and monitoring wildlife and habitat, and provides for coordination with Federal, State, Tribal, and local agencies, and the public. WAP emphasizes proactive measures to conserve declining species and habitats and to maintain the status of common species, and is helpful to Refuge staff in making biological and management decisions.

Washington Natural Heritage Plan (WNHP)

WNHP (WDNR 2011) is a product of the Washington Natural Heritage Program (in the Department of Natural Resources), whose mission is to conserve the full range of Washington's native plants, animals, and ecosystems through voluntary and cooperative actions. The program uses science to identify high-quality and representative examples of native Washington habitats and species and works to protect these natural treasures through voluntary and cooperative habitat conservation agreements.

Areas of critical environmental concern, wilderness areas, national monuments, and other public lands with management plans that adequately protect Washington's natural heritage include research natural areas (RNAs) as providing complete or partial protection for some ecosystems and species. For Refuges, the WNHP plan recommends that RNAs be established to protect natural areas of

exceptional value, particularly those areas that are unique and have no similar examples protected elsewhere.

Priority Habitats and Species (PHS)

WDFW has identified those fish and wildlife resources that are a priority for managing and conserving. Priority habitats are those habitat types with unique or significant value to many fish or wildlife species. Priority species are those fish and wildlife species requiring special efforts to ensure their perpetuation because of their low numbers, sensitivity to altered habitat, tendency to form vulnerable aggregations, or because they are of commercial, recreational, or tribal importance. Descriptions of those habitats and species designated as priority were published as individual documents on habitats, birds (WDFW 2004), fish, invertebrates (WDFW 1995), amphibians and reptiles (WDFW 1997), and mammals (draft), and as a summary report (WDFW 2008), and the online Priority Habitats and Species (PHS) Lists (continually updated).

1.7.5 Other Natural Resource Plans or Guidance Documents

Chehalis River Basin Action Plan (CRBAP)

The purpose and mission of the action plan is to, "Develop a dynamic plan that will improve surface water and ground water quality in the Chehalis River Basin, including the Chehalis River, Grays Harbor, and their tributaries, by reducing nonpoint source pollution in accordance with Federal, State and local guidelines. The CRBAP will foster opportunities for organizations and individuals to work together to prevent future pollution of the waters of the Chehalis River Basin. While achieving water quality goals, we recognize the need to maintain the viability of existing industries. All goals are of equal importance." This action plan also includes information on Chehalis tributaries, including the Black River (Chehalis River Council 1992).

Chehalis Basin Watershed Management Plan (CBWMP)

The plan is adapted from the CRBAP (Chehalis River Council 1992) with additional information incorporated from the Chehalis Basin Level 1 Assessment. It outlines the status and needs to restore and conserve the waters of the Chehalis Basin, which Grays Harbor and Grays Harbor Refuge depend upon (Chehalis Basin Partnership 2004).

Grays Harbor Estuary Management Plan (GHEMP)

The GHEMP is a long-range, coordinated, comprehensive plan to guide land and water use activities in the greater Grays Harbor estuary. It is an older, comprehensive guiding document that was and is being implemented through individual local shoreline master programs, ordinances, State and Federal regulations, and permits (Grays Harbor Estuary Management Task Force 1989).

Washington State Coastal Zone Management Section 309 Assessment and Strategy, 2011–2015

The Washington State Coastal Zone Management Plan (CZMP), approved in 1976, applies to 15 coastal counties, including Grays Harbor (NOAA 1987). The CZMP is authorized to fund specific improvements along the coast (WDOE 2010).

Grays Harbor Geographic Response Plan (GRP)

This Department of Ecology (WDOE 2013) plan was written as guidance to prioritize resources to be protected in the event of an emergency contaminant spill and allows for immediate and proper action by early responders and coordinators.

The Pacific Northwest Coast Ecoregional Assessment

This report (Vanderschaaf 2006) addresses the most important places for conserving native species and ecosystems in the Pacific Northwest. Using this assessment, TNC selected target species and communities that represented various habitat types. This assessment is a guide for providing the most conservation benefit for the lowest cost.

Wetlands in Washington State, Volume 1 and Volume 2

Volume 1 is a synthesis of science, reviewing the components of freshwater wetlands and the effects of changes on the wetlands. Volume 2 provides guidance on managing and protecting wetlands. Both volumes are from Department of Ecology and they provide guidance in understanding the wetland ecology of the Black River Unit and Grays Harbor Refuge (Granger et al. 2005, Sheldon et al. 2005).

Black River Conservation Area Plan

This TNC plan pulls together information regarding the Black River Watershed, its history, uses, special habitats, threats, and needs from the headwaters to the confluence with the Chehalis River. The purpose of the Black River Conservation Area Plan (TNC 2005) is to highlight the uniqueness of the Black River in the Puget Trough, to identify the species and communities within the watershed that are representative of the ecological region, and to emphasize the need to protect, restore, and link the diverse habitats found in the Black River watershed— habitats upon which the biodiversity and ecological functioning of this Puget Trough landscape are dependent.

1.8 Special Designation Lands

1.8.1 Western Hemisphere Shorebird Reserve Network Site of Hemispheric Significance

In 1996, the greater Grays Harbor estuary (including Grays Harbor Refuge) was designated as a Western Hemisphere Shorebird Reserve Network (WHSRN) Site of Hemispheric Significance in the Pacific Flyway. The relatively undisturbed estuary habitats were identified as subtidal (open water), intertidal (mudflat), rocky shore (harbor mouth) intertidal emergent (salt marsh), intertidal emergent (scrub/shrub), palustrine forested (forested wetland/willow), palustrine emergent, and palustrine emergent spoil (fill). To receive WHSRN designation, the site must support over 500,000 shorebirds during a year (WHSRN 2009). Counts from various sources report that an estimated 300,000+ shorebirds were observed during an aerial survey of Grays Harbor in April 1993; during that same time, ground counts on Bowerman Basin (which became Grays Harbor Refuge) on April 26 and 27, 1993, indicated about 150,000 and 125,000 shorebirds, respectively. The greater estuary and the Refuge provide spring and fall stopover habitat where shorebirds can forage on abundant invertebrates and rest during migration. The site also provides habitat and food for wintering

shorebirds. Most of the shorebirds identified in the NPCRSMP as having primary importance within the region use the greater Grays Harbor estuary as well as the Refuge.

1.8.2 Important Bird Areas (IBA)

There are two Important Bird Area (IBA) programs. The American Bird Conservancy's (ABC) IBA program concentrates on a global effort to identify the most important areas for maintaining bird populations and focus conservation efforts on protecting those sites. The National Audubon Society's (NAS) IBA program focuses on working within each state to identify a network of sites that provide critical habitat for birds. Both programs recognize that habitat loss and fragmentation are the most serious threats to birds across North America and around the world and they have become components of many bird conservation efforts.

Grays Harbor Refuge was designated by an IBA by Washington Audubon, the state office of the NAS (Cullinan 2001). Recently 10 coastal IBAs, including Grays Harbor and Willapa Bay, were combined into one regional IBA called Washington Coastal Estuaries IBA (Bayard, T. 2013, pers. comm.).

1.9 Planning Process and Issue Identification

1.9.1 Planning Process

The CCP planning process for Grays Harbor Refuge and the Black River Unit began in 2010. A core team and an expanded team were formed to develop the CCP. The core planning team consists of the project leader, deputy project leader, visitor services manager, wildlife biologist, and conservation planner. The extended team consists of biologists from the Service, WDFW, and WDNR. The extended team assisted in the development of this draft CCP, particularly in providing comments and information at milestones in the planning process. A full list of the plan contributors and their roles is provided in Appendix I.

Early in the planning process, we developed a list of preliminary issues, concerns, and opportunities for the CCP. These planning issues were initially presented to the public in Planning Update 1 in May 2011 and at two local public scoping meetings on May 18 and 19, 2011. A Notice of Intent to prepare a CCP and associated NEPA document was published in the Federal Register on June 8, 2011 (76 FR 33339).

Public outreach continued with the distribution of three planning updates to our mailing list and meetings with stakeholder groups. The comments and suggestions made through this process helped further develop and refine the issues and management alternatives for the CCP, including the preferred alternative. This draft CCP will result in additional comments, which will be evaluated by the planning team. Additional detailed information on public involvement can be found in Appendix J.

1.9.2 Key Issues Addressed in the CCP

The CCP planning team evaluated the issues and concerns raised both by staff and the public during public scoping, as well as throughout the multi-year planning process. 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 address in the CCP, pinpoint the types of information to gather, and help define alternatives for the CCP. Although CCPs are comprehensive plans, no single plan can cover all issues. It is the Service's responsibility to focus planning and the analysis 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 on the resource. Major issues influence the alternatives proposed in the draft CCP. Key issues, concerns, and opportunities analyzed in the draft CCP are presented below (also see Appendix J).

Grays Harbor Refuge

- *Habitat Management and Restoration.* What actions are needed to sustain and restore priority species and habitats over the next 15 years? How is sedimentation impacting shorebird habitat quality? What will the effects of climate change and sea level rise have on Refuge habitats and species?

- *Invasive Species Control.* Invasive plant species degrade habitat quality for shorebirds, migratory birds, fish, and wildlife. Invasive animals may compete with native fish and wildlife for limited resources. How can we reduce the incidence and spread of invasive species?

- *Visitor Services and Education Opportunities.* Wildlife observation, photography, interpretation, and environmental education are provided at Grays Harbor Refuge. How can we improve these services and programs? What visitor services facilities are needed or planned? What volunteer programs and partnerships can be developed or strengthened to improve outreach and education? What can be done to reduce trespassing, vandalism, and other illegal activities and improve wildlife and habitat protection? Are there opportunities to provide hunting and/or fishing at Grays Harbor Refuge?

- *Contaminants***.** What can be done to address potential sources and impacts of contaminants on and around the Refuge?

Black River Unit

- *Land and Water Protection.* What actions are needed to sustain and restore priority species and habitats over the next 15 years? How can we improve habitat protection and connectivity and reduce habitat fragmentation? How can we improve water quality and quantity in the Black River system for fish and wildlife?

- *Habitat Management and Restoration.* Most habitats have been altered by human actions and are in need of management and restoration to increase value as fish and wildlife habitat. What actions will help provide important information on key species, habitat composition, and the management prescription needed for the Black River Unit? What will the effects of climate change and sea level rise have on Unit habitats and species? How can we enhance Oregon spotted frog recovery?

- *Invasive Species Control.* Invasive plant species degrade habitat quality for migratory birds, fish, amphibians, and many other forms of fish and wildlife. Nonnative animals may compete

with native fish and wildlife for limited resources. How can we reduce the incidence and spread of invasive species?

- *Visitor Services and Education Opportunities.* The Black River Unit has remained largely closed because of the fragmented nature of current land ownership. How can we reduce trespassing, vandalism, and other illegal activities and improve wildlife habitat and protection? What wildlife-dependent priority public uses should be considered at the Black River Unit, where should they be allowed, and how should they be conducted? What opportunities are there for improving access to Black River, boat launching, and parking on the Unit? How can partnerships and volunteers be developed to support visitor service programs?

- *Conservation Partnership*. How can the Service develop a coordinated approach with other groups and agencies to plan and manage for the protection, restoration, and interpretation of lands and waters within the Black River corridor?

1.10 Refuge Visions and Goals

1.10.1 Grays Harbor National Wildlife Refuge Vision

The Refuge is recognized internationally for its significance to shorebirds as part of the Grays Harbor Western Hemisphere Shorebird Reserve Network. Each year, shorebirds make a seemingly impossible journey along the Pacific coast, traveling thousands of miles southward in the fall to reach their wintering areas as distant as South America. The following spring they return to their nesting grounds in Alaska and Canada.

To achieve this feat, thousands of shorebirds require key rest areas. Grays Harbor National Wildlife Refuge plays an important role in this respect: twice a day the tides recede, providing a vast expanse of mudflat habitat where migrating birds forage and rest during their long journey. This spectacular natural phenomenon provides visitors and students alike an opportunity to observe, photograph, and learn about these shorebirds and other local wildlife in their native habitats.

The Refuge works in partnership with others to protect and enhance the biological integrity and natural functions of the estuary for migratory birds and other native fish and wildlife, using adaptive management to respond to changing environmental and climatic conditions. Located in a gateway community of the Olympic Peninsula, the Refuge provides opportunities for adults and children to enjoy the outdoors, observe wildlife, and foster a lifelong connection with nature.

1.10.2 Grays Harbor National Wildlife Refuge Goals

1) Protect, maintain, and restore estuarine habitats representative of the Grays Harbor ecosystem for the benefit of shorebirds, other migratory birds, fish, and a diverse assemblage of other native species.

2) Protect and maintain upland habitat representative of the Grays Harbor ecosystem for the benefit of migratory passerines and other wildlife.

3) Contribute to the protection and long-term environmental health of the Refuge and greater Grays Harbor estuary and ecosystem.

4) Collect scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.

5) Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance visitors' understanding and appreciation of the Refuge's natural resources and to foster a connection with nature.

6) Provide environmental education opportunities that initiate a sense of wonder and foster a connection with nature and the Refuge for students both on and off the Refuge.

7) Support and strengthen an active volunteer work force and Friends Groups to assist in providing quality visitor services programs and outreach.

1.10.3 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge Vision

The waters of the Black River flow almost imperceptibly from Black Lake south to the Chehalis River. Meandering through a complex mosaic of wetlands, riparian forest, shrub swamp, and bogs, this area is considered the most intact low-lying river system remaining in western Washington. The Unit protects some of the most expansive and remote wetlands, sustaining a truly wild place.

The Unit provides a diverse community of fish and wildlife, large populations of once rare species such as the Oregon spotted frog, salmon, and unique bog, plants, and animals now flourish in the healthy wetland habitats.

Unit visitors will explore the quiet waterway, paddling canoes through the narrow river channel to fish and observe wildlife. Exploration of the native habitats offers opportunities to catch a glimpse of secretive wading birds, river otter, beaver, Roosevelt elk, and other wildlife, providing visitors with a sense of stewardship for the Unit.

Together, community members and partners, in concert with the Unit, protect and enhance the Black River, promoting biodiversity and natural ecological functions to benefit native fish, wildlife, and plant communities in wetland and upland habitats.

The Unit continues to build strong partnerships to protect and maintain the solitude, wild character, and health of the Black River so future generations can experience being a part of this very special place.

1.10.4 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge Goals

1) Protect, maintain, and enhance aquatic habitats characteristic of the upper Black River Watershed while maintaining historical characteristics of the north Puget Trough Lowlands for the benefit of native fish, amphibians, migratory birds, and a diverse assemblage of other native species.

2) Protect and maintain upland habitats characteristic of the upper Black River watershed.

3) Contribute to the protection and long-term environmental health of the greater Black River watershed and ecosystem.

4) Gather scientific information (inventories, monitoring, and research) to support adaptive management decisions.

5) Provide quality opportunities for visitors to experience a diversity of wildlife and habitats to enhance their understanding and appreciation of the Unit's natural resources and to foster a connection with nature.

6) Support and develop an active volunteer program and partnerships to assist in providing quality visitor services programs and outreach.

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Chapter 2 Management Alternatives

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Chapter 2. Management Alternatives

2.1 Alternatives Development

During development of the alternatives for this long-term conservation plan, the Service reviewed and considered a variety of resource, social, economic, and organizational aspects important for managing both Grays Harbor National Wildlife Refuge and the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge. As is appropriate for national wildlife refuges, resource considerations were fundamental in designing alternatives. House Report 105-106 accompanying the National Wildlife Refuge System Improvement Act of 1997 states "…the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first."

The CCP planning team reviewed scientific reports and studies to understand ecosystem trends and the latest scientific recommendations for species and habitats found at the Refuge and the Unit. The Service reached out to staff from Federal, State, and local agencies, Tribes, and elected officials to ascertain priorities and issues. Service staff met or communicated with Refuge and Unit users, representatives of nonprofit groups, and community organizations to ensure that their comments and ideas were considered during CCP development. Further details of public involvement and participation are found in Appendix J.

2.2 Alternatives Considered but Eliminated from Detailed Study

During development of the alternatives, the planning team considered the actions described below for Grays Harbor Refuge and the Black River Unit. These actions were ultimately eliminated from further consideration for the reasons provided.

2.2.1 Grays Harbor National Wildlife Refuge

Waterfowl Hunting: During the public scoping period, the Service received comments requesting opportunities to hunt waterfowl on the Refuge (see Appendix J). Waterfowl hunting is a wildlife-dependent, priority public use, which receives special consideration in planning (see Chapter 1.5.4).

By law, the Service is not to allow activities that would detract from the Refuge's purposes. After careful consideration, the planning team determined that due to the small size of the Refuge and conflicts with other uses and Refuge management focus, waterfowl hunting could not be supported as a priority public use. In particular, it was determined that the hunting activity would result in unacceptable impacts to migratory birds. These impacts would likely include disturbance and displacement of shorebirds and other migratory birds during the winter months when waterfowl hunting occurs. The Refuge is too small to allow the establishment of wildlife sanctuary areas in key habitats that would be separate from hunting areas. Allowing hunting on the Refuge would diminish the wildlife values of the mudflats and open water habitats during critical migration and wintering periods when birds rely upon undisturbed habitat for feeding and resting. In addition, existing high-quality wildlife observation, wildlife photography, and education programs would be negatively affected due to the small size of the Refuge and proximity of Refuge trails. Waterfowl hunting was considered but not implemented for similar reasons during the development of the Management and Development Plan for Grays Harbor NWR (USFWS 1990).

Boating: The planning team considered boating on the Refuge and determined that boating is not an appropriate use due to the Refuge's overall size and the potential for disturbance to migratory birds using the mudflat and open water habitats. Feasible areas for boating are already very limited on the Refuge due to shallow water conditions and extreme tidal fluctuations. The Refuge makes up less than 2 percent of the overall Grays Harbor estuary, and many boating opportunities already exist in areas more conducive to safe boating. Because of the small size of potential boating areas, a single boat could flush much of the migratory birds using open waters. In addition, boating would conflict with wildlife observation, wildlife photography, and education activities by disturbing wildlife in the limited viewing areas that are available to trail users. Therefore, the current closure to boating on the Refuge will be maintained. Boating was considered but not implemented for similar reasons during the development of the Management and Development Plan for Grays Harbor NWR (USFWS 1990).

Fishing: The planning team considered fishing within the Refuge boundary. Habitat within the Refuge is marginal for fishing opportunities due to the shallow waters and extreme tidal fluctuations. Similar to boating, it was determined that the activity would cause too much disturbance to migratory birds using the limited waters of the Refuge. Fishing would also negatively affect those participating in wildlife observation, photography, and education activities on Refuge trails. Fishing was not implemented for similar reasons during the development of the Management and Development Plan for Grays Harbor NWR (USFWS 1990).

2.2.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Waterfowl Hunting: Waterfowl hunting under state regulations occurs within the Black River channel. During the public scoping period, the Service received comments requesting opportunities to hunt waterfowl within the Black River Unit (see Appendix J).

When considering wildlife-dependent public uses on any refuge or refuge unit, we must determine if we can provide high-quality experiences that are compatible with the purposes of that refuge or unit. The term "quality" is identified as a baseline attribute for any wildlife-dependent, priority public use activity being considered. Considerations for quality waterfowl hunting on the Black River Unit included: 1) hunter safety; 2) hunter ethical behavior; 3) uncrowded conditions; 4) reasonable harvest opportunities; 5) a clear understanding about which areas are open and closed to hunting; and 6) minimal conflict between hunters and other visitors. Distance and access to the site also would have to be feasible in a reasonable timeframe. In addition, local landowners live along the river shoreline in some locations, and the need to avoid conflict and maintain a safety buffer was an important factor. Rare or listed species and their associated habitats were also considered regarding potential waterfowl hunting on Unit lands.

The planning team carefully considered the feasibility of waterfowl hunting on Unit lands that met these quality parameters. Both walk-in and boat-in hunting on Unit lands along the river bank were considered but not further developed because of the difficulty in accessing the bank due to dense vegetation, the difficulty in maintaining access to the bank, and the presence of the federally threatened Oregon spotted frog.

North of 110th Avenue, the river channel is extremely narrow, averaging 10 to 25 feet wide depending on location. Most of the narrow river channel is bounded on both sides by tall, impenetrable vegetation lining the river banks, including dense shrub scrub. These conditions make it extremely difficult-to-impossible to ensure that birds would drop in the river rather than become lost in the dense vegetation after being shot. The vegetation is too impenetrable even for dogs in most

places, which would result in the loss of many downed birds. A waterfowl hunting program under these conditions would result in the waste of natural resources (50 CFR 20.25), violate the Migratory Bird Treaty Act, and not provide a quality hunting experience on Unit lands. Other considerations include safety issues and the potential for user conflicts with boaters, including kayakers and canoeists.

Waterfowl hunting in Unit lowlands and wetlands from the southern boundary of the Unit to 110th Avenue was considered and not further developed because the river corridor is within critical habitat for the federally threatened Oregon spotted frog and harbors one of the core populations within western Washington. Additionally, local landowners live along the river shoreline in some locations and this was an important consideration to avoid conflicts and maintain a safety buffer. Because of all of these considerations, it was determined that a safe and quality waterfowl hunting program is not feasible under current conditions and this activity was not selected for further analysis.

The planning team has noted the possibility of future Unit acquisitions within the Black River area, where more suitable lands which could support a waterfowl hunting program could potentially be acquired. Unit-based waterfowl hunting would be reconsidered, and a separate planning and compliance effort could follow such future acquisitions.

Fishing: Fishing under state regulations occurs within the Black River channel. During the public scoping period, the Service received comments requesting opportunities to fish from Unit lands within the Black River, including the river bank (see Appendix J).

Fishing is a wildlife-dependent public use and therefore receives special consideration in planning (see Chapter 1.5.4). When considering fishing opportunities on any refuge or refuge unit, programs are designed to provide high-quality experiences that are compatible with the purposes of that refuge or unit. In this CCP process, fishing on Unit lands within the Black River was considered but not further developed because these parameters would not be met due to the difficulty in accessing the bank because of its dense vegetation, the difficulty in maintaining access to the bank, and the presence of the federally threatened Oregon spotted frog.

Within the Unit, the bank and adjacent areas are occupied by dense stands of shrubs or are dominated by emergent wetlands making foot access to the river extremely difficult. Successfully casting from within the shrubs would be difficult. Traveling through and fishing from the shrubs or wetlands would increase the potential for wildlife disturbance. Additionally, boat landing on the river bank for fishing would involve dragging boats in and out of the water and could cause erosion and turbidity. Fishing for crayfish usually involves use of traps, which have the potential to also catch federally threatened Oregon spotted frogs or possibly Olympic mudminnows, a State-sensitive species. For these several reasons, fishing for shellfish, fishing from the banks or in the tributaries of Black River, and fishing near the boat launch site were considered but not further developed in the CCP.

Boat Launch at 110th Avenue: Boat launch sites are an important component to providing safe, feasible public access on the Black River. The planning team examined the WDNR-owned boat launch site and the surrounding Unit lands on 110th Avenue. The planning team contacted WDNR and discussed various issues regarding the upgrade of the former boat launch and parking area. WDNR no longer maintains a boat launch at this site due to infrastructure problems with flooding, costs, and the difficulty in maintaining a launch site there. Issues include extreme flood events that regularly wash out any structures or docks; the soft substrate that requires constant gravel and fill to maintain a small, existing parking and access area; safety; security due to vandalism and theft; and feasibility and costs to maintain safe facilities and access. This site was physically limited in terms of

road clearance, parking space, boat launch size, and safety. Parking or public access on Unit lands adjacent to 110th Avenue is not feasible. These areas are more distant from the river and separated from the river channel by heavy brush and shallow wetlands. It was determined the site at 123rd Avenue offered the best opportunity to provide a high-quality, safe, and accessible parking and boat launch site in partnership with Thurston County (see Objective 5.2).

2.3 Alternative Descriptions

2.3.1 Features Common to All Alternatives

Under the National Wildlife Refuge System, Grays Harbor Refuge and the Black River Unit are managed to conserve native fish, wildlife, plants, and their habitats, and to provide opportunities for compatible, wildlife-dependent public uses. All alternatives contain some common features. The Refuge and the Unit would continue to conduct core management programs and follow policies regardless of which CCP alternative is selected for implementation. To reduce the length and redundancy of the individual alternative descriptions, following are brief descriptions of the principles and programs that are common to all alternatives evaluated in this CCP.

Implementation subject to staffing and funding availability: As funding becomes available, actions described in the CCP would be implemented at the Refuge and the Unit over a period of 15 years. Draft project priorities and projected staffing and funding needs are included in Appendix C, although special funding initiatives, unforeseen management issues, and other budget issues would likely require adjustments to the implementation schedule in the future. The Refuge and the Unit would continue to work with partners to implement the CCP by sharing science, providing updates on successes and challenges, initiating discussions, encouraging participation, and hosting working groups. The CCP will be reviewed at least every 5 years and updated as necessary.

Appropriateness and compatibility: Consistent with relevant laws, regulations, and policies, prior to allowing any public use of the Refuge or the Unit, including commercial use, each such use will first need to be found appropriate and determined compatible (16 U.S.C. 668dd-668ee, 50 C.F.R. 25, 26, and 29; and 603 FW 1 and 2). Appropriateness and compatibility are further discussed in Appendices A and B.

Adaptive management: Based on 522 Departmental Manual (DM) 1 (Adaptive Management Implementation), Refuge and Unit staff shall utilize adaptive management for conserving, protecting, and, where appropriate, restoring lands and resources. Within Title 43 of the Code of Federal Regulations (CFR) 46.30, adaptive management is defined as a system of management practices based upon clearly identified outcomes, where monitoring evaluates whether management actions are achieving desired results (objectives). Adaptive management is based on the recognition that ecosystem function is inherently complex and often results in data gaps. Adaptive management emphasizes learning while doing based upon available scientific information and best professional judgment, considering site-specific biotic and abiotic factors on refuge lands and waters. In the presence of accelerated climate change, adaptive management is an increasingly important management decision process. The Refuge and the Unit will employ adaptive management as a standard operating procedure under all alternatives. Part of measuring the success of and adaptively managing the Refuge and the Unit includes 5-year reviews and a 15-year revision of the CCP, which will be initiated by the Service and involve many of the same steps and engagement with partners and the public as the original CCP.

Biological integrity, diversity, and environmental health: The Administration Act directs the Service to "ensure that the biological integrity, diversity, and environmental health of the [NWRS] are maintained for the benefit of present and future generations of Americans . . . ." The policy is an additional directive for the Service to follow while achieving refuge purposes and the Refuge System mission. It provides for the consideration and protection of the broad spectrum of native fish, wildlife, and habitat resources found on the Refuge and the Unit. When evaluating the appropriate management direction for the Refuge and the Unit (e.g., in compatibility determinations), the Service will use sound professional judgment to determine the Refuge's and the Unit's contributions to BIDEH at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of Refuge or Unit resources, an understanding of a Refuge's or Unit's role within the 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."

Climate change: As stated in DOI's Secretarial Order 3226 and the Service's Climate Change Strategic Plan, the Service considers and analyzes climate change in its decisions, long-range plans, and other activities. Refuge habitats and wildlife populations are directly and indirectly sensitive to changing climatic conditions, especially temperature and precipitation, and the resultant effects on physical environments (e.g., hydrology, sea levels, ocean chemistry).

The combined changes can affect a refuge's habitats and species directly (e.g., sea level rise, timing of migratory bird arrival, changes to plant flowering phenology, changes in species' ranges and physiology), and indirectly (e.g., added vulnerability to other stressors including increasing invasive species and pathogens). Predicting biological response at the population level, however, requires complex, sophisticated data collection and modeling that must be validated with field studies over time. This highlights the importance of monitoring habitat and species to establish potential correlations and adaptation options.

Knowledge and monitoring of regional and local climate trends on Refuge and Unit resources will be used to assess potential changes or enhancements to management actions and techniques and their timing, using the adaptive management approach described above.

The Refuge and the Unit will participate in and contribute to climate change assessment efforts, including those underway at a landscape scale. Participation in the North Pacific Landscape Conservation Cooperative (LCC) will provide Refuge and Unit staff with a means to tie-in with a larger-scale assessment of the impacts of climate change. LCCs are formal, integrated, science-management partnerships between the Service, Federal agencies, states, Tribes, NGOs, universities, and other entities to address climate change and other biological stressors. LCCs provide science support, biological planning, conservation design, research, and design of inventory and monitoring programs. As guided by future empirical or projected climate impacts, relevant management objectives and strategies will be adjusted to assist in enhancing the Refuge's and Unit's resources' resiliency to climate change.

Reduce the Refuge's and Unit's carbon footprints: The Service has developed a strategic plan for responding to accelerating climate change (USFWS 2010) and an action plan that outlines 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 and the Unit will work toward this goal by replacing their current vehicles with more fuel-efficient vehicles and by building appropriately sized, energy-efficient facilities, as funding becomes available. The Refuge and the Unit will reduce the carbon

footprint of land management activities by using energy-efficient techniques, where feasible and in line with management goals. The Refuge and Unit will also explore ways of offsetting any remaining carbon balances, such as carbon sequestration.

Complete land acquisition within the current approved boundaries: Based on the availability of funds, the Service will continue to negotiate with willing sellers to acquire lands within the existing approved Refuge and Unit boundaries, through fee title acquisition, easement, or other land conservation tools.

Landscape-scale conservation: The Refuge System's strategic vision document, *Conserving the Future: Wildlife Refuges and the Next Generation,* emphasized the importance of using a "scientific, adaptive, landscape-level approach to conserving, managing, and restoring refuge lands and waters, and facilitate conservation benefits beyond our boundaries" (USFWS 2011). Following from this vision, the Service's strategic growth policy (602 FW 5) described a landscape planning process termed landscape conservation design (LCD) where a partnership, including the Service, along with other local, State, and Federal government agencies, tribal governments, and other interested parties would identify priority conservation species; develop measureable conservation targets; assess current and projected landscape patterns, processes, and stressors; depict spatially-explicit desired future conditions; and produce a suite of management strategies for achieving those conditions on a landscape scale.

In fall 2015, the North Pacific LCC launched an LCD project within the lower Columbia River basin and adjacent outer coasts of Oregon and Washington, including Grays Harbor Refuge. The Black River Unit would be included within the scope of a separate, future landscape planning process. Under all alternatives, the Service will participate in landscape planning processes for both the Refuge and the Unit. Outcomes from the landscape planning processes will identify the Service's role in conservation efforts within the ecoregion and inform potential strategic growth, land protection, and management decisions for the Refuge and Unit. As landscape-scale planning is a non-regulatory process, additional evaluation, planning, and compliance will need to occur prior to any implementation of strategies identified through any landscape planning process.

State, local, and interagency coordination: Under all alternatives, the Service will continue to maintain regular discussions with Washington Department of Fish and Wildlife (WDFW) and the Department of Natural Resources (WDNR), among other agencies and entities. Topics for discussion include implementing CCP projects, threatened and endangered species, landscape-scale planning, land protection planning, managing wildlife, and recreational activities and access.

Tribal coordination: The Service will coordinate and consult with Tribes on a government-to-government basis regarding issues of shared interest. The Service seeks assistance from Tribes on issues related to cultural resources, education and interpretation, natural resource programs, and the National Historic Preservation Act (NHPA).

Invasive species control: Because invasive plants and animals pose threats to all Refuge and Unit wildlife and habitat, control of invasive species will be a high priority management activity in all alternatives. Species that limit the Refuge's and the Unit's abilities to provide high-quality habitat for refuge purposes and trust species will be controlled to the degree that funding and staffing permit. The magnitude of invasive species problems at the Refuge and the Unit 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 invasive species that are pervasive on Refuge and Unit lands are the subject of long-term control efforts and will continue to be a high priority for

Refuge and Unit resources. The Early Detection Rapid Response model will be used to 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. The Service will embark on a systematic effort to eradicate, contain, or control newly discovered invasive species and isolated infestations of a previously established, nonnative species, while the infestation is still localized. Invasive species control will be initiated prior to or concurrently with any habitat restoration efforts. Regardless of whether the invasive species is well established or newly introduced, it will be essential that the Refuge and the Unit 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. The Integrated Pest Management Plan is included in this CCP (See Appendix G).

Integrated pest management: In accordance with DOI and Service policies 517 DM 1 and 569 FW 1, an integrated pest management (IPM) approach will be used, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on Refuge and Unit lands. IPM uses methods based upon effectiveness and cost, with minimal ecological impacts to nontarget species and the Refuge or Unit 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 or Unit lands, the most specific (selective) chemical available for the target species will be used unless considerations of persistence or other environmental or biotic hazards would preclude it. However, pesticides with substantial effects to species or the environment may be used in order to protect human health and safety. In accordance with 517 DM 1, pesticide usage will be further restricted because only pesticides registered with the U.S. Environmental Protection Agency (EPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act and as provided in regulations, orders, or permits issued by EPA may be applied on lands and waters under Refuge and Unit jurisdiction. Appendix G provides detailed documentation of the IPM program and its potential implementation and evaluation.

Mosquito control: Mosquito populations on Refuge and Unit lands will be allowed to fluctuate and function unimpeded unless they jeopardize wildlife or human health and safety. We recognize mosquitoes are native invertebrates inhabiting aquatic habitats, which provide a forage base for fish and wildlife, including migratory birds. To protect human and wildlife health and safety, mosquito monitoring will be allowed under a Special Use Permit (SUP) by the State or a local vector control agency as needed. Pesticide treatments (larvicides, pupacides, or adulticides) are not currently conducted but will be considered on Refuge or Unit lands only if local, current population monitoring or disease surveillance data indicate Refuge- or Unit-based mosquitoes jeopardize wildlife or human health and safety. Mosquito treatments will only be allowed following completion of a compatibility determination, disease contingency plan, and in accordance with IPM principles applicable to all pests (unless there is a mosquito-borne, health-related emergency). Proposed pesticide uses for mosquito control will utilize appropriate and practical best management practices, where possible, given potential effects documented in Chemical Profiles (see Appendix G).

Regulatory compliance: This draft CCP/EA provides descriptions of the affected environments and resources, potential environmental consequences of certain types of activities, and general themes for management alternatives. Consequently, this draft CCP/EA can be incorporated by reference into future proposals to avoid lengthy recital and repetitive information. However, since this draft CCP/EA is programmatic in many areas, it may not contain the necessary detail on every future action outlined to adequately present and evaluate all physical, biological, and socioeconomic impacts. Some of these details are dependent on funding and implementation schedules. Therefore,

prior to implementation, all 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 appropriate evaluations and documentation under NEPA, evaluation and consultation required by Section 7 of ESA, and review and consultation required by Section 106 of the National Historic Preservation Act (NHPA). Approved Section 7 consultation processes will be followed for areas potentially affecting listed species or designated critical habitat on a site-specific basis as project implementation occurs. Any new ground-disturbing projects will undergo a review under Section 106 of NHPA.

Participation in planning and review of regional development activities: The Service will actively participate in planning and studies pertaining to future industrial and urban development, transportation, recreation, contamination, and other potential concerns that may affect the Refuge's or the Unit's resources. The Service will continue to cultivate working relationships with county, State, and Federal agencies to stay abreast of current and potential developments. The Refuge and the Unit will utilize outreach and education as needed to raise awareness of their resources and dependence on the local environment.

Refuge revenue sharing: Annual payments to local county governments under the Refuge Revenue Sharing Act (16 U.S.C. 715s) will continue according to the established formula and are subject to congressional appropriations. Total payments made to local counties are listed in Chapter 5 and in Appendix C: Implementation.

Volunteer opportunities: Volunteer opportunities are key components of the successful management of public lands, and are vital to Refuge and Unit programs, plans, and projects, especially in times of static or declining budgets. Currently the Nisqually National Wildlife Refuge Complex, which includes Grays Harbor Refuge and the Black River Unit, makes extensive use of volunteers in invasive species control, habitat restoration, education, and visitor services programs. In the future, successful implementation of native habitat restoration, survey and monitoring activities, and environmental education and interpretation programs will require the use of partnerships and volunteers. The volunteer program will be managed through the Refuge Complex headquarters volunteer program.

Partnerships: Partnerships on the Refuge and Unit are critical components in maintaining and continuing efforts to enhance recreation opportunities or implement resource management improvements, such as restoring habitat for threatened and endangered species. These partnerships typically involve joining forces with Federal, State, and local agencies, Tribes, organizations, and businesses.

Transportation coordination: Roads, bridges, parking areas, and trail systems play a vital role in providing access to the public for compatible, wildlife-dependent recreation opportunities. Under all alternatives, the Service will look for opportunities to collaborate with the Washington Department of Transportation, Department of Public Works, and the local communities to maintain and improve safe and appropriate transportation access between gateway cities and the Refuge and the Unit.

Inventory and monitoring**:** Inventory and monitoring (I&M) policy (701 FW 2) requires refuges to prepare I&M plans. Refuge I&M plans have two sequential phases (parts):

1. A prioritized list of surveys for approval by the Refuge Supervisor.
2. Individual protocols based upon the finalized list of surveys.

An I&M step-down management plan will be developed for the Refuge and the Unit within 3 years of CCP completion. See also Goal 4.

Research: The Refuge and the Unit will continue to work with regional experts to share information and expertise on habitat management and restoration techniques. Collaboration with local universities, NGOs, State and local agencies, and others to conduct research that will advance the science of habitat management and restoration on Refuge and Unit lands will be an important part of the science program. SUPs will be issued to permit research that furthers the mission of the Refuge System under the stipulations specified in the Research Compatibility Determination (see Appendix B).

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 found in Appendix D. This review concluded that neither of the Refuge or the Unit meets the requirements for wilderness designation.

Step-down management plans: The CCP provides guidance in the form of goals, objectives, and strategies for several Refuge and Unit program areas, but may lack some of the specifics needed for implementation. Regardless of the alternative selected as the final management plan for the Refuge and the Unit, several subsequent, or step-down, plans will be developed.

All step-down management plans require appropriate NEPA compliance, and implementation may require additional Federal, State, and county permits. Project-specific plans, with appropriate NEPA compliance, may be prepared outside of these step-down management plans. The following step-down management plans have been identified for the Refuge and/or the Unit:

- Inventory and Monitoring Plan;
- Wildland Fire Management Plan revision;
- Habitat Management Plan.

Refuge fire management: Fire Management Plans were finalized for the Refuge and the Unit in 2003. Until revised, fire management actions will continue to be guided by the direction set forth in the plans.

Law enforcement: The goal of law enforcement on the Refuge and the Unit is to protect natural resources, maintain the safety and security of the visitors and employees, and protect facilities. Law enforcement activities will include patrols, when staffing allows, to establish and maintain an effective, professional, and courteous law enforcement presence to eliminate unauthorized uses. Coordination and fostering partnerships with local law enforcement agencies will be an important part of the law enforcement program. The Service will investigate reports of violations in a timely fashion. Preventive law enforcement through education, signing, and regulation information will be used as important measures of the program.

2.3.2 Features Common to All Alternatives at Grays Harbor National Wildlife Refuge

Maintenance and updating of existing facilities: Periodic maintenance and updating of Refuge buildings and facilities will be necessary regardless of the alternative selected. Periodic updating of facilities is necessary for safety, accessibility, and support of staff and management needs.

Maintenance information is incorporated in the Service Asset Maintenance Management System. While new facilities are identified within this CCP, emphasis will also be placed on maintaining existing facilities.

Nature center and other facilities planning: Public Law 100-406, which authorized the establishment of Grays Harbor National Wildlife Refuge in 1988, directed the Service to develop a management plan to include: 1) the construction of a visitor center suitable for year-round use with special emphasis in interpretative education and research; 2) viewpoints, boardwalks, and access; and 3) parking and other necessary facilities. With public involvement, the Grays Harbor National Wildlife Refuge Management Plan was completed in 1990; all of the public facilities listed above were included in the plan.

The Refuge has begun work on some of the facilities described in the 1990 Management Plan, including a parking area with an information kiosk along Airport Way; public access to wildlife viewing areas; and construction of the Sandpiper Trail, a mile-long boardwalk trail which provides safe access and viewpoints. Although the Refuge has not constructed a building as described in the Management Plan, the Refuge has provided educational opportunities to both local and outside communities through educational programming in local schools, Refuge field trips for educational groups, the annual Grays Harbor Shorebird and Nature Festival, and the annual Shorebird and Nature Festival Poster Contest.

In 2007, the Service developed a conceptual building design for a nature center and associated facilities based on standard designs for Refuge facilities. The proposed building was to be located within a 4-acre site along the east boundary of the Refuge and the west side of Paulson Road. The design included a small administrative space, medium-sized visitor facilities, and an environmental education module (see Appendix M for more details about the site-selection process, building design, and a preliminary site map). However, due to a lack of funding, these plans have not been implemented.

Support from partners to help fund, staff, and maintain a nature center is essential. Under all alternatives, the Service proposes to work with other agencies, current and new partners, the community, and others to review the current nature center plan and to evaluate other options, including alternate funding, sites, and designs, that could lead to a viable plan for the center. If constructed, the Refuge will work with partners to develop biological, ecological, and cultural education and interpretative content, as well as any associated facilities (e.g., trails, viewing platforms).

The Refuge is adjacent to a highway used by one million people a year who are recreating in Grays Harbor County and on the Olympic Peninsula. The local area serves as a gateway community to the Olympic Peninsula. The potential for reaching a portion of these visitors and providing wildlife- and Refuge-related information is high. Additional visitor facilities could be a draw and destination, enhancing nature-based travel and experiences that brings new people to the Refuge and the local area. The additional facilities could provide a home for the Refuge's environmental education program, allowing students from the local area a place to extend classroom learning and enhance the outdoor experience, and would also strengthen ties with the community, partners, and volunteers associated with the Refuge.

In the interim, other improvements proposed under Goal 5 would provide additional and enhanced opportunities for visitors.

Salt marsh restoration (berm removal): As part of the revised Nestucca Oil Spill Restoration Plan completed in 2004, the Service included project planning to remove an artificial berm located at the northwest portion of the Refuge. The berm removal will improve the quality of salt marsh habitat for shorebirds, other migratory birds, and wildlife. This restoration plan was included in the Revised Nestucca Oil Spill Restoration Plan and Environmental Assessment with a Finding of No Significant Impact (USFWS 2004). For more details on the restoration plans, see Objective 1.4.

Sweetgrass harvesting: Historically, sweetgrass (*Schoenoplectus pungens,* formerly *Scirpus americanus*) was traditionally gathered and used by Native Americans for weaving baskets. Sweetgrass is an important cultural resource for many Tribes and an integral plant component of the salt marsh habitat. Sweetgrass stands are limited on the Refuge and concerns remain about the long-term health of this unique resource. The Refuge will continue to support this traditional use and cultural need and issue SUPs to Native American Tribal members for gathering sweetgrass. Permit stipulations are designed to provide long-term habitat protection and to sustain a thriving population of sweetgrass on the Refuge. Sweetgrass stands will also be available as a seed and plant source to establish new stands on Tribal lands as requested on a case-by-case basis (see Appendices A and B).

2.3.3 Features Common to All Alternatives at the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Removal of old buildings: The Black River Unit has several old, derelict buildings in need of removal. These include old barns, outbuildings, and houses that are in various states of disrepair and need to be demolished. Many have already been removed during the past 10 years. The remaining buildings are subject to trespass, vandalism, and other criminal activities, so these areas will remain closed to public access until building removal can be accomplished. These buildings will continue to be removed as funding becomes available. See Appendix C for further details on project priorities and estimated costs of removal.

Protection of vegetation and natural processes: Woody vegetation, beaver dams, and other vegetation in the river channel provide cover and other important values for native fish, salmon, and other wildlife. Vegetation clearing for recreational purposes will not be allowed or conducted. Unit staff will continue to control invasive plants or conduct other habitat management practices needed to benefit river channel habitat as part of operating and managing the Unit.

River channel habitat: The Service will work with WDNR to develop an interagency agreement, or similar instrument, that promotes cooperative management of the river channel between WDNR and the Service within the approved Unit boundary. Cooperative management will provide improved protection to fish and wildlife that use Unit and State-owned aquatic lands, provide improved habitat protection, allow the enforcement of Unit laws and regulations on the river channel, and define public access restrictions and management needed to provide improved wildlife protection from disturbance, while supporting high-quality, wildlife-dependent recreation opportunities. An agreement will benefit natural resources of interest to both agencies and strengthen the Service's partnership with WDNR. Cooperative management of the river channel will also contribute to achieving the Service's mission, Unit purposes, and help meet several goals by allowing the Unit to protect and better manage wildlife resources as well as meet the WDNR's objectives for the stewardship of State-owned aquatic lands.

2.3.4 Summary of Alternatives

Each alternative describes a combination of management actions designed to achieve Refuge or Unit purposes, vision, and goals. These alternatives provide different ways to address and respond to management concerns, public and partner issues, and opportunities identified during the planning process. They also reflect the direction in the Refuge Administration Act, Service policies, and legal mandates outlined in Chapter 1. A short description of each alternative is presented next, followed by summary tables (Tables 2-1 and 2-2). The tables summarize the key differences between the current management activities and the preferred alternative. Habitat acreages are included in each objective.

Detailed descriptions of the management goals, objectives, and strategies for each alternative are presented next. Maps are presented for the Refuge and the Unit, including each of the two alternatives and habitat maps at the end of the document, in Appendix N.

Alternatives for Grays Harbor National Wildlife Refuge

Alternative 1 – No-Action Alternative

The Refuge would continue to emphasize and promote the protection of Refuge habitats. Management actions include continuing with limited control of invasive species and monitoring of migratory bird use. Environmental education would continue to be a focus of the visitor services program. Existing visitor services, including wildlife observation, wildlife photography, and interpretation, would continue with the current facilities. No new facilities would be developed; however, planning for a new nature center would continue.

Alternative 2 – Preferred Alternative

Habitat programs would continue as currently managed with greater emphasis and improvements on invasive species management and pursuing priority science inventory, monitoring, and research needs. The environmental education, interpretation, volunteer, and outreach programs would be enlarged and improved as staffing allows. In addition to continuing actions described under Alternative 1, the visitor services program would target facility improvements including improved parking, an expanded Sandpiper Trail, interpretive panels, and two viewing platforms.

Alternatives for the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Alternative 1 – No-Action Alternative

Habitat management would continue to focus on monitoring and habitat management for the federally threatened Oregon spotted frog. There would be limited invasive species management and habitat management. Land acquisition efforts would continue as a priority for the Unit as funding allows. The Unit would not be open and no visitor services would be available.

Alternative 2 – Preferred Alternative

Greater emphasis would be placed on enhancing and managing habitat, especially in wetland habitats, to benefit the Oregon spotted frog and migratory birds. Increased inventory, monitoring, and research would be used to guide management decisions to benefit fish and wildlife. These inventories would be used to evaluate whether to propose designation of a research natural area (RNA) to

improve protection and management of unique bog and wetland habitats. The Unit would be opened to public use, including wildlife observation, interpretation, and wildlife photography. Proposed facilities to support visitor services include a viewing platform with a short walking trail on the east side of Endicott Road and a vehicle pull-off area with interpretive signs for viewing wildlife on the west side of Endicott Road. The Service would establish a cooperative agreement with Thurston County to develop a boat launch, small parking area, and new kiosk and interpretive signs on the southeastern side of the 123rd Avenue bridge. Outreach and volunteer programs would be expanded as staffing allows.

Table 2-1. Grays Harbor NWR Summary of Alternatives by Issue.

Theme/Issue	Alternative 1 No-Action Alternative (Current Management)	Alternative 2 Preferred Alternative
Estuarine Habitats		
Tidal open water	Protect 723 acres of open water and channel habitat	Same as Alternative 1, plus conduct IPM program
Intertidal mudflats	Protect 497 acres of intertidal mudflats and maintain limited IPM program	Same as Alternative 1, plus increase IPM program
Tidal salt and brackish marsh	Protect 156 acres of tidal salt and brackish marsh habitat and maintain IPM program. Remove constructed berm and restore tidal circulation to 15–20 acres	Same as Alternative 1, plus increase IPM program
Forest Habitat		
Mixed forest	Protect 95 acres of mixed forest habitat and maintain limited IPM program	Same as Alternative 1, plus increase IPM program and additional partnerships to control knotweed
Estuary and Ecosystem		
Partnerships	Maintain current partnerships	Same as Alternative 1, plus enhance and develop new partnerships and initiatives for conservation purposes
Inventories, Monitoring, and Research		
Inventory and monitoring	Develop and implement an Inventory and Monitoring Plan; continue shorebird monitoring as it applies to Refuge management decisions	Same as Alternative 1, plus initiate and support additional monitoring opportunities and projects
Research	Continue support of research opportunities as they apply to Refuge management decisions	Same as Alternative 1, plus initiate and support research opportunities where they contribute to understanding shorebird habitat use, sedimentation rates, and the effects of climate change on shorebird habitat and shorebird ecology

Theme/Issue	Alternative 1 No-Action Alternative (Current Management)	Alternative 2 Preferred Alternative
Visitor Services		
Welcoming and orientation	Maintain current facilities, signs, outreach materials	Same as Alternative 1, plus update signs and improve parking, visibility, and outreach materials
Wildlife observation and photography	Collaborate with Port of Grays Harbor to maintain access to the Sandpiper Trail and maintain current facilities	Same as Alternative 1, plus coordinate with Port of Grays Harbor and Federal Aviation Administration (FAA) to install additional viewing platforms on Refuge lands adjacent to the blacktop road; explore extension of the Sandpiper Trail spur; increase viewing opportunities at the parking area; and work with partners to consider the feasibility of a bike/pedestrian trail along Paulson Road
Interpretation	Maintain current interpretive panels and continue to support interpretation and provide guided walks during the Shorebird and Nature Festival	Same as Alternative 1, plus develop new interpretive panels for Sandpiper Trail and other viewing areas and work with partners to provide guided walks and other interpretive programs for the public
Environmental education	Contact and coordinate participation by teachers and students in Grays Harbor County in the Refuge's environmental education program; conduct annual Shorebird and Nature Festival Poster Contest; and maintain educator resources and trainings	Same as Alternative 1, plus hire a permanent education specialist and coordinate curriculum and additional programs throughout the county; explore ways to secure stable funding for an education coordinator; improve and expand teacher training opportunities
Volunteer Program and Partnerships		
Refuge volunteers	Maintain current training and volunteer opportunities	Same as Alternative 1, plus expand efforts to recruit and train volunteers to participate fully in Refuge programs
Partnerships	Maintain partnerships with existing groups, organizations, and agencies	Same as Alternative 1, plus identify new local partnerships to support visitor services programs

Theme/Issue	Alternative 1 No-Action Alternative (Current Management)	Alternative 2 Preferred Alternative
Outreach		
Outreach programs and events	Maintain current efforts with the Grays Harbor Shorebird and Nature Festival	Same as Alternative 1, plus identify new opportunities for programs and events in the community and develop ways to reach nontraditional audiences

Table 2-2. Black River Unit Summary of Alternatives by Issue.

Theme/Issue	Alternative 1 No-Action Alternative (Current Management)	Alternative 2 Preferred Alternative
Aquatic Habitats		
River channel habitat	Alongside WDNR, protect 7.5 miles of river channel habitat and maintain limited IPM program	Same as Alternative 1, plus increase IPM program; complete a Water Resources Inventory and Assessment
Tributary channel habitat	Protect 6–16 miles of tributary channel habitat and maintain limited IPM program	Same as Alternative 1, plus increase IPM program and habitat enhancement
Bog habitat	Protect 56 acres of bog habitat	Same as Alternative 1, plus conduct baseline inventories and Water Resources Inventory and Assessment; conduct IPM program; introduce rare plant species as appropriate; evaluate the designation of an RNA if warranted
Shrub swamp habitat	Protect 512 acres of shrub swamp habitat and maintain limited IPM program	Same as Alternative 1, plus increase IPM program
Riparian forest habitat	Protect 265 acres of riparian habitat and maintain limited IPM program	Same as Alternative 1, plus increase IPM program
Emergent marsh habitat	Protect 34 acres of emergent marsh habitat and maintain limited IPM program	Same as Alternative 1, plus improve habitat for Oregon spotted frog; increase IPM program
Seasonally flooded, nonnative grassland habitat	Protect 82 acres of seasonally flooded, nonnative grassland habitat and maintain limited IPM program	Same as Alternative 1, plus improve habitat for Oregon spotted frog; evaluate and enhance seasonally ponded areas and improve water management capabilities as needed; increase IPM program

Theme/Issue	Alternative 1 No-Action Alternative (Current Management)	Alternative 2 Preferred Alternative
Upland Habitats		
Dry, nonnative grassland habitat	Protect 163 acres of nonnative grassland habitat and maintain limited IPM program	Same as Alternative 1, plus plant big leaf maples and/or Garry oaks where appropriate; enhance up to 15 acres (within the 163 acres) with native plants; increase IPM program
Mixed forest habitat	Protect 394 acres of mixed forest habitat and maintain limited IPM program	Same as Alternative 1, plus enhance 5–10 acres (within the 394 acres) and increase IPM program
Watershed and Ecosystem		
Partnerships	Maintain current partnerships	Same as Alternative 1, plus enhance and develop new partnerships and initiatives for conservation purposes
Inventories, Monitoring, and Research		
Inventory and monitoring	Develop and implement an Inventory and Monitoring Plan; continue inventory and monitoring projects as they apply to Refuge management decisions	Same as Alternative 1, plus initiate and support additional monitoring opportunities and projects
Research	Limited current research	Initiate and support research opportunities where they contribute to understanding of Unit resources and management
Visitor Services		
Welcome and orientation	No visitor facilities or outreach materials	Develop print and electronic media outreach materials; improve Unit visibility; install signs
Wildlife observation and photography and educational programs	No visitor facilities or environmental education programs	Construct vehicle pull-off area with interpretive signs for viewing wildlife on the west side of Endicott Road; install small parking area, kiosk, viewing platform, short walking trail on east side of Endicott Road; identify links to Regional Trail System in coordination with Thurston County; establish a cooperative agreement with the county to develop a boat launch, small parking area, and new kiosk and interpretive signs at 123rd Avenue bridge; partner with local

Theme/Issue	Alternative 1 No-Action Alternative (Current Management)	Alternative 2 Preferred Alternative
		organizations to incorporate Unit messages into their programs
Volunteer Program and Partnerships		
Volunteer program	No volunteer program	Develop and promote a Unit volunteer program, including efforts to recruit and train volunteers
Partnerships program	No partnership program	Build community partnerships to support Unit programs

2.4 Goals, Objectives, and Strategies

Goals and objectives are the unifying elements of successful refuge and unit management. They identify and focus management priorities, resolve issues, and link to establishing purposes, Service policy, and the Refuge System mission.

A CCP describes management actions that help bring a refuge or a unit closer to its vision. A vision broadly reflects the refuge or unit purposes, the Refuge System mission and goals, other statutory requirements, and larger-scale plans as appropriate. 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.

In the development of this CCP, the Service has prepared an Environmental Assessment (EA). The EA evaluates alternative sets of management actions derived from a variety of management goals, objectives, and implementation strategies.

The goals for the Refuge and the Unit to be implemented over the next 15 years under the CCP/EA are presented on the following pages. Each goal is followed by the objectives that pertain to that goal. All goals are for the lifetime of the CCP unless otherwise specified. Some objectives pertain to multiple goals and have simply been placed in the most reasonable spot. Similarly, some strategies pertain to multiple objectives. The goal order does not imply any priority in this CCP. The Implementation Plan articulates the current Refuge and Unit priorities (Appendix C).

Readers, please note the following:

1) The objective statement indicates specific items that vary in the alternatives. How those items vary is displayed in the short table under each objective statement, as applicable.

2) If an objective is not in a particular alternative, a blank box indicates that this objective is not addressed in that alternative.

Finally, below each objective statement are the strategies that could be employed in order to accomplish the objectives.

1) Check marks alongside each strategy show which alternatives include that strategy.

2) If a column for a particular alternative does not include a check mark for a listed strategy, it means that strategy would not be used in that alternative.

2.4.1 Grays Harbor National Wildlife Refuge

Goal 1. Protect, maintain, and restore estuarine habitats representative of the Grays Harbor ecosystem for the benefit of shorebirds, other migratory birds, fish, and a diverse assemblage of other native species.

Grays Harbor Refuge Objective 1.1: Protect and maintain tidal open water habitat

Protect and maintain 723 acres of tidal open water habitat for the benefit of native fish, waterfowl, waterbirds, and other native wildlife.

Desired attributes of open water include:

- Marine water continually covering land regardless of tidal cycles
- Salinities ranging from 5 to 20 parts per thousand (ppt), varies seasonally
- Presence of phytoplankton, zooplankton, algae, and invertebrates
- Large woody debris brought in by storm events and tides
- Presence of patchy native eelgrass beds**
- Minimal human disturbance
- High water quality
- ≤5% nonnative, invasive plants and animals**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Protect and promote natural processes that dictate habitat changes, including water depths.	✓	✓
Maintain and develop new partnerships to protect and promote the ecological integrity of Grays Harbor estuary (see Objective 3.1).	✓	✓
Coordinate with the U.S. Coast Guard, other agencies, and update the Grays Harbor Geographic Response Plan as necessary.	✓	✓

Rationale:

The open water habitat, prior to construction of the airport peninsula and diking and filling along the shoreline, was historically part of the larger open estuary. However, the long-term implications of these permanent changes to habitat and wildlife resources are not yet fully understood. Currently, open water habitat accounts for nearly 50 percent of the overall Refuge area (see Map 1).

Maintaining and protecting open water habitat is extremely important because it provides habitat for a variety of estuarine plants and animal species that live in the shifting waters and substrates of the

estuary. The area provides a large disturbance-free expanse for thousands of migrating birds needing food and rest. Submerged areas in the open water habitat are channels and sloughs, which function as pathways and foraging areas for a variety of rare and common fish species, including salmon, eulachon, lamprey, sea-run cutthroat trout, and steelhead. Submerged eelgrass beds serve as shelter for fish, provide food for fish and waterfowl, help reduce shoreline erosion, and capture sediments. Considered a vital element to the ecosystem, the Refuge staff would assess the health and abundance of this important plant species (see Objective 4.1).

Threats that have and could continue to further compromise the ecological integrity of this habitat and its inhabitants include sediment and water pollution, invasive species, and climate change. To identify and respond to threats of water pollution and invasive species within the estuary and adjacent watersheds, Refuge staff would work with partners such as the Chehalis Basin Partnership and the U.S. Coast Guard to assist with spill response planning, invasive and pest species control, and other protection efforts (see Objective 3.1).

Staff would also actively seek opportunities to develop new collaborative partnerships to address issues that affect the overall health of the ecosystem. Partnerships would focus on resource protection measures, such as short and long-term research opportunities to protect the estuary and its resources (see Objective 4.3).

Grays Harbor Refuge Objective 1.2: Protect and maintain intertidal mudflat habitat

Protect and maintain 497 acres of intertidal mudflat for shorebirds and native wildlife.

Desired attributes of intertidal mudflats include:

- 90 percent of the habitat is a large expanse of exposed mud, sand, and silt-flats at low tide that are approximately 80 percent free of rooted vegetation and support algae growth
- Tidal sloughs are present (cut into the mud substrate by natural tidal forces)
- Twice daily, tidally driven marine waters flood the mudflats between 0.0 and 9.0 feet NGVD (National Geodetic Vertical Datum)
- Tidal salinity ranges from 5 to 20 ppt, varies seasonally
- Marine water carries zooplankton, phytoplankton, algae, and fish throughout the estuary**
- Presence of epibenthic and benthic invertebrate populations**
- Patches of native eelgrass, exposed briefly during extreme low tides**
- Large woody debris on mudflats (naturally occurring and continually changing with tides)
- Minimal human disturbance
- $\leq$ 2 percent coverage of key invasive plant species such as *Spartina*, *Phragmites*, yellow flag iris, and other nonnative, priority-target plants**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Participate in contaminant spill response exercises in Grays Harbor estuary and cooperate with spill response lead agencies as needed.	✓	✓
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓

Rationale:

The greater Grays Harbor estuarine mudflats are among the most important feeding and resting areas for migratory birds along the west coast of the United States and in the Pacific Flyway. The importance of this habitat has led to the recognition of the greater Grays Harbor estuary as a Site of Hemispheric Importance in the Western Hemisphere Shorebird Reserve Network (WHSRN 2009) and as a Globally Important Bird Area (ABC 2010). The estuary supports large concentrations of migratory birds, including over 500,000 shorebirds a year (WHSRN 2009).

The Refuge contains 497 acres of intertidal mudflat habitat which is valuable habitat for migratory birds, juvenile fish, clams, and invertebrates. The configuration of the Refuge tidal mudflats are unique within the estuary, as they are slightly higher in elevation and are one of the last areas to flood by rising tides. Because the mudflats remain exposed 1 to 2 hours longer than other areas in the estuary they provide extended resting and foraging opportunities for migrating shorebirds.

Threats which have and could continue to further compromise the ecological integrity of this mudflat habitat include water pollution, invasive species, increased sedimentation (which encourages growth of vegetation on mudflats), and climate change. To identify and respond to threats, Refuge staff would continue to work with Federal, State, local, and Tribal agencies and community groups to expand and utilize partnerships critical to maintaining the estuary's health (see Objective 3.1).

Staff would continue shorebird monitoring, identification and control of priority invasive species and expand the development of monitoring and research opportunities. Increased research would be necessary to understand the implications of increased sedimentation rates and the effects of sea level rise resulting from climate change (see Objectives 4.1–4.3).

Grays Harbor Refuge Objective 1.3: Protect and maintain tidal salt and brackish marsh habitat

Protect and maintain existing 156 acres of tidal salt and brackish marsh habitat for native fish, shorebirds, waterfowl, waterbirds, passerines, and other wildlife.

Desired attributes of tidal salt and brackish marsh include:

- Salt tolerant vegetation usually occurring (between mean high water [MHW] and slightly above mean higher high water [MHHW]) or within tidal range of 9 to 13 feet NGVD
- Estuarine marine water (5 to 20 ppt), varies seasonally
- Brackish marsh waters (≤5 ppt) are less saline because of freshwater inputs that usually come from upland drainages (freshwater streams and rivers)
- Tidal sloughs are present at varying depths and locations
- 25–100 percent herbaceous coverage of native salt marsh vegetation in low, mid-, and high salt marshes with species such as sand spurry, saltgrass, pickleweed, jaumea, lilaeopsis, seaside arrowgrass, silverweed, Lyngby's sedge, sweetgrass, Baltic rush, and tufted hairgrass
- Brackish marsh plants include cattail and bulrushes
- Salt marsh vegetation density is based in part on tidal inundation frequency and duration
- Minimal human disturbance
- ≤ 2 percent coverage of invasive plant species such as *Spartina*, *Phragmites*, yellow flag iris, and other nonnative, priority-target plants on the Refuge**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Establish full-time refuge manager position to manage day-to-day operations of the Refuge, including managing and restoring habitat, coordinating with partners, and managing facilities.		✓

Rationale:

The Refuge supports 156 acres of tidal salt and brackish marsh habitat. Tidal wetlands are of high ecological importance and are considered essential habitat for many marine and anadromous fish and migratory birds. Salt and brackish marshes provide food and nursery areas for numerous young fish, crabs, shrimp, clams, and other invertebrates. Migratory birds use these areas as breeding, feeding, and resting sites. In addition, the estuarine marshland supports large numbers of migratory waterfowl and shorebirds, which in turn provide an important prey base for raptors such as bald eagles and peregrine falcons. The salt and brackish marsh is functionally connected with mudflat and riverine habitats and acts as a transition zone between aquatic and terrestrial sites. These marshes provide shoreline stability against wave and wind erosion, reduce flood peaks, trap nutrients, sediment, and pollutants.

In the Pacific Northwest, a large portion of estuarine habitat has been lost to diking, channeling, dredging, and filling. The state of Washington is estimated to have lost between 45 percent and 62 percent of its pre-settlement estuarine habitat (Aitkin 1998). Within Grays Harbor, approximately 3,840 acres of salt marsh habitat was lost to dredge material disposal (Recht 1998).

Issues and concerns for the overall health of the habitat include sedimentation, invasive species, and climate change. Research is necessary to determine the impacts of changing habitats, management options, and the effects of climate change (see Objectives 3.1 and 4.3). Monitoring sedimentation rates and vegetation response within the tidal salt and brackish marsh and mudflats is important to the understanding of the potential resilience of these habitats to sea level rise, storm surges, and flood events. Another threat to the vitality and health of the habitat includes the potential spread of invasive species such as *Spartina*, *Phragmites*, and knotweed. Refuge staff would continue to collaborate and work with partners (WDFW, WSDA Grays Harbor County Noxious Weed Board, Grays Harbor Public Utility District (GHPUD)) to reduce invasive species within the Refuge and estuary.

Staffing priorities would include establishing a refuge manager position to manage the day-to-day operations, manage restoration and habitat management projects, manage the expanded facilities operations, develop and expand partnership projects, and implement expanded visitor services programs.

Grays Harbor Refuge Objective 1.4: Restore salt and brackish marsh habitat

Restore then protect and maintain up to 20 acres of salt and brackish marsh for the benefit of juvenile fish, waterfowl, wading birds, shorebirds, and other native species.

Desired characteristics include:

- Full, unimpeded tidal function**
- Infrequent total tidal inundation, except on highest of high tides
- Interspersion of connected tidal sloughs
- Vegetation usually occurring within tidal range of 9 to 13 feet NGVD dominated primarily by pickleweed, tufted hairgrass, seashore salt grass, seacoast angelica, gumweed, seaside plantain, small spikerush, seaside arrowgrass, and Lyngby's sedge**
- ≤ 2 percent coverage of invasive plant species such as *Spartina*, *Phragmites*, yellow flag iris, and other nonnative, priority-target plants on the Refuge**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Develop partnerships to secure funding for restoring salt and brackish marsh.		✓
Restore salt and brackish marsh by removing the berm and reconnecting tidal channels. See also Section 2.3.1, Features Common to All Alternatives.	✓	✓

Rationale:

If unaltered or restored to a more natural hydrologic state (i.e., characterized by sinuous, deeply-incised, and complex tidal channel networks and the absence of alterations such as ditching, diking, tidegates, restrictive culverts, and roads), the estuarine wetlands would maintain itself with very little or no input from land managers. To improve the quality and complexity of 15–20 acres of salt and brackish marsh habitat for fish and wildlife, the Refuge would remove a berm in the northeast portion of the Refuge. The berm was originally constructed to retain disposed dredge spoils that were deposited there until the 1970s (see Map 1). This restoration project was identified, developed, and approved in the revised 2004 Nestucca Oil Spill Plan (USFWS 2004).

The berm has been breached, but it prevents full tidal penetration and evacuation in the salt marsh habitat except during the highest high tides and flood events. This inhibition of tidal flow reduces the quality and complexity of saltmarsh habitat, contributes to deep channeling of the slough, and may be creating a ponding problem when the floodwaters recede, trapping fish and other aquatic organisms. Berm removal would allow a natural ebb and flow and restore function to tidal waters, improving the habitat value for marine species, migratory birds, and terrestrial wildlife.

Staff would continue to seek project funding and develop partnerships to implement this project. The project would include identifying, monitoring, and managing invasive plant species. The Service would coordinate with Federal, State, and county agencies on restoration design review.

Goal 2. Protect and maintain upland habitat representative of the Grays Harbor ecosystem for the benefit of migratory passerines and other wildlife.

Grays Harbor Refuge Objective 2.1: Protect and maintain forest habitat

Protect and maintain 95 acres of forest habitat for migratory passerines, landbirds, and native wildlife.

Desired attributes of this habitat include:

- 75–100 percent canopy cover of native trees such as red alder, willow species, cascara, Oregon ash, Pacific crabapple, and big leaf maple with thick lichen and moss coverage
- ~30 percent cover of native deciduous shrubs such as red elderberry, osoberry, twinberry, thimbleberry, salmonberry, and spirea
- >30 percent herbaceous cover consisting of native forbs and ferns such as sword and lady ferns, horsetail species, slough sedge, and *Galium*
- Natural succession to mixed forest to occur over time
- Minimal human disturbance
- <2 percent coverage of knotweed and other nonnative priority-target plants**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Partner with GHPUD, Grays Harbor County, and Grays Harbor County Noxious Weed Board to control encroaching knotweed along State Highway 109 (see Objective 3.1).		✓

Rationale:

The Refuge protects 95 acres of forest habitat which provides for a variety of neotropical migratory birds and small mammals. Management of this habitat would continue to focus on forest health, protection, and maintaining natural succession.

Resource threats influencing the future health of the forest and its wildlife resources include undesirable invasive plant species such as knotweed, *Phragmites*, Scotch broom, and blackberry. The Service uses a variety of control methods because different invasive species require specific techniques for control to be effective (see Appendix G).

Continued monitoring and treatment of invasive species would be maintained as staffing and funding allows. Refuge staff would build partnerships and collaborate with GHPUD, Grays Harbor County, and Grays Harbor County Noxious Weed Board to target removal of encroaching knotweed along State Highway 109.

Goal 3. Contribute to the protection and long-term environmental health of the Refuge and greater Grays Harbor estuary and ecosystem.

Grays Harbor Refuge Objective 3.1: Develop and strengthen partnerships

The Refuge would initiate, develop, and continue to strengthen existing partnerships with interested groups for the benefit of the long-term environmental health of native wildlife and their habitats.

Partnership actions include:

- Working with and involving local communities, universities, landowners, NGOs, Tribes, agencies, and other interested parties
- Identifying the Service's role in conservation efforts with the focus on partnerships that provide support for natural resources
- Utilizing existing and supporting new eco-regional plans and priorities
- Working with and assisting others in the recovery of threatened and endangered species
- Considering habitat vulnerabilities and stressors (e.g., climate change, habitat fragmentation, invasive species, pollution)
- Working with others and assisting with management objectives for protecting and researching shorebird habitat **
- Considering and participating in climate change initiatives and research**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Through a collaborative LCD process, work with partners (State, county, Tribes, NGOs, and others) to identify the Service's role in conservation efforts in the Grays Harbor estuary ecosystem and surrounding habitats.	✓	✓
Maintain a strong partnership with the Port of Grays Harbor to further cooperation and protection of Grays Harbor estuary resources and the Refuge.	✓	✓
Coordinate with other natural resource agencies and interested partners to develop collaborative monitoring projects important for the Grays Harbor estuary, including the Refuge.		✓
Coordinate with the spill response agencies, Port of Grays Harbor, other Federal and State agencies, and appropriate partners to quickly mobilize a spill response, protect Refuge lands, and reduce impacts when possible following Geographic Response Plan procedures.	✓	✓
Participate in the Chehalis Basin Partnership, Chehalis Basin Weed Partnership, Pacific Birds Habitat Joint Venture, Marine Resources Committee, Nearshore and Estuarine Partnership, and other existing partnerships to further the protection of the Grays Harbor estuary and native habitats.	✓	✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Work with partners to coordinate control or monitoring of invasive species with appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.		✓
Coordinate with partners and support efforts to survey, control, and monitor *Spartina* and *Phragmites* in the greater Grays Harbor estuary as well as in the Refuge.	✓	✓
Work with GHPUD, Grays Harbor County, and Grays Harbor County Noxious Weed Board to control knotweed along State Highway 109.		✓
Share training opportunities and information with partners, the public, agencies, groups, and landowners.		✓
Communicate with landowners, recreational users of the estuary, and the public on the threats of invasive plants and animals and methods of reducing and controlling infestations.		✓
Provide technical and other assistance to partners working to restore natural resource lands in the Grays Harbor estuary.		✓
Work with partners to assess lands within the Grays Harbor estuary to identify potential alternative habitats appropriate for shorebirds in relation to future sea level rise.		✓
Work with partners to study environmental factors that are climate change related stressors (e.g., changes to hydrology and water chemistry) and their impacts on Refuge habitats and species. See Objectives 4.1–4.3.		✓
Establish a refuge operations specialist or wildlife biologist position that would focus on maintaining, protecting, and restoring lands, and working with partners.		✓

Rationale:

The habitats within the Refuge represent less than 2 percent of the overall Grays Harbor estuary. The Service recognizes that it will not be able to achieve many of the major conservation goals for the long-term environmental health of the Refuge and greater Grays Harbor estuary and ecosystem by working only within the existing Refuge boundary. Protected Refuge habitats currently provide substantial conservation benefits to shorebirds, threatened and endangered species, anadromous fish, migratory birds, and other native wildlife, but are vulnerable to a variety of landscape-scale threats such as climate change, sea level rise, invasive species, and pollution.

Strong collaborative partnerships and public education would enable the Service to achieve its vision and goals for the Refuge and the Grays Harbor estuary. Cooperative efforts with key partners would greatly further protecting and restoring habitat, watershed efforts, and education.

Developing and coordinating information needs in support of the health of the estuary resources would include expanded inventory, monitoring, and research. Refuge staff would provide technical assistance to partners as appropriate with continued participation in spill response planning and invasive species control (*Spartina*, *Phragmites*, knotweed). Monitoring and research related to climate change-related stressors would help inform adaptation strategies at the Refuge, and potentially, a larger landscape scale.

Establishment of a refuge operations specialist position or wildlife biologist position would benefit the natural resources of the estuary by providing coordination with partners on a variety of projects including inventory, monitoring, and research activities, habitat restoration and enhancement projects, invasive species control, and planning.

Goal 4. Collect scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.

Grays Harbor Refuge Objective 4.1: Inventory

Conduct scientific inventories to provide information regarding the status of Refuge resources and better inform resource management decisions. These scientific inventories and surveys would contribute to developing Refuge resource objectives. They would also be used to facilitate habitat restoration through selection of appropriate habitat management strategies based upon site-specific conditions.

These inventory activities would have the following attributes:

- Inventory habitats, species, and species groups according to the Refuge's approved I&M Plan and associated protocols
- Use of accepted standards, where available, for completion of inventories
- Scale and accuracy of inventories would be appropriate for developing and implementing Refuge habitat and wildlife management actions
- Data collection techniques should have minimal animal mortality or disturbance and minimal habitat destruction
- Proper cleaning of investigator equipment and clothing and quarantine methods, where necessary, would minimize the potential spread or introduction of invasive species and disease

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Within 3 years of CCP completion, develop and implement an I&M Plan that provides the management rationale, timing, and costs for conducting Refuge surveys; lists the prioritized surveys; identifies the surveys selected for implementation; and documents the protocols that describe the survey objectives and methods.	✓	✓
Seek funding and develop or strengthen partnerships to accomplish priority baseline inventories (primarily focused on determining presence or absence) and mapping species and habitats.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Conduct inventory to gather data regarding year-round fish presence or absence in Refuge tidal open water, inundated mudflats, and inundated saltmarsh habitats.		✓
Conduct inventory to gather data regarding primary shorebird prey species, such as macro-invertebrate bi-valves, shrimp, crabs, and worms, in mudflats and saltmarsh habitats.		✓
Conduct inventory to gather data (presence/absence, habitat use, relative abundance) on wildlife species such as small mammals (e.g., rodents, bats), amphibians, reptiles, and pollinators.		✓
Conduct inventory to establish baseline data on Refuge tidal waters, sediments, and invertebrate biota regarding possible contamination from organochlorines, and heavy metals in particular, as well as polyaromatic hydrocarbons and conduct conventional tests such as fecal coliform, nutrients, and turbidity based on recommendations included in the Contaminants Assessment Process.		✓
Develop partnerships to survey eelgrass beds (both native and nonnative) within the Refuge boundary, establishing a baseline inventory and map of eelgrass species presence (see Objective 1.1, 1.2).		✓

Rationale:

An inventory is defined as a survey that estimates the presence, abundance, or distribution of species, habitats, ecological communities, or abiotic features at a particular time (701 FW 2). Inventories may also establish a beginning time-step (baseline) or reference information for subsequent monitoring. For example, a well-designed inventory may be repeated at a later time to assess the status and trends in the same location, which would then be considered monitoring. Appropriate and applicable inventories are necessary to determine resource status, promote learning, and evaluate progress toward achieving objectives whenever using adaptive management. Inventories would establish a benchmark for future comparisons and ensure that implementation of on-the-ground resource management activities achieve resource management objectives identified under Goals 1–3.

A Refuge I&M Plan needs to be developed to document the surveys required to determine species status, assess habitat condition, detect and identify changes in the Refuge's diverse fish, wildlife and plant communities and physical resources including water, air and soils, and ecological processes. The Refuge I&M Plan would include information on the specific metrics required for supporting management decision-making and may include presence/absence, species composition, seasonal habitat use, spatial distribution, and/or population estimates. Specific inventories would establish baseline information on many aspects of different Refuge habitats and the fish, invertebrates, and most wildlife groups that use them. Information regarding contaminant levels of sediments, water, and invertebrates (shorebird and fish prey) would establish a baseline standard for comparison as harbor development increases or contaminant spills occur. Invasive species, both plant and animal, are threats, and some have already caused damage to habitats and affected wildlife, but the extent of some species, such as nonnative eelgrass, is unknown.

Funds are currently prioritized to perform the most pressing projects at the Refuge Complex, leaving few resources and staff available to do Grays Harbor Refuge-specific baseline inventories. Partnering with other field biologists from natural resource agencies, NGOs, private lands, and using qualified volunteers would be helpful in getting some of the needed inventories underway.

Grays Harbor Refuge Objective 4.2: Monitoring

Conduct high-priority monitoring activities that evaluate changes in the status of fish, wildlife, and their habitats. Information gathered facilitates adaptive management actions for resource management and visitor services. Monitoring projects can take place annually or periodically depending on the species, habitat, or management needs.

Monitoring of wildlife and habitat contributes to the enhancement, protection, use, preservation, and management of wildlife populations and their habitats on and off Refuge lands. Information gained can be used to evaluate achievement of resource management objectives identified under Goals 1–3.

These monitoring and survey activities would have the following attributes:

- Adhere to scientifically defensible protocols for data collection, where available and applicable
- Data collection techniques should 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 would be collected for identification and experimentation in order to minimize long-term or cumulative impacts
- Proper cleaning of investigator equipment and clothing and quarantine methods, where necessary, would minimize the potential spread or introduction of invasive species and disease

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Within 3 years of CCP completion, develop and implement an I&M Plan that provides the management rationale, timing, and costs for conducting Refuge surveys; lists the prioritized surveys; identifies the surveys selected for implementation; and documents the protocols that describe the survey objectives and methods.	✓	✓
Seek funding with partner contributions for priority surveys.		✓
Coordinate, plan, and periodically conduct a comprehensive shorebird survey of the entire Grays Harbor estuary in cooperation with partners.	✓	✓
Conduct annual ground surveys for shorebird species that use Refuge intertidal mudflats and marshes.	✓	✓
Conduct annual ground surveys for waterfowl and other migratory waterbird use of Refuge habitats.	✓	✓
Develop aerial spring shorebird survey methods for all of Grays Harbor estuary and seek funding to conduct annually.		✓

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Assist in monitoring efforts related to threats to biological integrity from contamination in the Grays Harbor estuary.		✓
Monitor the health and abundance of sweetgrass on the Refuge through periodically measuring basic parameters and mapping, especially in relationship to the threats of climate change and sea level rise.		✓
Install sediment gauges in appropriate Refuge locations to gather preliminary information on sedimentation accretion rates to use with future research projects on climate change and sea level rise.		✓
Coordinate within the greater Grays Harbor estuary area to identify the latest monitoring and research efforts and to determine possible data gaps and research needs regarding sea level rise and climate change.		✓
Following the salt and brackish marsh berm removal, monitor the restored areas to determine the status of the changing plant community and fish and wildlife use.		✓
Annually work with Service Regional, Refuge, and migratory bird biologists and other agencies and partners to collect data of regional or flyway value such as the mid-winter aerial waterfowl survey.	✓	✓
Work with Service Regional, Refuge, and migratory bird biologists and other partners to establish a Pacific Coast Flyway protocol for shorebird migration surveys and assist in executing coordinated surveys to gain greater understanding of shorebird populations, status, and ecology.	✓	✓
Continue evaluating and improving control methods for nonnative plants, including *Spartina, Phragmites,* and other invaders as they are found.	✓	✓
Conduct surveys for invasive animals, such as Griffins isopod, green crab, invasive mussels, snails, and other marine invaders.		✓
Periodically conduct priority, invasive, nonnative plant surveys, map treatment control effectiveness, and assess treatment need.	✓	✓
Conduct baseline monitoring of water chemistry (especially acidity) and monitor changes over time.		✓
Hire a full-time wildlife biologist at the Refuge to ensure biological information is gathered and analyzed to support Refuge management, species recovery, and make management recommendations.		✓
Hire a biological technician to monitor invasive plants, control programs, and assist with high-priority monitoring programs.		✓

Rationale:

Monitoring consists of repeated survey efforts intended to document changes over time (e.g., months to years) and space in select attributes of wildlife, plants, habitats, ecological communities, or abiotic resources. Two types of monitoring in the Service policy (701 FW 2) are:

> (1) Baseline monitoring. Monitoring that is not tied to specific predictions of how a natural resource will respond to management or environmental stressors, but instead is designed to document change over time of a natural resource. Examples include monitoring wildlife population trends, disease incidence, and climate change.
>
> (2) Monitoring to inform management. Monitoring to assess whether a natural resource is approaching or exceeding a known threshold, or if a resource is responding to a management action or system stressor in a specified manner. This type of monitoring involves defining the threshold values or expected response, then surveying to measure the response or a closely related indicator. Comparing monitoring results with these expected values may show a need for initiating, intensifying, or altering management actions. Results from this type of monitoring are used in an adaptive management context to improve management or evaluate progress toward achieving management objectives, as derived from the Refuge System mission and Refuge purposes.

A new full-time biologist and a biological technician would make it possible to conduct needed surveys and monitoring of rare and sensitive species, as well as key avian, mammalian, or other wildlife species to provide information on their status. Species response to habitat enhancements would need to be understood to adapt management techniques and support sound management decisions.

The Refuge would partner with natural resource entities, specifically the North Pacific LCC, to address climate change and other biological stressors. As needed, objectives and strategies would be adjusted to assist in enhancing Refuge resources' resiliency to climate change and to potentially manage for new species assemblages in the future.

Grays Harbor Refuge Objective 4.3: Research

Conduct high-priority scientific research projects that provide the best science for habitat and wildlife management on and off refuges. These research projects may identify cause and effect relationships, produce new knowledge, and may last 1–3 years. Scientific findings gained through these projects would expand knowledge regarding life-history needs of species and species groups, as well as identify or refine habitat and wildlife management actions.

Research also would 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 would 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 would likely have minimal animal mortality or disturbance and minimal habitat destruction

- Collect samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) to meet statistical analysis requirements for identification and experimentation in order to minimize long-term or cumulative impacts
- Utilize proper cleaning of investigator equipment and clothing and quarantine methods, where necessary, to minimize the potential spread or introduction of invasive species and disease
- Often result in peer-reviewed articles in scientific journals and publications and/or symposiums

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Seek funding, develop research partnerships, and initiate research to benefit the Refuge and the Service.		✓
Conduct research that supports Refuge informational and management needs and assists regional needs for greater understanding of applied resource management.	✓	✓
Work with university graduate school programs, Federal, State, and local agencies, Tribes, NGOs, and others to conduct research that would advance the science of habitat management on Refuge lands.	✓	✓
Develop a collaborative plan and initiate research to investigate the effects of sedimentation upon Refuge habitats over time, accretion rates and distribution, sediment sources, and hydrologic effects on sediment distribution within the Refuge, including comparisons to predicted sea level rise to assess shorebird foraging and roosting implications.		✓
Initiate research on avian shorebird predators, how avian shorebird predators utilize surrounding habitats and if predator activity affects how shorebirds use the Refuge.		✓
Initiate research into shorebird food resources including biofilm and macro/micro-invertebrate population abundance to better understand food availability during spring migration and shorebird needs.		✓
Work with the Service's I&M program on Refuge legacy data (e.g., shorebird counts) to determine long-term population trends, use of Refuge habitat, and reliability of the data.		✓
Continue to support red knot ecological research on the Refuge and in the greater estuary.	✓	✓
Support red knot conservation with research on population trends and habitat needs and develop management measures as appropriate.		✓
Participate in regional Pacific Flyway research studies on shorebird ecology, population trends, and habitat needs, especially those that support Refuge management needs.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Coordinate with other natural resource agencies and partners to better understand the ramifications of nonnative and invasive Japanese eelgrass in open water, mudflats, and saltmarsh habitats and how it affects native habitat for shorebirds, invertebrates, fish, and other wildlife.		✓
Seek funding for, develop, and assess shorebird habitat use in the Grays Harbor estuary to identify areas that may provide alternative habitat in the face of future sea level rise (see Objective 3.1).		✓

Rationale:

Research projects on Refuge lands would address a wide range of natural and cultural resource and public-use management issues. Examples of research projects include habitat use and life-history requirements for specific species and 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 and wildlife response, identification and analyses of paleontological specimens, wilderness character, modeling of wildlife populations, and assessing response of habitat and wildlife to disturbance from public uses. Projects may be species-specific, refuge-specific, or evaluate the relative contribution of the Refuge to larger landscape (ecoregion, region, flyway, national, international) issues and trends. Like monitoring, results of research projects would 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 would promote adaptive management on Refuge lands. Scientific publications resulting from research on Refuge lands would help increase the visibility of the Refuge System as a leader in the development of the best science for conserving and managing resources.

Specific research needs on the Refuge include understanding the tidal movement, sediment deposition, and the rate of accretion and the effects on the mudflat habitat that is so critical to shorebird foraging during spring migration. Research into the relationship of avian predator activity and their impacts on shorebird site use would provide important information that would help managers determine how to manage certain habitat types. Shorebird foraging information, especially regarding prey and biofilm abundance and use, would be vital for managers to understand how adaptive management can be used. Some shorebirds are in decline and more information is needed to understand shifting habitat needs and use and foraging preferences. The Refuge would work with partners to identify higher elevation potential transition habitats that would able to support shorebirds as water levels rise and habitats change over time.

The Refuge supports external research projects that explore factors affecting focal wildlife species and their habitats, with the intent to increase our understanding and ability to manage these resources, as well as to support regional needs for greater understanding of applied resource management.

The Refuge would join the North Pacific LCC, which is a series of formal science-management partnerships between the Service, Federal agencies, States, Tribes, 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. As needed, objectives and strategies would be adjusted to assist in

enhancing the Refuge's resources' resiliency to climate change and to potentially manage for new species assemblages in the future.

Goal 5. Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance visitors' understanding and appreciation of the Refuge's natural resources and to foster a connection with nature.

Grays Harbor Refuge Objective 5.1: Welcome and Orientation

Provide visitors with welcoming and orienting features, facilities, and experiences. These would be characterized by:

- Directional signage on roadways
- Refuge entrance sign
- Information kiosk
- Orientation signs
- Signed parking
- Trailhead and trail signs
- Use of electronic and print media to reach and orient visitors

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Work with WSDOT to maintain directional signs on State Highway 109.	✓	✓
Work with WDFW to maintain Watchable Wildlife signs.	✓	✓
Maintain Refuge entrance sign on State Highway 109 and Paulson Road.	✓	✓
Maintain information kiosk at Port of Grays Harbor gate.	✓	✓
Improve parking area surface and install appropriate signs.		✓
Provide electronic and print media with accurate information that is positively worded and available at the Refuge kiosk and other local venues such as the Chamber of Commerce.		✓
When possible, provide information in English and Spanish.		✓
When and where appropriate, provide visitor amenities such as toilets and garbage cans, i.e., during special events and if the new nature center is built.		✓
Enhance the hardscape around the kiosk and Port of Grays Harbor gate to make the pedestrian passage more visible and accessible, in coordination with Port of Grays Harbor.		✓
Establish administrative assistant position to support Refuge operations, habitat management and restoration, visitor services program, and facilities management.		✓

Rationale:

Customer service and first impressions are important for visitors to feel welcome and safe at national wildlife refuges. Local visitors to Grays Harbor Refuge do not necessarily know they are on a national wildlife refuge, and those that come from outside the area need welcome and orientation features that are easily found and well maintained. Visitors need accurate, timely, and appropriate orientation materials and information on Refuge facilities, programs, and experiences. These strategies would increase Refuge visibility and promote visitor compliance with Refuge regulations.

Staffing priorities would include an administrative assistant position to assist with Refuge management activities, facilities operation, expanded habitat management projects, and expanded visitor services programs.

Grays Harbor Refuge Objective 5.2: Provide high-quality wildlife observation and nature photography opportunities

Provide compatible wildlife observation and photography opportunities with the following characteristics:

- Safe and accessible facilities that are available to a broad spectrum of the public
- Opportunities to view and photograph a diversity of wildlife in their habitats and in a natural setting
- Access provided to a diversity of habitats
- Viewing opportunities tied to interpretive and educational opportunities
- Observation opportunities promote public understanding of Grays Harbor Refuge resources and the Refuge's role in managing and protecting those resources
- Observations occur in places with the least amount of disturbance to wildlife
- Observers have minimal conflict with other visitors or operation of the Refuge

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Collaborate with Port of Grays Harbor to maintain access to the Sandpiper Trail (pedestrian and maintenance vehicles).	✓	✓
Maintain Sandpiper Trail and, where appropriate, keep vegetation low to allow shorebird viewing.	✓	✓
Continue to work with partners to provide wildlife observation and photography opportunities during the spring shorebird migration.	✓	✓
Enhance viewing opportunities along the Port of Grays Harbor road. Select at least one site and install a small viewing platform on Refuge lands in coordination with the Port of Grays Harbor and FAA.		✓
Explore extension of the Sandpiper Trail spur at the northwest end by up to 250 feet for improved shorebird viewing in coordination with the Port of Grays Harbor and FAA.		✓
Increase viewing opportunities at the parking area. Build a viewing deck/platform associated with the information kiosk.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Rehabilitate existing Refuge building for use as a maintenance shop to support habitat management and trail and visitor facility maintenance programs.		✓
Work with partners to consider feasibility of constructing a bike and walking trail along Paulson Road.		✓
Hire a permanent maintenance worker to maintain trails, visitor facilities, and assist with habitat management.		✓
Hire a permanent visitor services manager to operate the nature center, if constructed, and plan and conduct the visitor services program for a broad range of visitors.		✓
Hire a refuge officer to protect Refuge resources and for visitors, employees, and facilities.		✓

Rationale:

Observation and photography of wildlife and nature promote public understanding and appreciation for the Refuge's natural resources. Wildlife observation is the primary visitor activity at Grays Harbor Refuge. Wildlife observation and photography programs are designed to provide a diversity of high-quality viewing opportunities for visitors while minimizing disturbance to wildlife and habitats.

Grays Harbor Refuge offers excellent bird watching and wildlife observation opportunities for a wide variety of shorebird and waterbird species. Native habitats are easily viewed from the Sandpiper Trail, which is open year round. The Refuge is open to the public from sunrise to sunset; however, some areas are closed to protect wildlife and habitat from disturbance. Volunteers walk the trail and provide interpretive and other information to visitors to increase their understanding of natural resources. High-quality wildlife viewing would continue to be provided on the Refuge through the maintenance and development of trails and observation sites.

Grays Harbor Refuge Objective 5.3: Provide high-quality interpretive opportunities

Provide a variety of high-quality interpretive opportunities to Refuge visitors. Interpretive developments shall include information about the importance of the Refuge to native habitats and their associated plants, fish, and wildlife species throughout the year.

High-quality interpretive programs should consist of the following attributes:

- State-of-the-art technology incorporated into interpretive materials, where appropriate
- Target all users regardless of demographics
- Facilitate self-discovery of information using all five senses
- Incorporate the importance of the Refuge System and the purpose, goals, and objectives of the Refuge
- Use a variety of interpretive materials, including signage, exhibits, brochures, and a website.
- Explore interconnections of natural and human world

- Emphasize nonguided activities but also include periodic guided programs
- Link to wildlife observation and environmental education programs

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Maintain all existing interpretive features on the Sandpiper Trail.	✓	✓
Update the Wildlife List and produce in the Service's standard format.		✓
Update plant list and make available to the public upon request.		✓
Continue to improve the Refuge's website to include expanded information on the native habitats and their associated plants, fish, and wildlife species, and visitor opportunities throughout the year, and link with other appropriate sites.	✓	✓
Develop a series of interpretive panels for placement on the Sandpiper Trail and at the Refuge kiosk.		✓
Develop a panel that includes a map and Refuge regulations for placement on the Refuge kiosk.		✓
Develop an interpretive panel on the Refuge System for placement on the Refuge kiosk.		✓
Work with partners to provide guided walks and interpretive programs for the general public.		✓
Continue to provide guided walks during the spring shorebird migration, including during the Grays Harbor Shorebird and Nature Festival.	✓	✓
Maintain the general Refuge brochure and have available at the Refuge kiosk, the local Chamber of Commerce, and other local venues as appropriate.	✓	✓
Continue to work with partners on the Grays Harbor Shorebird and Nature Festival and provide high-quality interpretive experiences along the Sandpiper Trail with the help of volunteers.	✓	✓
Look for unique ways to provide information about the Refuge such as a radio spot that drivers can tune into along State Highway 109, narrated podcast for smartphones or computers, and Quick Response (QR) codes on interpretive materials.		✓
Incorporate current issues, such as invasive species and climate change, into new interpretive materials.		✓

Rationale:

As one of the Service's priority public uses, environmental interpretation is an important management activity for the Refuge. Interpretation is a communication process that forges emotional and intellectual connections by providing opportunities for visitors to make their own connection to the resources. It is at the heart of connecting people of all ages in a variety of ways to our natural world. Messages and stories are delivered through both formal (e.g., programs and walks) and informal methods (e.g., materials, panels, and exhibits). Both methods have the objective of facilitating self-discovery, examining systems, and exploring how the natural world and human activities are interconnected. Participants of all ages would engage in stimulating and enjoyable activities as they learn about the Refuge and issues confronting fish and wildlife resource management and protection. We would emphasize first-hand experiences with the environment through presentations, audio-visual media, and exhibits as necessary components of the Refuge interpretive program.

Goal 6. Provide environmental education opportunities that initiate a sense of wonder and foster a connection with nature and the Refuge for students both on and off the Refuge.

Grays Harbor Refuge Objective 6.1: Environmental Education (onsite)

Provide and support field trips to the Refuge, particularly during the spring shorebird migration, for 3rd and 4th grade students in Grays Harbor County. The onsite program would include:

- Extending and enhancing classroom learning and providing students with a first-hand experience with shorebirds, other wildlife, and native habitats
- A minimum of 50 percent of field trips associated with in-classroom presentations.
- Reaching a minimum of 500 grade school students annually
- Supporting the Service's "Connecting People with Nature" emphasis
- Using a diversity of education methods and tools

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Provide an education coordinator through the AmeriCorps program or other avenues that become available.	✓	✓
Hire a permanent education specialist to manage the day-to-day programming for the education program and coordinate with education partners throughout Grays Harbor County.		✓
Maintain trails that enable students to view wildlife.	✓	✓
Develop additional facilities that would enhance learning while at the Refuge, including interpretive panels, viewing areas, and trails.		✓
Work with partners and the Refuge volunteer program to continue to support school field trips to the Refuge.	✓	✓
Continue coordination with the Port of Grays Harbor to allow access to the Sandpiper Trail trailhead.	✓	✓

Rationale:

Environmental education is a high-priority, wildlife-dependent public use of the Refuge and an important focus of the visitor services program. The program reaches local students that may not otherwise have opportunities to visit and learn about their local natural areas and the wildlife found there.

The Refuge is in a special position to offer local schools, teachers, and students an opportunity to learn about shorebirds, waterbirds, rare or endangered species, and engage in conservation issues in an outdoor setting. Field trip options would allow classes to experience what they have learned in the classroom firsthand. Volunteers and partners would assist in providing support for groups visiting the Refuge.

To meet student needs, Refuge staff is committed to working with schools and teachers to provide opportunities for students to experience fish, wildlife, and habitats at the Refuge and learn about

Refuge resources, habitat conservation, and cultural resources. A full time education specialist would allow the program to grow and reach more students with quality education programs.

Grays Harbor Refuge Objective 6.2: Environmental Education (off-site)

Provide and support offsite environmental education opportunities through classroom lessons and activities for 3rd and 4th grade students in Grays Harbor County.

The offsite program would include:

- Working with teachers willing to commit to both classroom lessons and a Refuge field trip
- Providing a series of six lessons per class from November through June that emphasize shorebirds, shorebird conservation, ecology, and the natural history of the area
- Providing materials and ideas for extending lessons throughout the year
- Providing home extension activities
- Emphasizing hands-on, multi-disciplinary learning

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
When funding is available, provide an education coordinator through the AmeriCorps program or other similar venues.	✓	✓
Make yearly contact with 3rd and 4th grade teachers in Grays Harbor County to provide information about the Refuge's environmental education program and invite participation.	✓	✓
Utilize the materials and resources provided through the Shorebird Sister School Program.	✓	✓
Conduct the annual Shorebird and Nature Festival Poster Contest in coordination with partners and assist teachers with student entries.	✓	✓
Maintain up-to-date and accurate information for teachers on the website.	✓	✓
Evaluate and keep current materials and activities that are offered to teachers and students to ensure topics of importance to the local area, like climate change, are addressed.	✓	✓
Work with partners to continue to find more long-term ways to financially support the education coordinator position and program.	✓	✓
Work with partners to develop educational outreach tools utilizing new technologies (e.g., web cam, YouTube, Flickr) for virtual Refuge educational experiences.		✓

Rationale:

Environmental education is one of six wildlife-dependent public uses that are outlined in the 1997 Refuge Improvement Act. Environmental education is a high-priority, wildlife-dependent public use of the Refuge. Off-site environmental education can encourage participation from more students than

could otherwise be reached and helps to strengthen partnerships with schools, educational organizations, and local community members.

The Refuge is in a unique position to offer local education agencies, teachers, and students an opportunity to learn about shorebirds, shorebird conservation, and rare or endangered species and engage in natural resource management and conservation issues in their local community. To meet student needs, Refuge staff is committed to working with schools and teachers to provide in-classroom presentations and help with the environmental curriculum. Support could also include field trips, participation in off-site activities like poster contests or festivals, and strengthening of long term partnerships with local schools and the community.

Grays Harbor Refuge Objective 6.3: Environmental Education Teacher and Volunteer Training

Provide training and support for teachers, Refuge volunteers, and interns who would assist in conducting the environmental education programs for the Refuge.

Attributes of the education training program would include:

- Providing one-on-one or group assistance to educators who would use the training and information each year with students
- Partnering with other groups to provide training to educators on a variety of natural history and conservation topics for a variety of age groups, e.g., early childhood educators
- Conducting periodic volunteer training sessions to prepare volunteers to provide high-quality and accurate educational methods, techniques, and tools that are appropriate for teaching students and introduce new volunteers to the education program
- Requesting feedback from teachers and partners to improve the program

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Maintain an up-to-date “Educator’s Guide to Grays Harbor NWR” and make available for educators.	✓	✓
Notify educators at the beginning of the school year that training is available.	✓	✓
Recruit and train Refuge volunteers who would work with the education program.	✓	✓
Look for ways to partner with other organizations to provide teacher training.	✓	✓
Ensure that teachers involved in the program receive one-on-one or group training about the Refuge, classroom activities, and Refuge field trips.	✓	✓

Rationale:

Training is an important component of environmental education. By training teachers about environmental issues important to the Refuge, they could use the information and resources each year with their students. Teachers look for ways to become more knowledgeable, enhance their skills, and

acquire new resources; teacher training provides them with new knowledge and opens up different avenues for teaching. Teachers participating in Refuge trainings are more likely to use resources offered and are more likely to take students outside, including to the Refuge. Training of Refuge volunteers and interns to assist with the education program would enable the Refuge to maintain the level of quality programming provided to students.

Goal 7. Support and strengthen an active volunteer work force and Friends Groups to assist in providing quality visitor services programs and outreach.

Grays Harbor Refuge Objective 7.1: Strengthen and promote a Refuge volunteer program

Improve volunteer opportunities associated with the Refuge with the following attributes:

- Provide effective training and program management
- Support and complement the Service mission and current initiatives
- Increase visibility and foster conservation
- Support a variety of Refuge programs and activities and increase their effectiveness
- Encourage community involvement and strengthen relationships

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Publicize volunteer opportunities to attract new volunteers representing a broad spectrum of the community.	✓	✓
Look for ways to partner with other organizations to provide volunteers.	✓	✓
Maintain and provide to volunteers an up-to-date "Volunteer Training Manual" for Grays Harbor Refuge.	✓	✓
Provide a training course for volunteers on the Service; Refuge history, management, and natural resources; the specifics of the Refuge volunteer program and volunteer opportunities; and about the specifics of the volunteer duties.	✓	✓
Recruit and train volunteers who would work with the education and outreach programs.	✓	✓
Recruit and train volunteers to work as trail rovers and weed warriors.	✓	✓
Recruit and train volunteers from the Refuge Complex to help with a variety of Refuge activities.		✓
Provide volunteers with an annual recognition.		✓

Rationale:

Volunteers provide an important and needed service on national wildlife refuges. Successful volunteer programs are recognized as a key component of the successful management of public lands and vital to implementation of Refuge programs, plans, and projects, especially in times of declining budgets.

The Refuge volunteer program began in 2001 and since then a small group of volunteers has worked performing a variety of jobs, including assisting with the environmental education and interpretation programs, special events, trail roving, wildlife surveys, invasive plant control, administration, and maintenance. Recruitment and training of new volunteers has occurred almost annually. A volunteer

training manual is kept up-to-date and provided to volunteers. Partners such as Grays Harbor Audubon Society have provided the bulk of volunteer services over the years and would probably continue to do so in the future. Recruiting volunteers has been challenging and attrition is high. Managing an effective volunteer program at the Refuge has proven to be difficult because the Refuge is not staffed, has no facilities, and is an hour's drive from the Refuge Complex Headquarters where the volunteer manager is stationed.

The role volunteers have played over the years has been very important and the Refuge would continue to have a need for volunteers into the future. In addition to providing assistance with programs and helping the Refuge meets its mission, volunteers are outreach ambassadors in the community. They spread the word about the Refuge throughout the local community where they live.

Grays Harbor Refuge Objective 7.2: Support and encourage partnerships to support Visitor Services programs

Support and encourage partnerships with the following attributes:

- Partners would support the mission of the Refuge
- Working together with Refuge staff, partners would be advocates for the Refuge in helping secure resources and funding for programs and facilities
- Partners would provide needed volunteer support to Refuge programs

Partners may be a part of a network of Friends Groups across the county supporting and advocating for the National Wildlife Refuge System

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Identify local community groups, businesses, and organizations that could help support the Refuge's visitor services program and facilities development.	✓	✓
Work with local partners to produce the Grays Harbor Shorebird and Nature Festival.	✓	✓
Explore ways to work with the Chehalis Basin Partnership to provide education and outreach to local communities.		✓
Explore ways to partner with Grays Harbor College.		✓
Continue to work with Refuge Friends groups including Grays Harbor Audubon Society and Friends of Nisqually NWR in support of education, outreach, and habitat programs.	✓	✓

Rationale:

National wildlife refuges have developed extensive and sophisticated partnerships and Friends Groups in order to carry out the mission of the Refuge System. Partners provide support in a variety of ways at the local, regional, and national levels. Partnerships and Friends Groups provide a way for citizens to be involved in and work to enhance and improve the resources Refuges are mandated to

protect. Without a constituency of local support, Refuges today would not be able to accomplish their mission.

The visitor services program at the Refuge has relied on, and would continue to rely on, partnerships to support the various components of the program. Production of the yearly Grays Harbor Shorebird and Nature Festival requires the collaboration of numerous local partners, including Grays Harbor Audubon Society, the City of Hoquiam, the Port of Grays Harbor, WDFW, and numerous others. Financial support by partners for the education program has enabled the Refuge to have an AmeriCorps volunteer and has supported bus transportation for Refuge field trips. These invaluable contributions by partners would continue to play an important role in the success and growth of the Refuge's visitor services programs.

New partners need to be identified and engaged in order to ensure the development of new facilities can be accomplished. Support at the local level would continue to be extremely important for the building of a nature center and associated trails (See Section 2.3.2 Features Common to All Alternatives at Grays Harbor National Wildlife Refuge for information on the nature center).

Working with a variety of partners, such as the Chehalis Basin Partnership and Grays Harbor College would enable the Refuge to reach new audiences and to stay active and visible in the local community.

Grays Harbor Refuge Objective 7.3: Enhance outreach targeting local communities to promote appreciation of and generate support for the Refuge

Develop, maintain, and provide outreach programs in communities throughout Grays Harbor County that focus on fish, wildlife, and their habitats, with an emphasis on shorebirds and shorebird conservation.

Outreach program attributes would:

- Provide accurate information about natural resources, management, and conservation of those natural resources
- Actively include partners and volunteers in development and implementation of programs and events
- Reach a broad spectrum of audiences regardless of demographics
- When possible, provide materials in Spanish
- Use a variety of media

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Continue to support and be an active participant in the yearly annual Grays Harbor Shorebird and Nature Festival.	✓	✓
Identify ways to reach out to nontraditional audiences, e.g., the Latino population in Grays Harbor County.		✓
Develop outreach materials in Spanish.		✓
Work with partners and volunteers to identify opportunities for Refuge involvement in outreach programs and events.		✓

Rationale:

Local support for national wildlife refuges is critical to achieve the mission of the Refuge. Conservation and enhancement of habitats and wildlife is extremely difficult without local support. Many people in Grays Harbor County do not know about the Refuge. The challenge is to find ways to inform people and get them interested in supporting Refuge programs.

Since 1994, the Grays Harbor Shorebird and Nature Festival has been the main outreach event for the Refuge. Working in partnership with Grays Harbor Audubon Society, the City of Hoquiam, the Port of Grays Harbor, and many other sponsors, the Refuge helps develop and execute an event celebrating the spring migration of shorebirds in Grays Harbor County. The Festival has an attendance average of 1,400 people. The Shorebird and Nature Festival Poster Contest, free guided walks at the Refuge, and free lectures have all been established to try and attract local participation; however, more needs to be done.

The opportunity to participate in other local events exists; time and volunteer and staff availability is a challenge in attending these events. In past years, the Refuge has had a booth at the Grays Harbor County Fair, Hoquiam River Days, and Volunteer Day at the Mall.

Reaching a more diverse audience would be beneficial. Grays Harbor County has a large Latino population and many of them are first-generation and may or may not speak English. Some children of these families are being reached through the education program; finding ways to reach the families would be a logical next step. Outreach to the Latino community via churches, events, and clubs could be a great way to start making contacts. Providing materials in Spanish would also be essential.

Outreach to local businesses would also benefit the Refuge and help achieve the goals set out in this plan. Advocacy and financial support for new programs and facilities would be necessary for progress to be made. Finding common ground with the business community through personal contacts, events, partnerships, and volunteer help would be essential.

2.4.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Goal 1. Protect, maintain, and enhance aquatic habitats characteristic of the upper Black River Watershed while maintaining historical characteristics of the north Puget Trough Lowlands for the benefit of native fish, amphibians, migratory birds, and a diverse assemblage of other native species.

Black River Unit Objective 1.1: Protect, maintain, and enhance the Black River channel habitat

Alongside WDNR, protect, maintain, and enhance up to 7.5 miles of channel habitat for native fish and wildlife, including rare and declining species such as the Oregon spotted frog and Olympic mudminnow.

Desired characteristics of this channel habitat include:

- Channel depths range from 2–15 feet deep in the main channel
- Plentiful water supply throughout the seasons to maintain channel habitat and sustain fish and wildlife populations**
- Annual high water events spread water out over the floodplain in winter and spring
- Abundant native submersed and emergent vegetation such as American waterweed, pondweed species, smartweed, narrow leaf bur-reed, and water starwort**
- 5–20 percent of channel edge is exposed mud without vegetation
- Muddy, silty, and sometimes unconsolidated river bottom
- Water temperatures are seasonally <64°F
- Presence of decaying, large woody debris that may support herbaceous vegetation such as small flowered forget-me-not, smartweed, monkey flower, and water starwort
- Low to minimal populations of nonnative bullfrogs and warm-water fish populations that threaten natural food web processes**
- < 15 percent cover of nonnative, invasive plants that threaten the native plant community
- Reduce reed canarygrass**

Channel habitat is defined by the location of water flows within the confines of river or tributary banks and includes the nearby edges of the sloped bank. The current length/measurement of channel habitat includes lands and waters that are under the jurisdiction of WDNR.

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Work with WDNR to develop an interagency agreement or similar instrument that promotes cooperative management of the river channel between WDNR and the Service within the approved Unit boundary. See also Section 2.3.3, Features Common to All Alternatives at the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge.	✓	✓
Within 8 years of completion of the CCP, complete a detailed Water Resources Inventory and Assessment (WRIA).		✓
Coordinate and partner with appropriate agencies to sustain and enhance hydrological conditions needed to support channel habitat and ensure an		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
appropriate water budget and delivery, including water quantity and quality.		
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Annually control nonnative, invasive, or undesirable plants such as yellow flag iris in the river channel habitat.		¼ mile treated/ year
Annually control all purple loosestrife along the edge of the river channel (see Appendix G).	south of pipeline	north and south of pipeline
Coordinate with other agencies to determine best control methods for reed canarygrass to use in river channel and implement control.		✓
Establish permanent refuge operations specialist position to coordinate and conduct Unit operations, habitat management, and visitor services programs.		✓

Rationale:

The Black River is a unique lowland river and considered by some to be the most complete intact river system of its type remaining in western Washington. The Black River is an important tributary of the Chehalis River watershed, the second largest watershed in Washington State. Located within the approved Unit boundary, there are approximately 7.5 miles of free flowing river channel habitat that serves as a vital migration pathway, provides some spawning grounds, and good quality rearing habitat for juvenile salmonids, resident fish, and amphibians. However, multiple stressors (both on and off the Unit) have compromised the natural function and hydrology of the northern section of the river influencing water temperature, water movement, water quality, sediment transport, habitat complexity, and animal passage.

A WRIA is necessary to study these stressors and to assist Unit staff by identifying various management options to improve habitat conditions, water quality, and hydrologic regimes in the river system.

Unit staff would implement an inventory and monitoring program to understand and manage impacts from invasive species on the resources. Invasive plants within the river channel and along the edges, such as reed canarygrass, are present, and some nonnative, submerged plant species are suspected. Reed canarygrass has severely altered the habitat in some places by impeding water flow and developing monotypic plant stands, thereby affecting habitat quality and wildlife use. The Unit would work with other agencies to determine the best methods to control reed canarygrass and other species in the river channel. (See Obj. 3.1 and Goal 4.) Staff would increase control measures annually on yellow flag iris by treating or removing the plant on an additional quarter-mile of river channel habitat each year. In addition, purple loosestrife would be found and treated along the river channel, including the northernmost locations for the benefit of a variety of native wildlife, including

rare species such as Olympic mudminnow and Oregon spotted frog, and to enhance native plant communities.

Control and treatment for bullfrogs is needed because bullfrogs outcompete, predate upon, and displace Oregon spotted frogs (see also Section 4.6). Auditory bullfrog presence/absence surveys would take place in June. Control techniques would be used during day or night as needed using hand capture, gigging, and netting as appropriate. Captured bullfrogs would be anesthetized with 20% benzocaine gel on its ventral abdomen and then frozen until dead.

The Refuge Complex would seek to establish a permanent refuge operations specialist position to ensure enhanced coordination with our partners and implementation of all habitat management projects, completion of inventory, monitoring, and research programs and projects, invasive species removal, and management of the new visitor services programs.

Black River Unit Objective 1.2: Protect, maintain, and enhance Black River tributary channel habitat

Protect, maintain, and enhance up to 16 miles of Black River tributary channel habitat for native fish, amphibians, invertebrates, and wildlife.

Desired characteristics of tributary channel habitats include:

- Clear, running shallow streams or deeper water streams
- Cool water temperatures in riparian associated tributaries < 60°F
- Equal or higher dissolved oxygen level than in the Black River
- Firm channel bed with graduated-size cobble or soft, peat substrate
- Presence of natural woody debris
- Barrier-free passage for native fish and tadpoles
- Low to minimal populations of nonnative bullfrogs and warm-water fish populations**
- < 15 percent cover of nonnative, invasive plants that threaten the native plant community
- Reduce reed canarygrass (see Rationale in Objective 1.1)**

Tributary channel habitat is defined by the location of water flows within the confines of tributary banks and includes the nearby edges of the sloped bank. The length/measurement includes tributaries currently under ownership (fee title) of Billy Frank Jr. Nisqually National Wildlife Refuge.

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Annually control invasive plants on a minimum of 20 percent of tributary channel habitat.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Within 3 years of acquisition of new parcels, identify and remove or replace fish barriers including any culverts or other artificial structures that would deter fish passage.	✓	✓
Use standard enhancement techniques (riparian plantings, IPM techniques, placement of large woody debris, etc.) as appropriate to improve tributary channel conditions.		✓
Coordinate and partner with agencies and other partners to sustain and enhance the hydrological conditions needed to maintain a healthy habitat.		✓
Coordinate with other agencies to determine best control methods for reed canarygrass to use in tributary channel and implement control.		✓

Rationale:

Tributaries within the Unit boundary where Unit ownership occurs include Waddell, Dempsey, and several smaller unnamed creeks. Prior to entering the Unit boundary, these creeks meander through agricultural and residential areas presenting a variety of issues and conservation challenges for maintaining a healthy watershed. Unit staff would seek to expand and build relationships to work with various agencies and landowners in an effort to improve the quality of this habitat influenced by off-Unit activities. The Unit would complete a WRIA prior to identifying priority enhancement opportunities that are essential for improving the health of the Black River Watershed (Objectives 1.1 and 4.3). Implementing habitat management techniques such as riparian plantings, IPM techniques, and placement of large woody debris, as appropriate would benefit the watershed and fish and wildlife.

Unit staff would increase invasive species control measures to treat 20 percent of tributary habitat annually on species such as yellow flag iris and purple loosestrife to benefit stream function and a variety of native wildlife, including some endemic and rare species such as Olympic mudminnow and Oregon spotted frog. Research and monitoring are vital to assess overall water flow, channel function, water quality, quantity, and wildlife and fish usage. (See Obj. 4.2 and 4.3.) Reed canarygrass is present within tributary channels and along the immediate edges. Reed canarygrass has severely altered the habitat in some places by impeding water flow and developing monotypic plant stands, thereby affecting its wildlife inhabitants. The Unit would work with other agencies to determine best methods to control reed canarygrass and other species in tributary channel habitat. (See Objective 3.1 and Goal 4.) See Objective 1.1 and Section 4.6 for the rationale for bullfrog control and treatment.

Maintaining and improving the quality of the tributary channel habitat supports the ecological health of the Black River Watershed and the greater Chehalis Watershed, supporting numerous species of aquatic plants, fish, amphibians, mammals, and birds.

Black River Unit Objective 1.3: Protect, maintain, and enhance bog habitat

Protect, maintain, and enhance a minimum of 56 acres of unique and rare bog habitat that includes characteristic plant species and associated wildlife.

Desired characteristics of bog habitat include:

- Peat soils dominated by sphagnum or have sphagnum species growing on the soil surface
- Soils are generally saturated year round, in some cases are seasonally flooded, yet are isolated from surface water flow
- Low pH and low nutrient availability
- Fed primarily by precipitation and are generally restricted to areas in which precipitation exceeds evapotranspiration
- Bog species may include sphagnum moss, Labrador tea, native cranberry, sundew, white beak-rush, cottongrass, western bog laurel, and lodgepole/shore pine, and Beller's ground beetle, Hatch's click beetle, or Queen Charlotte's copper butterfly**
- ≤ 5 percent cover of nonnative, invasive plants that threaten the native plant community**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Within 5 years, partner with bog specialists to identify locations and map bog types.		✓
Within 5 years, conduct conduct survey to inventory plant and animal species composition, distribution, and relative abundance within the bog habitat.		✓
Within 8 years of completion of the CCP, complete a detailed WRIA by the Service.		✓
Coordinate and partner with appropriate agencies to evaluate hydrological conditions necessary to support this habitat.		✓
Upon completion of inventories, surveys, and the WRIA, develop a good understanding of hydrologic processes, abiotic and biotic processes and threats, and how to manage them to sustain this sensitive and rare habitat.		✓
Initiate appropriate habitat enhancement if a rare or declining species or habitat is found.		✓
If valid, develop an RNA proposal package, including habitat description, map, and rationale for Regional/National approval.		✓
Participate and partner with National Natural Areas Network information sessions by sharing research information.		✓
Evaluate potential for translocation of rare species as appropriate, including marsh sandwort and water howellia, implement recovery actions if warranted.		✓
Annually control invasive plants on a minimum of 30 percent of known bog habitat.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Work with partners and researchers to develop protocols for inventory, monitoring, and research within the bog habitats (see Goal 4).		✓
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.		✓

Rationale:

Bog habitats are unique in Washington State and are increasingly rare in the Puget Trough ecoregion. Only a fraction of western Washington's original bogs remain undisturbed. Knowledge regarding the extent and type of bog habitat found within the Unit boundary is extremely limited. A partial assessment of Unit lands has identified over five types/classifications of bog habitats which may include Federal and State-listed species and species of concern. There are a variety of unique plant species which have been specially adapted to live in bogs; some found on the Unit include western Labrador tea, sphagnum moss species, sundew, bog cranberry, bog laurel, bog orchid, and bog birch. Other species are found in bogs and other habitats including shore pine, thin-leaf or gray alder, and cottongrass. A number of Federal and State-listed insect species specifically adapted to bogs may also inhabit the Unit. Directed inventories of the plant and animal species within the bog habitat are necessary to assess habitat quality and the potential for establishing an RNA to advance scientific research, education, and protection. Additional inventories and research would also identify rare plant and animal species and assist in protecting this unique habitat (see Objectives 4.1 and 4.3).

Additional inventory and research is necessary to identify rare plant and animal species and assist in protecting this unique habitat (see Objectives 4.1 and 4.3). Unit staff would expand partnerships to help conduct inventories, surveys, and research (see Objective 3.1). Bog research would begin by 2016 to inventory and investigate the habitat condition, health, and stability (Objectives 4.1 and 4.3). A WRIA (Objective 1.1) would be necessary to understand the hydrological conditions and potential threats to the bog and other aquatic habitats. This inventory and assessment would assist the Unit staff by identifying management options to monitor and improve habitat conditions.

A thorough inventory of this complex habitat type is necessary prior to implementing an invasive species removal program. More information is needed regarding nonnative plant species within the bog habitat. Known invasive species, including holly and reed canarygrass, in this area would be controlled on approximately 30 percent of the bog habitat annually.

By obtaining general plant and animal inventories, the Unit would gain the knowledge necessary to evaluate the special characteristics and diversity found in this bog habitat and the potential for establishing an RNA with the following characteristics: a rich and complex matrix of mixed conifer forests, bogs, shrub swamps, and spring upwellings which includes the headwaters of the Black River; is mostly undisturbed and in a natural state; contains rare and sensitive bog habitat; and rare and declining plants and animals are associated with the bog habitat (see Map 2). If designated as an RNA, the area would become part of a national network of ecosystems found in relatively pristine condition, managed primarily for their natural ecological processes, and would receive additional attention by potential partners and researchers focusing on research and education (see Objective 3.3).

The Unit may consider translocation of an endangered plant species to its historical range within bog habitat or other habitats that are appropriate. Translocation of any plant species would be part of a formal research program requiring planning and permits (see Objective 4.3). The Service policy for Biological Integrity, Diversity, and Environmental Health (601 FW 3) allows for the reintroduction of extirpated native flora and fauna back to their historic range.

Black River Unit Objective 1.4: Protect, maintain, and enhance the shrub swamp habitat

Protect, maintain, and enhance 512 acres of shrub swamp for migratory birds including marshbirds, Oregon spotted frog, Olympic mudminnow, and other native wildlife.

Desired characteristics of shrub swamp include:

- Semi-permanently to permanently flooded with water depths from <1 to 24 inches
- During late summer months, ground has less surface moisture but retains root zone saturation
- Poorly drained, fine-textured organic or muck soils
- Associated with beaver dam-building activity
- 20–50 percent canopy cover of shrubby native, deciduous trees (such as willows, ash, and Pacific crab apple; 15–30 feet high) with lichen and moss growth**
- 50–100 percent canopy cover of native deciduous shrubs (such as red-osier dogwood, ninebark, and black twinberry 5–20 feet high)**
- 10–20 percent coverage (patchy) of native, herbaceous understory plants (such as skunk cabbage, veronica, marsh speedwell, bur-weed, smartweed, and sedges)**
- 20–50 percent patches of exposed soils**
- Low to minimal levels of nonnative bullfrog populations that threaten natural food web processes**
- < 20 percent coverage of nonnative, invasive plants that threaten native plant community processes
- Reduce reed canarygrass (see Rationale in Objective 1.1)**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Annually control invasive plants on a minimum of 5 percent of shrub swamp habitat.		✓
Develop methods to select appropriate sample sites in shrub swamp habitat for inventory and assessment. Conduct the inventory and assessment.		✓

Rationale:

The Unit supports 512 acres of shrub swamp habitat interspersed with other habitats, such as emergent marshes, bogs, and riparian forests, supporting a wide variety of neotropical migratory

birds, wading birds, small mammals, and invertebrates. It is an essential habitat connecting other key habitat types, providing a buffer to the river channel, reducing the impacts of flooding, and providing food and cover for a diversity of resident and migratory birds including declining species and populations, endemic species such as Olympic mudminnow, rare species including the federally threatened Oregon spotted frog, Pacific clubtail dragonfly, bristly sedge, the federally endangered water howellia, as well as other wildlife.

The shrub swamp habitat dominates the northern most portion of the Unit south of Black Lake, and along the river channel and adjacent floodplain south to 123rd Avenue. Identifying presence/absence of invasive species and implementing IPM treatment methods has been found to be extremely challenging due to the difficulty accessing and navigating through the habitat which has been described as an "impenetrable shrub thicket." Reed canarygrass, yellow flag iris, purple loosestrife, possibly knotweed, and other nonnative, invasive, wetland-adapted plants most likely thrive in small, open patches. If left unchecked, they could negatively affect water flow, habitat function, and key wildlife habitats.

The Unit would expand control measures for invasive plants on a minimum of 5 percent shrub swamp annually. Newly identified, small sized infestations would be targeted for spot treatment to prevent them from spreading. IPM-approved methods would be utilized to control invasive plants (see Appendix H).

See Objective 1.1 and Section 4.6 for the rationale for bullfrog control and treatment.

Although not noted as a strategy for this specific habitat, completing a detailed WRIA on the river system would help identify resource threats and provide details regarding management and protection options.

A complete inventory of the shrub swamp plant community is needed to understand if and how hydrological changes over time affect the bog and shrub swamp habitats (see Objective 4.1).

Black River Unit Objective 1.5: Protect, maintain, and enhance the riparian forest habitat

Protect, maintain, and enhance 265 acres of riparian forest for migratory birds, amphibians, small mammals, and other native wildlife.

Desired characteristics of a riparian forest include:

- Slightly higher elevation than shrub swamp habitat
- Soils are saturated part of the year
- ≥ 75–95 percent cover from native deciduous, broadleaf trees of mixed age and species dominated by big leaf maple, western cottonwood, red alder, and Pacific willow**
- Over time, previously logged-out Sitka spruce and western hemlock may grow in with natural succession in the absence of major disturbance
- ≥ 50 percent native shrubs such as black twinberry, red osier-dogwood, snowberry, salmonberry, thimbleberry, salal, red and evergreen huckleberry, rose species, osoberry, and devil's club**
- ≥ 40 percent herbaceous understory such as skunk cabbage, inside-out flower, twinflower, wild ginger, trillium, vanilla leaf, false lily of the valley, stinging nettle, and lilies**

- Diverse lichen and moss growth on trees and shrubs**
- Trees grow to become sufficient size to provide large woody debris to the river channel and floodplain
- Individual trees of >12"diameter and 20+' long or groups of trees become snags and downed logs.
- ≤ 20 percent nonnative, invasive plants that threaten the native plant community**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Within 5 years of acquiring lands, reestablish or enhance altered riparian habitats where appropriate by planting native trees and shrubs.		✓
Manage a minimum of 20 percent of Unit riparian forest habitat annually to control invasive plants.		✓
Establish maintenance staff position for habitat enhancement, invasive species control, and other management activities.		✓

Rationale:

Since the late 1800s, the vast majority of riparian habitat in Washington has been lost or extensively modified due to agricultural clearing, logging, construction, and channel alteration activities. Intact riparian forests provide cover and serve as important travel corridors for many wildlife species. Healthy riparian forests also support native fish populations by benefitting in-stream characteristics such as water temperature, water quality, water chemistry, cover, structural diversity from woody debris, and nutrients.

The Unit currently supports 265 acres of riparian habitat for a diverse assemblage of native wildlife such as resident and migratory birds, cavity-nesting waterfowl, possibly great blue heron colonies, and red-legged frogs. Riparian forest habitat is naturally located within floodplain areas and serves as a natural floodwater storage area during high water events.

Maintenance and enhancement of this habitat would contribute to function and health by improving the connectivity for wildlife that is dependent on riparian forests. Management would include evaluating, planting, and using established forestry management techniques to enhance a mix of early, mid-, and late successional riparian forest habitat. This habitat is vulnerable to invasive plant degradation and IPM-approved control methods would be utilized to control this and other invasive plants (see Appendix G).

Establishment of a maintenance staff position is essential for conducting proposed habitat enhancement projects, nonnative invasive plant and animal control, and other daily management projects and activities in the Refuge Complex. This position would support Unit partnerships, visitor services facilities and programs, and habitat enhancement and maintenance projects to benefit wildlife both on and off Unit lands.

Black River Unit Objective 1.6: Protect, maintain, and enhance emergent marsh habitat

Protect, maintain, and enhance 34 acres of emergent marsh for amphibians such as Oregon spotted frog, migratory and marsh birds, and other wildlife.

Desired characteristics of this freshwater emergent marsh include:

- Semi to permanently flooded lands with standing water between <2 to 25 inches deep. Deep water conditions occur between October and June
- Provides a pathway for amphibians and fish to deeper water sites
- Located along the river and tributary edges, swales, oxbows, and land depressions that connect to other wetlands and deeper waters
- Topography includes a mosaic of shallow depressions
- Poorly drained soils (peat, muck, or mineral)
- 15–35 percent soil exposure (no vegetation)
- <20 percent moderately high-growing (>4+ feet high) native plants such as cattail, hard or soft stem bulrush, or slough sedge**
- 30–70 percent cover of low-growing, native, emergent, hydrophilic vegetation and seed-bearing plants such as water plantain, bur-reed, sedges, rushes, and creeping grasses**
- Decaying large woody debris in the marsh brought in by high-water events
- Zero to minimal invasive bullfrogs to prey on Oregon spotted frog tadpoles, juveniles, or adults, other amphibians, or other native species**
- < 20 percent coverage of nonnative, invasive plants that threaten the native plant community processes
- Reduce or manage reed canarygrass (see Rationale in Objective 1.1)**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Develop an array of appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods, including mechanical mowing, haying, selective hand-cutting and thatch removal, herbicides, herbivore grazing, prescribed fire, water control methods, or barrier cloth placement, that are minimally detrimental to rare or declining species populations such as Oregon spotted frog or water howellia (see Appendix G).	✓	✓
Continue partnerships with other agencies to develop and implement reed canarygrass management in non-diked emergent marshes and enhance native and nonnative grassland habitats.	✓	✓
Annually manage a minimum of 20 percent of emergent marsh habitat to control invasive plants and enhance habitat, especially for Oregon spotted frog.		✓
Move stranded Oregon spotted frog eggs into nearby water as appropriate.	✓	✓

Rationale:

The Refuge supports approximately 34 acres of emergent marsh habitat found in patches along the edge of the river and tributary channels. This important habitat is vital for providing Oregon spotted frog breeding and egg-laying locations. Thurston County's Oregon spotted frog population is the second largest in Washington State.

Emergent marsh habitat has perhaps the most reed canarygrass. Staff would expand IPM control measures on an additional 20 percent of the habitat specifically to benefit the rare and declining Oregon spotted frog. Unit staff would continue to work with partners and seek new partnerships to develop and implement new techniques for controlling reed canarygrass (see Appendix H). The Unit would work with Natural Resources Conservation Service on Workforce Recruitment Program lands to reduce the negative impacts reed canarygrass causes to Oregon spotted frog and to improve habitat for Oregon spotted frog use.

Unit staff would continue to monitor and manage all known Oregon spotted frog use sites and expand inventory areas on the Unit to identify oviposition and overwintering sites (see Goal 4). Promoting the survival of the Oregon spotted frog, staff would continue to relocate the few stranded egg masses laid each year to safer habitat as necessary. Enhanced inventories and surveys would be necessary to identify the presence of the federally listed plant, water howellia, which is suspected to occur on the Unit.

See Objective 1.1 and Section 4.6 for the rationale for bullfrog control and treatment.

Black River Unit Objective 1.7: Manage and enhance seasonally flooded, nonnative grassland habitat

Manage 82 acres of seasonally flooded, nonnative grasslands for amphibians such as Oregon spotted frog, migratory and marsh birds, and other wildlife.

Characteristics of these wet, nonnative grasslands include:

- Dominated by combination of pasture grasses and reed canarygrass
- Former farm-, crop-, or pasturelands
- 0–25 percent remnant emergent marsh or shrub swamp species
- Located along the river and tributary edges, swales, oxbows, and land depressions that connect to other wetlands and deeper waters
- Annual high surface water conditions between November and May ranging from 5 inches to 4 feet of standing water depth, depending upon land elevation
- Surface water levels drop throughout the summer resulting in dry, moist, or saturated soils in early fall
- A portion of this habitat may be minimally appropriate for amphibian (including Oregon spotted frog) breeding and egg-laying conditions in late winter or early spring**
- Connection to deeper water sites in early summer for frog or tadpole movement
- Water conditions that may support rearing juvenile Oregon spotted frog in late spring and early summer**
- Algal growth on the monoculture reed canarygrass vegetation provides some juvenile amphibian foraging opportunities
- Zero to minimal levels of nonnative bull frog populations**

- Managed reed canarygrass

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Develop and implement an array of effective techniques (including IPM strategies) to contain, control, manage, or retard reed canarygrass in difficult-to-access conditions. Manage this habitat using a variety of tools such as mechanical, physical, biological, herbicide, or chemical methods, which include mowing, haying, selective hand-cutting and thatch removal, disking or tilling, fertilizing, herbicides, herbivore grazing, prescribed fire, water control methods, barrier cloth placement, and/or planting more appropriate plant species.	0.75 acres	Up to 25 acres
Continue partnerships with other agencies to develop and implement reed canarygrass management in non-diked emergent marshes and seasonally flooded habitats.	✓	✓
Use IPM methods to manage reed canarygrass growth and create low grass, moist soil conditions.	✓	✓
Manage reed canarygrass on all known Oregon spotted frog breeding sites as needed to enhance egg-laying, larval, and juvenile frog development.		✓
Move stranded Oregon spotted frog eggs into nearby water as appropriate.	✓	✓
Evaluate and enhance seasonally ponded areas and improve water management capabilities as needed through installation of water control structures, ditch or culvert removal, and improvements to water level management capabilities.		✓

Rationale:

Historically, this seasonally flooded, nonnative grassland habitat was likely healthy emergent marsh habitat. However, over time, nonnative grasses used for agricultural purposes have dominated and changed the former emergent marsh habitats. The Unit manages approximately 82 acres of seasonally flooded, nonnative grassland habitat that supports a variety of species including Oregon spotted frog, migratory and marsh birds, and other wildlife.

The Unit focus would be to implement and increase Oregon spotted frog management activities by improving breeding sites, enhancement of egg-laying areas, and expansion of juvenile frog-rearing habitat.

Seasonally ponded areas would be evaluated and water management capabilities may be improved through the installation of water control structures and/or ditch or culvert removal in order to achieve appropriate water conditions for Oregon spotted frogs. Per WDFW (2013), the hydrological needs for Oregon spotted frogs are summarized thusly:

Watson et al. (2000) found that different life stages of Oregon spotted frogs had different hydrological needs that varied by season. For development of eggs and larvae, relatively stable water levels were needed during the breeding season. For survival of transformed frogs, deeper water pools were critical during the summer dry season. Adequate water levels over emergent vegetation were important for survival of all age classes during the wet season and coldest time of the year. A topographic gradient with overall gradual relief was vital for providing this mix of aquatic conditions and aquatic connectivity between areas used. Watson et al. (2003) stressed that the most important features for microhabitat use were water depth, flow characteristics (still water was used over flowing water) and a high degree of water surface exposure (i.e., 50–75% water) or conversely, a low to moderate degree of emergent vegetation (i.e., 25–50%). The predominant use of shallow water habitat by Oregon spotted frogs was illustrated by Watson et al. (1998, 2003), who found Oregon spotted frogs (n = 295 radio-telemetry locations) selected water depths of 10– 30 cm (~4–11.7 in.) with less emergent vegetation and more submergent vegetation than adjacent habitats.

Nonnative grasses, such as reed canarygrass and other pasture grasses, have increased the habitat management challenges and made restoration efforts nearly impossible in some areas. To manage nonnative grasses and provide the best Oregon spotted frog breeding habitat requires an intensive management program that includes herbivore grazing and mowing of the nonnative grasslands.

Unit staff would seek partnerships to develop effective IPM techniques to control and manage nonnative grasses such as reed canarygrass where feasible.

Staff would continue to monitor Oregon spotted frog populations and evaluate habitat improvement projects (see Objective 4.1–4).

Goal 2. Protect and maintain upland habitats characteristic of the upper Black River watershed.

Black River Unit Objective 2.1: Protect, maintain, and enhance dry, nonnative grassland habitat

Protect, maintain, and enhance 163 acres of dry, nonnative grassland for species that depend upon open, short, forbacious, upland grassland conditions such as migratory birds and other wildlife.

Characteristics of nonnative grasslands include:

- Well-drained soils in upland areas, may have been former croplands, pasturelands, or forests
- ≥ 30-acre patches of low-growing vegetation
- Mosaic of vegetation heights between 6 and 36 inches
- Mix of desirable, palatable grasses such as native Roemer's fescue, red fescue, California oatgrass, and nonnative grasses such as velvet and timothy**
- Mix of native and nonnative forbs to benefit pollinators such as early blue violet, large leaf lupine, pearly everlasting, northwest cinquefoil, yarrow, aster, blue-eyed Mary, goldenrod, clovers, and alfalfa**
- Contain a single or occasional patch of large growing, cavity-producing trees such as big leaf maple or Garry oak
- Native shrubs form a border around the grasslands and provide transitional habitat for nesting cover and roosting habitat for birds and provide dispersal habitat for small mammals
- Minimal human disturbance to wildlife populations, especially during spring nesting season and winter use by elk and migratory birds
- ≤5 percent cover of nonpalatable/invasive plants such as burdock, broom, teasel, thistle, or blackberries**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Maintain dry, nonnative grasslands in appropriate early successional stage, as open savannah-like habitats to benefit open, short-grassland-adapted species. Techniques may include mechanical mowing, haying, fertilizing, herbicides, herbivore grazing, prescribed fire, barrier cloth placement, invasive plant control, seeding, and/or planting native plants.	163 maintained acres	148 maintained acres
Achieve greater composition of native grasses and forbs by enhancing 15 acres. Techniques may include mechanical mowing, haying, fertilizing, herbicides, herbivore grazing, prescribed fire, barrier cloth placement, invasive plant control, seeding.		15 acres enhanced
Identify potential enhancement sites for native grasses and forbs.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Plant 3–5 big leaf maples and/or Garry oaks where appropriate on approximately 50-acre blocks to provide habitat for cavity-nesting birds and enhance grassland habitat diversity to benefit appropriate species. Protect solitary or interspersed big leaf maple or Garry oak trees within nonnative grasslands by placing tree collars, fencing saplings, and similar habitat enhancement measures.		✓
Hire permanent maintenance worker to conduct habitat management and enhancement in uplands and wetlands, invasive control work, and maintain posting and signing needed to protect Black River Unit habitats.		✓

Rationale:

Historically, this habitat may have been grasslands maintained by Native American burning practices or possibly late successional forest habitat before the habitat was converted for agricultural purposes in the late 1800s. It is not classified as prairie because it lacks the appropriate soil types normally associated with prairie habitats in the Black River watershed. However, because so little native prairie remains in Thurston County, these grasslands, with some enhancement, can help support species that prefer larger, open spaces of short grass, flowering herbaceous plants, and an occasional large cavity-producing tree that provides perches and nesting cavities. Ideally a transition area of shrubs would provide an area of cover for animals utilizing both grasslands and woodlands.

The Unit supports 163 acres of dry, nonnative grassland habitat, which consists of a mixture of mostly nonnative grasses, nonnative forbs, and shrubs that function to support a wide variety of birds and animals.

The Unit would conduct active management on 148 acres of this nonnative grassland habitat by mowing, haying, and controlling invasive plants to maintain an early successional stage of open, savannah-like habitat. Grassland-oriented species, including resident and migratory birds such as western meadowlark, American kestrel, and owls; foraging herbivorous waterfowl such as geese and American wigeon; pollinators such as butterflies, moths, and hummingbirds; and wintering ungulates such as black-tailed deer, would benefit from early successional stage habitat.

The Unit would identify and enhance a minimum of 15 acres with native grass and native forb species to benefit native pollinators, other native insects, birds, and other native animals. Enhancement techniques to achieve the desired plant compositions may include mechanical mowing, haying, fertilizing, herbicides, herbivore grazing, prescribed fire, barrier cloth placement, invasive plant control, seeding, and/or planting native plants. IPM techniques would be utilized to control and monitor undesirable and nonpalatable plant species (see Appendix G).

Unit staff would establish and protect a few big leaf maples and/or Garry oaks on approximately 50-acre blocks to provide habitat for passerine and raptor perching, cavity-nesting birds such as owls, and bat roosting to enhance both habitat and wildlife diversity.

Black River Unit Objective 2.2: Protect, maintain, and enhance upland mixed forest habitat

Protect, maintain, and enhance 394 acres of mixed forest for migratory birds, mammals, and other native wildlife.

Desired characteristics of a good quality mixed forest include:

- Well-drained soils that are moist much of the year and dry for approximately 3–4 months
- As stands mature, Douglas-fir, grand fir, western hemlock, western red cedar, and big leaf maple dominate the canopy as early successional red alder becomes less dominant**
- Selected individual trees or groups of trees of >12”diameter and 20’ long become snags and logs and enhance diversity
- Mid-story and understory development depend upon forest maturity, moisture, and light availability and may include yew, salal, salmonberry, osoberry, tall Oregon grape, beaked hazel, vine maple, red, evergreen, and black huckleberry, trailing blackberry, twinflower, inside-out flower, wild ginger, sorrel, Pacific bleeding heart, starflower, trillium, columbine, and bunchberry**
- < 10 percent cover of invasive plants in the mid- and understory layers

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Monitor and use appropriate IPM techniques, such as mechanical, physical, biological, and chemical methods (see Appendix G), to control invasive or undesirable plant or animal species.	✓	✓
Annually control or manage invasive species in a minimum of 20 percent of mixed forest habitat.		✓
Evaluate and manage forests through various forest management practices (variable density stand thinning, etc.) to convert young stands into structurally diverse mature forests that include diverse mid- and understory development.		5–10 acres

Rationale:

Mixed forest habitats are abundant throughout the southwest Washington region. This upland mixed forest habitat type is made up of a variety of deciduous and coniferous trees found in a mosaic of successional stages important for wildlife diversity. Most upland areas on the Unit are young forest stands recovering from logging and currently include a predominance of young Douglas-fir. No old-growth forest is located on Unit lands, and forests over 80 years are rare in this watershed. This younger age-class lacks the density of snags that are found in older forests.

The Unit would encourage upland mixed forests to mature over time into old-growth forests that might eventually support rare species such as the marbled murrelet and Northern spotted owl. Linkage between conifer forests of Capital State Forest, Unit upland mixed forests, riparian forests, and swamps provide habitat corridors for wildlife to move as seasons dictate or food requirements change. Forest enhancement and linkage would benefit many species of wildlife associated with this

habitat type including many species of landbirds, both resident and migratory, many myotis bat species, as well as silver-haired and hoary bats, many small rodent species, including mountain beaver, Douglas and flying squirrels, Townsend's chipmunk, and larger mammals such as elk, black-tailed deer, black bear, and mountain lion.

Forest management would include a thorough evaluation of the Unit forests and overall forest health with the aid of partners such as USDA Forest Service, Pacific Northwest Research Station. Forest management practices (variable density stand thinning, etc.) would be implemented on a minimum of 5–10 acres to transition young stands into structurally diverse forests that include multi-species mid- and understory development.

To maintain the health and diversity of the habitat, Unit staff would manage invasive species, such as reed canarygrass, Scotch broom, and nonnative blackberry, on a minimum of 20 percent of mixed forest habitat (see Appendix H).

Goal 3. Contribute to the protection and long-term environmental health of the greater Black River watershed and ecosystem.

Black River Unit Objective 3.1: Develop and strengthen partnerships

The Unit would initiate, develop, and continue to strengthen existing partnerships with interested groups for the benefit of the long-term environmental health of native wildlife and their habitats.

Partnership actions include:

- Working with and involving local communities, Tribes, universities, landowners, NGOs, agencies, and other interested parties
- Identifying the Service's role in conservation efforts with the focus on partnerships that provide support for natural resources
- Utilizing existing and supporting new eco-regional plans and priorities
- Working with and assisting others in the recovery of threatened and endangered species**
- Working with others and assisting with management objectives, resource protection, and research**
- Working with others to control and manage nonnative plants and enhance habitats**
- Considering and participating in climate change initiatives and research**

***Attributes identified in current and/or proposed inventory, monitoring, and research activities*

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Continue to work with partners such as the Thurston County Noxious Weed Control Board (TCNWCB) to continue coordinated control efforts and monitoring of invasive plant and animal species.	✓	✓
Continue to participate and coordinate with the Washington and Oregon Spotted Frog Working Group partners to plan and implement recovery strategies both on- and off-Refuge. (Objectives 1.1, 1.2, 1.4, 1.6, 1.7, 4.3.)	✓	✓
Maintain and improve partnerships with natural resource agencies, Tribes, NGOs, and private companies involved in land management and restoration at Black River.	✓	✓
Work with State, county, Tribes, and other partners to develop a plan (based on a completed WRIA) to ensure an appropriate water budget and delivery conditions (water quality and quantity) are sustained in the Black River and tributaries. (see Objectives 1.1, 1.2, 1.3, 1.6, 1.7)		✓
Endorse and partner (where feasible) with public and private organizations, Tribes, and adjacent landowners to maintain and enhance connectivity of native plant communities and habitat quality on lands adjacent to the Refuge and other protected lands in the watershed.		✓
Partner with the TCNWCB and others to provide education and outreach opportunities, including with local landowners, on invasive plant control and the impacts of invasive plants to the habitat and methods of reducing and controlling infestations.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Partner to educate and encourage private landowners to maintain healthy habitats for fish, amphibians, and native wildlife.		✓
Coordinate with partners to develop and/or evaluate suitability of techniques to control populations and reproduction of invasive frogs and invertebrates.		✓
Partner with interested agencies to determine an array of effective techniques (including IPM strategies) available to contain, control, or manage reed canarygrass in difficult wetland conditions.		✓
Work with partners to locate, protect, and conserve land within the watershed, especially priority habitats such as bogs and emergent marsh and rare and declining species.		✓
Endorse and partner (where feasible) with public and private agencies and adjacent landowners to maintain and enhance connectivity of native habitats, habitat quality, and native plant communities within the watershed.		✓

Rationale:

The approved Unit boundary includes only the northern portion of the Black River, and further acquisition is ongoing. The limited size of current ownership limits the Unit's ability to provide landscape-level benefits, such as greater watershed protection and buffers for sensitive habitats and species.

Achieving landscape-level habitat protection would require partnerships beyond the Unit boundary. Unit staff would work to develop new partnerships to provide the necessary habitat monitoring, protection, resources, and educational information to help maintain the Black River ecosystem in a healthy, sustainable condition. Conservation projects occurring near the Unit also strengthen habitat and wildlife protection inside the Unit boundaries. By developing and strengthening partnerships, conservation of the Black River watershed would be more effective by combining efforts and leveraging financial and technical resources from other entities (other governmental organizations, NGOs, Tribes, and private landowners). Whenever possible the Unit would seek to engage private landowners in voluntary conservation projects to enhance the health of wildlife habitat and protect water quality. Through an active role in local, State, Tribal, and Federal partnerships, Unit staff would work to improve and protect water quality and the ecological integrity of the Black River Watershed.

Partnerships include the Chehalis Tribe, Capitol Land Trust, Port Blakely, Center for Natural Land Management, TCNWCB, Thurston County, Thurston Conservation District, Washington Department of Ecology, WDFW, WDNR, and the Service's Washington Fish and Wildlife Office. Conservation efforts would continue to focus on protecting and enhancing habitats locally by participating in various groups such as the Washington Oregon Spotted Frog Working Group, Chehalis River Cooperative Weed Management Working Group, and others to implement working-group strategies and goals shared by the Unit.

Goal 4. Gather scientific information (inventories, monitoring, and research) to support adaptive management decisions.

Black River Unit Objective 4.1: Inventory

Conduct scientific inventories to provide information regarding the status of Unit resources and better guide resource management decisions. These scientific inventories and surveys would contribute to the development of Unit resource objectives. They would also facilitate habitat restoration through selection of appropriate habitat management strategies based upon site-specific conditions.

These inventory activities would have the following attributes:

- Inventory habitats, species or species groups according to the Unit's approved I&M Plan and associated protocols
- Scale, accuracy, and completeness of inventories that would be appropriate for development and implementation of Unit habitat and wildlife management actions
- Data collection techniques that would reduce animal mortality, disturbance, and habitat destruction
- Proper cleaning of investigator equipment and clothing and use of quarantine methods, where necessary, to minimize the potential spread or introduction of invasive species and disease

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Develop a Unit I&M Plan within 3 years of CCP completion that provides the management rationale, timing, and costs for conducting Refuge surveys; lists the prioritized surveys; identifies the surveys selected for implementation; and documents the protocols that describe the survey objectives and methods.	✓	✓
Implement the Black River Unit I&M Plan within 5 years on currently owned tracts and within 2 years of acquiring any new tracts; create a plan for appropriate habitat enhancement.		✓
Characterize all known Oregon spotted frog oviposition sites, including habitat, elevation, and hydrology, to provide a comparison for future monitoring.		✓
Inventory new areas and identify new oviposition locations for Oregon spotted frog (see Objective 1.2).	✓	✓
As tributary and river channel habitat is acquired, assess each for key biotic and abiotic characteristics and potential enhancement needs (see Objectives 1.1 and 1.2).		✓
Partner with appropriate science experts to find, classify, and map all bog sites on the Unit. (Objectives 1.3 and 3.3)		✓
Conduct inventory of terrestrial and wetland plants in existing and any newly acquired tracts to determine nonnative plant species presence, relative abundance, and determine the need for nonnative species control.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Conduct submerged plant inventory to determine presence or absence of invasive species growing in the river and tributary channels.	✓	✓
Conduct presence or absence inventories on nonnative animal populations and evaluate distribution and relative abundance in key habitats.		✓
Within 5 years of CCP completion, begin inventories for bullfrog concentrations and their egg-laying locations. Survey first at known Oregon spotted frog oviposition habitats.		✓
Conduct inventories to gather data (presence/absence, habitat use, relative abundance) on wildlife species such as small mammals (e.g., rodents, bats), amphibians, reptiles, invertebrates, and pollinators.		✓

Rationale:

An inventory is defined as a survey that estimates the presence, abundance, or distribution of species, habitats, ecological communities, or abiotic features at a particular time (701 FW 2). Inventories may also establish a beginning time-step (baseline) or reference information for subsequent monitoring. For example, a well-designed inventory may be repeated at a later time to assess the status and trends in the same location, which would then be considered monitoring. Inventories would provide fundamental information about biotic (e.g., vegetation data) as well as abiotic processes and conditions (e.g., water quality, water flow) that are necessary to ensure that implementation of on-the-ground resource management achieves the resource management objectives identified under Goals 1–3.

Specifically for the Black River Unit, a Unit I&M Plan needs to be developed to document the surveys required to determine species status, assess habitat condition, detect changes in diverse fish, wildlife, and plant communities and physical resources including water, air, and soils and ecological processes. The I&M Plan would include information on the specific metrics required for supporting management decision-making and may include presence/absence, species composition, seasonal habitat use, spatial distribution, and/or population estimates. Field work to inventory biological status of current and newly acquired lands would take place on each of the habitats, especially in the bog habitat.

Funds are currently prioritized to perform the most pressing projects on the Nisqually National Wildlife Refuge Complex, leaving few resources and staff available to conduct Black River-specific baseline assessments. Partnering with other field biologists from natural resource agencies, NGOs, private lands, and using qualified volunteers would be instrumental in accomplishing these inventories.

Black River Unit Objective 4.2: Monitoring

Conduct high-priority monitoring activities that evaluate changes in the status of fish, wildlife, and their habitats. The information gathered facilitates adaptive management actions for resource management and public use activities. Monitoring projects can take place annually or periodically depending on species, habitat, or management needs.

Monitoring of wildlife and habitat contributes to the enhancement, protection, use, preservation, and management of wildlife populations and their habitats on and off Unit lands. Information gained can be used to evaluate achievement of resource management objectives identified under Goals 1–3.

These monitoring and survey activities have the following attributes:

- Projects would adhere to scientifically defensible protocols for data collection, where available and applicable
- Data collection techniques should have minimal animal mortality, disturbance, habitat destruction
- Minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) to meet statistical analysis requirements would be collected for identification and/or experimentation in order to minimize long-term or cumulative impacts
- Proper cleaning of investigator equipment and clothing and use of quarantine methods, where necessary, would minimize the potential spread or introduction of invasive species and disease

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Within 3 years of CCP completion, develop a Unit I&M that provides the management rationale, timing, and costs for conducting Refuge surveys; lists the prioritized surveys; identifies the surveys selected for implementation; and documents the protocols that describe the survey objectives and methods.	✓	✓
Monitor and assess condition and availability of appropriate habitats for rare, declining, federally or State-listed, and priority species or species groups.		✓
Annually conduct Oregon spotted frog egg surveys to assess population status and habitat use (see Objective 1.6).	✓	✓
Annually assess Oregon spotted frog oviposition site locations for habitat enhancement opportunities.		✓
Monitor to determine if Oregon spotted frog eggs develop successfully when laid on reed canarygrass leaf mats in deep water.		✓
Annually monitor the effects of habitat enhancement project success in Oregon spotted frog oviposition habitat using frog-egg-mass numbers and location (see Objective 1.6).		✓
Monitor the effectiveness of any bullfrog control methods to benefit Oregon spotted frog, other amphibians, small fish, birds, and invertebrates.		✓
Partner with other agencies or groups to periodically monitor the river and tributary channel(s) within Unit boundaries for water quality, quantity, flow rate, turbidity, dissolved oxygen, pH, nutrients, connectivity, and other parameters to benefit all native species and nearby wetland habitats.		✓
Within 5 years, specifically establish a long-term bog habitat monitoring program to look at habitat condition, threats, and changes over time.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Include monitoring of plant and animal species composition and density, ground pH, nutrient levels, soils, hydrology, and incorporate the I&M Plan (see Objective 1.3).		
Periodically monitor for potential biological integrity threats that may develop in habitats NOT targeted for enhancement to benefit species that use those habitats.		✓
Periodically monitor actively managed or enhanced habitats to assess response by key avian, mammalian, and other wildlife species to support adaptive management.		✓
Annually survey at least 0.5 miles of the river or tributaries for nonnative submersed plants in the channels (see Objectives 1.1 and 1.2).		✓
Survey, GPS, and map the invasive, nonnative reed canarygrass along the river channel and monitor changes over time (see Objective 1.1).		✓
Survey, GPS, and map locations of yellow flag iris, purple loosestrife, reed canarygrass, and other specific nonnative or invasive plant species threatening Unit wetlands. If plants are found, implement IPM control strategies (see Appendix G).	✓	✓
Continue to partner with agencies to monitor effectiveness of various management techniques used to control, contain, or manage reed canarygrass to learn most efficient, useful, effective, and long-term methods for the benefit of Oregon spotted frog and other wildlife.	✓	✓
Periodically monitor nonnative animal control effort efficacy, if implemented, in specific wetland habitats and monitor wildlife response (presence/absence) to nonnative animal removal over time.		✓
Annually monitor all enhanced habitats for invasive plant regrowth and needed treatment.		✓
Monitor results of Landscape Conservation Cooperative and other large-scale and long-term monitoring and research efforts to assess resilience of refuge habitats to changing climate trends.		✓
Work with partners to monitor environmental factors that are climate change-related stressors (e.g., changes to hydrology, water temperature).		✓
Establish a biological technician position to focus on wildlife and habitat surveys and monitoring of trends and changes in plant and wildlife populations.		✓

Rationale:

Monitoring consists of repeated survey efforts intended to document changes over time (e.g., months to years) and space in select attributes of wildlife, plants, habitats, ecological communities, or abiotic resources. Two types of monitoring in the Service policy (701 FW 2) are:

> (1) Baseline monitoring. Monitoring that is not tied to specific predictions of how a natural resource will respond to management or environmental stressors, but instead is designed to document change over time of a natural resource. Examples include monitoring wildlife population trends, disease incidence, and climate change.
>
> (2) Monitoring to inform management. Monitoring to assess whether a natural resource is approaching or exceeding a known threshold, or if a resource is responding to a management action or system stressor in a specified manner. This type of monitoring involves defining the threshold values or expected response, then surveying to measure the response or a closely related indicator. Comparing monitoring results with these expected values may show a need for initiating, intensifying, or altering management actions. Results from this type of monitoring are used in an adaptive management context to improve management or evaluate progress toward achieving management objectives, as derived from the Refuge System mission and Refuge purposes.

Periodic monitoring for rare and sensitive species, as well as key avian, mammalian, and/or other wildlife species would provide information on their status and habitat quality. Species response to habitat enhancements would need to be understood to adapt management techniques. As noted in Objective 4.1 and Chapter 4 the bog habitat and potential RNA may include a complex mosaic of habitats and species that are very sensitive to abiotic changes and require close monitoring.

Working with partners to monitor Oregon spotted frog on Unit lands has been ongoing and with increased monitoring, would provide critical information on the frog populations, habitat usage, and habitat quality. Additionally, long-term monitoring of bullfrog presence/absence is important for continued Oregon spotted frog survivorship. Monitoring habitat manipulation efforts and results, especially to control reed canarygrass, would assist managers in learning and adapting techniques to further enhance habitats. Monitoring fish and wildlife response to habitat manipulations would help guide managers to support sound management decisions and provide higher quality habitat.

Most wetland habitats in the Black River Unit are difficult and time consuming to physically access, and walking or paddling are challenging. Extensive field work is needed to survey and monitor habitats, fish and wildlife, rare and sensitive species, and specific responses of animals to management techniques. The current, single biologist for the three refuges in the Nisqually National Wildlife Refuge Complex would not be able to conduct all of the needed Black River Unit monitoring activities, even with partner and volunteer assistance. Because of the work load, a new biological technician position is needed to help conduct habitat inventory and monitoring projects in the field, enter data, work with partners, and assist researchers.

The Unit would partner with natural resource entities, specifically the North Pacific LCC, to address climate change and other biological stressors. As needed, objectives and strategies would be adjusted to assist in enhancing Unit resources' resiliency to climate change, and to potentially manage for new species assemblages in the future.

The Unit would monitor wildlife corridor analyses, research potential shifts in species distributions and/or timing of migration, vulnerability assessments, and other efforts, including those underway at a landscape scale, such as the North Pacific LCC. LCCs are formal science-management partnerships between the Service, other Federal agencies, States, Tribes, 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. As needed, objectives and strategies would be adjusted to assist in enhancing Unit resources' resiliency to climate change, and to potentially manage for new assemblages of species in the future.

Black River Unit Objective 4.3: Research

Conduct high-priority scientific research projects that provide the best science for habitat and wildlife management on- and off-Unit. These research projects may identify cause-and-effect relationships, produce new knowledge, and last 1–3 years. Scientific findings gained through these projects would expand knowledge regarding life-history needs of species and species groups as well as identify or refine habitat and wildlife management actions.

Research would also reduce uncertainty regarding wildlife and habitat responses to Unit management actions in order to achieve desired outcomes reflected in resource management objectives and facilitate adaptive management.

These research projects would 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 would likely have minimal animal mortality, disturbance, and 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 and disease
- Often result in peer-reviewed articles in scientific journals and publications or symposiums

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Within 5 years, set up research to investigate the status and long-term condition of known bog habitat, including general plant and related animal species composition, hydrological conditions and needs, and relative health and stability of this rare plant community.		✓
Continue to participate in studies to develop an array of effective methods to contain, control, manage, or retard rank reed canarygrass in wet and wetland conditions and implement as methods are developed.	✓	✓
Investigate effective IPM control techniques specifically for reed canarygrass that is invading river and tributary channels and apply to 0.25 miles annually as effective, feasible techniques are developed.		✓

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Within 7 years of CCP completion, develop effective techniques to reduce known populations of nonnative bullfrogs using IPM methods and implement and monitor where needed in key locations based on survey results.		✓
Develop research projects with the help of qualified researchers to explore factors affecting priority wildlife species and their habitats, with the intent to increase our understanding and ability to manage these resources.		✓
Seek funding and support partnerships to conduct a hydrological modeling study of the entire Black River system to identify impairments, management needs, and identify feasible measures to improve water quality and flows for natural resource management and improvements in the watershed.		✓
Coordinate with partners to develop and/or evaluate suitability of techniques to control populations and reproduction of invasive frogs and/or invertebrates without negatively affecting salmonids, Olympia mudminnow, Oregon spotted frog, or rare or declining species in the Black River ecosystem.		✓
Examine ephemeral Oregon spotted frog habitats and connectivity to permanent water locations during the dry seasons, and determine the value and/or threats of artificially connecting isolated marshes.		✓
Conduct research to examine survivorship of Oregon spotted frog eggs, larvae, tadpole and juvenile frogs, habitat use, and investigate predation and other threats.		✓
Support partnerships to investigate Oregon spotted frog ecology and nonbreeding habitat use and needs to provide information to support habitat management and land protection decisions.		✓
Determine the threats and challenges to Oregon spotted frog that could be reduced through adaptive management.		✓

Rationale:

Research projects on Unit lands would address a wide range of natural and cultural resources. Examples of research projects include habitat use and life-history requirements for specific species/species groups, practical methods for habitat management and enhancement, extent and severity of environmental degradation, including water loss or contamination, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, or modeling of wildlife populations. Projects may be species-specific, Unit-specific, or evaluate the relative contribution of the Unit to larger landscape (ecoregion, region, flyway, national, international) issues and trends. Like monitoring, results of research projects would expand the best available scientific information and potentially reduce uncertainties to promote

transparent decision-making processes for resource management on Unit lands. In combination with results of surveys, research would promote adaptive management on Unit lands.

Specific research needs in the Black River Unit include developing and implementing more effective yet practical methods to control reed canarygrass without having the ability to control water levels. Special attention and study is needed to learn cost efficient, practical methods to control or reduce reed canarygrass density in all wetland habitats but especially in the river and tributary channels, while minimizing impacts to aquatic residents. One of the challenges of developing reed canarygrass management techniques for use in the river is the difficulty in accessing sites.

Ensuring that enough high-quality water flows through the river and tributaries and provides an adequate hydrologic regime for the mosaic of associated wetlands is of utmost importance to the Unit purpose and function. A WRIA of the Black River system is needed to identify impairments, management needs, and feasible measures to improve water quality and flows for natural resource management and improvements in the watershed. This information is vital to effectively managing the Unit.

The Unit would monitor wildlife corridor analyses, research on potential shifts in species distributions and/or timing of migration, vulnerability assessments, and other efforts, including those underway at a landscape scale, such as the North Pacific LCC.

Goal 5. Provide quality opportunities for visitors to experience a diversity of wildlife and habitats to enhance their understanding and appreciation of the Black River Unit's natural resources and foster a connection with nature.

Black River Unit Objective: 5.1 Welcome and Orientation

Provide visitors with welcoming and orienting features, facilities, and experiences. These would be characterized as follows:

- Refuge sign
- Information kiosk
- Orientation signs
- Signs directing visitors to a parking area
- Use of electronic and print media to reach and orient visitors

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Install a Unit sign at the vehicle pull-off area on the west side of Endicott Road when it is developed.		✓
Work with WDFW to provide Watchable Wildlife signs.		✓
Develop a brochure for the Unit.		✓
Provide electronic and print media with accurate information that is positively worded and available at the Unit kiosk and other local venues such as the Chamber of Commerce.		✓

Rationale:

Customer service and first impressions are important to visitors feeling welcome and safe at national wildlife refuges. Visitors to the Black River Unit do not necessarily know they are on a unit of a national wildlife refuge and need welcome and orientation features that are easily found and well maintained. Materials should provide accurate, timely, and appropriate information on Unit facilities, programs, and experiences. These strategies would increase Unit visibility and promote visitor compliance with Unit regulations.

Black River Unit Objective: 5.2 Provide high-quality wildlife observation and nature photography, interpretation and environmental education opportunities

Provide compatible wildlife observation and photography, interpretation and environmental education opportunities with the following characteristics:

- Facilities are safe, fully accessible, and available to a broad spectrum of the public
- Opportunities exist to view and photograph a diversity of wildlife in their natural habitat and setting
- Access is provided to several habitat types, but mainly the river habitat
- Viewing opportunities are tied to interpretive and educational opportunities
- Observation opportunities promote public understanding of the Unit's resources and its role in managing and protecting those resources

- Observation occurs in places with the least amount of disturbance to wildlife
- Observers have minimal conflict with other visitors or operation of the Unit

Strategies Applied to Achieve Objective:	**Alt 1**	**Alt 2**
Design and install a vehicle pull-off area with interpretive signs on west side of Endicott Road for wildlife viewing. The area could accommodate several parked cars and a pull-through for cars and buses to stop briefly for wildlife and habitat viewing.		✓
Provide interpretive and regulatory signage at the vehicle pull-off area.		✓
Install a small viewing deck at the vehicle pull-off area for wildlife viewing.		✓
Design and install a small parking area on the east side of Endicott Road.		✓
Install a short trail to a viewing deck with views of the Black River and associated habitats at the parking area on the east side of Endicott Road. Interpretive panels would enhance the visitors experience and knowledge of the area's natural resources.		✓
Develop an interagency agreement or similar instrument with WDNR to allow cooperative management of public uses of the Black River channel.		✓
Upon establishment of the planned Thurston County Gate-Bellmore Trail, which would run along the eastern edge of the Unit, explore potential spur trails into the Unit to provide wildlife viewing opportunities.		✓
Explore opportunity for a cooperative agreement with Thurston County to facilitate improvements on the county right of way at 123rd Avenue including a boat launch, small parking area, and new kiosk and interpretive signs on the southeastern side of bridge.		✓
Look for opportunities to partner with business, agencies, and organizations that are providing environmental education to local students.		✓

Rationale:

Compatible wildlife observation, photography, interpretation, and environmental programs receive priority consideration in planning and management on national wildlife refuges, secondary to the needs of fish and wildlife. Wildlife observation is the primary visitor activity at the Black River Unit. Wildlife observation and photography programs are designed to provide a diversity of high-quality viewing opportunities for visitors while minimizing disturbance to wildlife and habitats. These activities increase public understanding and appreciation for America's natural resources and incorporate a message of stewardship and conservation.

The Unit allows bird watching, wildlife observation, and recreational opportunities in habitats unique to the local area. The native habitats at the Unit, such as the river corridor and the associated uplands and wetlands, are most easily experienced by boat. Currently, the only place available for public boat launching is an undeveloped Thurston County right-of-way at 123rd Avenue. By making

improvements to this county land and adding a small parking area in the Unit-owned uplands adjacent to the ROW, visitors would have an improved place to launch boats.

A small vehicle pull-off area and interpretive information are proposed to bring vehicles off Endicott Road to view wildlife and increase visitor safety. Trail connections with Thurston County would enhance both the County's trail system and provide an avenue for Unit visitors to experience the habitats closely associated with the river. The Unit would be open to the public from sunrise to sunset. Areas not specifically open would be closed to protect wildlife and habitat from disturbance.

Goal 6. Support and develop an active volunteer program and partnerships to assist in providing quality visitor services programs and outreach.

Black River Unit Objective: 6.1 Develop and promote a Unit volunteer program

Develop, support, and maintain a volunteer program associated with the Unit with the following attributes:

- Provide effective training and program management
- Support and complement the Service mission and current initiatives
- Increase visibility and foster conservation
- Support a variety of Unit programs/activities and increase their effectiveness
- Encourage community involvement and strengthen relationships

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Identify areas where volunteers could work in support of Unit programs and management objectives.		✓
Publicize volunteer opportunities to recruit new volunteers from the local community.		✓
Look for ways to partner with other organizations to provide volunteers.		✓
Maintain an up-to-date "Volunteer Training Manual."		✓
Provide a training course for volunteers on the Service, Billy Frank Jr. Nisqually National Wildlife Refuge and the Black River Unit history, management, and natural resources; the specifics of the Unit volunteer program and volunteer opportunities; and the specifics of volunteer duties.		✓
Recruit and train volunteers who would work with a variety of Unit programs.		✓
Recruit and train volunteers from the Nisqually National Wildlife Refuge Complex to help with a variety of Unit activities.		✓
Provide volunteers with annual recognition.		✓

Rationale:

Volunteers provide a very important and needed service on national wildlife refuges. Successful volunteer programs are recognized as a key component of the successful management of public lands and are vital to implementation of refuge programs, plans, and projects, especially in times of declining budgets.

Unit volunteers would be recruited from the local area as well as from the Nisqually National Wildlife Refuge Complex volunteer program. New volunteers would participate in the volunteer training course provided at Nisqually National Wildlife Refuge and be given the necessary information to perform the required tasks. Volunteer projects could include: 1) weed warriors who help to identify and control invasive plants; 2) wildlife surveys and monitoring; and 3) education and outreach.

Volunteers would play an important role as the Unit continues to acquire lands, increase habitat enhancement and management programs, and assist with visitor services programs to the public. In addition to providing assistance with programs and helping the Unit meets its mission, volunteers are outreach ambassadors in the community. They spread the word message about the Unit throughout the community where they live.

Black River Unit Objective: 6.2 Support and encourage partnerships to support visitor services programs

Support and encourage partnerships with the following attributes:

- Partners support the mission of the Unit and Refuge System
- Working together with Unit staff, partners would be advocates for the Unit in helping secure resources and funding for programs and facilities
- Partners would provide needed volunteer support to Unit programs
- Partners may be a part of a network of Friends Groups across the county supporting and advocating for the National Wildlife Refuge System

Strategies Applied to Achieve Objective:	Alt 1	Alt 2
Identify local community groups, businesses, and organizations that could help support the Unit's visitor services program and facilities development.		✓
Work with local partners to develop public programs.		✓
Explore ways to work with the Chehalis Basin Partnership and other partners to provide education and outreach to local communities.		✓

Rationale:

National wildlife refuges have developed extensive and sophisticated partnerships and Friends Groups in order to carry out the mission of the Refuge System. Partners provide support in a variety of ways at the local, regional, and national levels. Partnerships and Friends Groups provide a way for citizens to be involved in and work to enhance and improve the resources that refuges are mandated to protect.

As the Unit continues to acquire land, improve and enlarge habitat management programs, and open areas and activities to the public, the need for partner support of the visitor services programs would grow. Partners could provide financial or technical support as well as on-the-ground program support. These invaluable contributions by partners would play an important role in the success and growth of the Unit's visitor services programs.

Support at the local level would be important for the development of visitor facilities and programs. Working with a variety of partners would enable the Unit to reach new audiences and to stay active and visible in the local community.

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Chapter 3
Physical Environment

USFWS

Chapter 3. Physical Environment

3.1 Introduction

3.1.1 Grays Harbor National Wildlife Refuge

Grays Harbor lies midway along the Washington coast about 60 miles west of Olympia and 45 miles north of the mouth of the Columbia River in Washington State (Map 1). Grays Harbor Refuge is located in the northeast corner of Grays Harbor estuary in Grays Harbor County. It encompasses Bowerman Basin and consists of 1,471 acres of estuarine open water, intertidal mudflats, salt marsh, and uplands. The Refuge is bordered by industrial development on the east and south, with State Route 109 and a steep upland slope to the north and open estuary water to the west. Approximately 32 miles inland from the mouth of Grays Harbor, the Chehalis River empties into the estuary. Other major tributaries that empty into Grays Harbor include the Humptulips River in North Bay, the Hoquiam and Wishkah Rivers near Hoquiam and Aberdeen, and the Elk and Johns Rivers in South Bay.

3.1.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Black River Unit is located 7 miles southwest of Olympia in Thurston County (Map 1). The Unit boundary begins at the south end of Black Lake at river mile 25. It extends south on either side of the river approximately 7.5 miles to river mile 17.5, just south of 123rd Avenue. The Unit's acquisition boundary is 3,873 acres, and 1,566 acres have been acquired. Much of the Unit lies within the Black Lake, Dempsey Creek, and Black River sub-basin drainages of the Chehalis River. In spite of rapidly growing development nearby, the Unit has retained an isolated and wild character.

3.2 Climate

3.2.1 Grays Harbor National Wildlife Refuge

Grays Harbor has a maritime climate of cool, wet winters and cool, dry summers. Weather patterns are primarily influenced by the Pacific Ocean. Weather parameters representative of the Refuge are measured daily at the Hoquiam/Bowerman Airport adjacent to the Refuge.

The mean annual air temperature between 1953 and 2012 in areas surrounding Grays Harbor was 50.9 °Fahrenheit (°F) (WRCC 2015a). The average temperature difference between day and night is 14 °F during the summer months and 10 °F in the winter. Monthly average air temperatures between 1953 and 2012 can be seen in Table 3-1.

The average annual precipitation for the Hoquiam area from 1953 to 2012 was 69.42 inches and occurred mostly as rain in the winter months (WRCC 2015b). The wettest months are generally November through February. Low temperatures generally range between 20 and 30 °F November through February. During the winter, rainfall is usually of light to moderate intensity and continuous over a long period of time rather than heavy downpours for brief periods. Gray, cloudy days are the norm during the rainy season. Rain can occur any month but is more likely in September and May. The driest months of the year are June, July, and August. Highest temperatures can range in the 90s and can occur from June through September. Two to four weeks may pass with only a few showers

during the summer months. Fog and drizzle may occur year-round, but during the summer months fog often moves in along Washington's coast (GHEMPTF 1987).

Table 3-1. Hoquiam/Bowerman: Air Temperature and Precipitation Summaries, 1953–2012 (WRCC 2015a, 2015b).

Month	Average Temperature (Fahrenheit)	Total Precipitation (Inches)
January	41.9	10.37
February	43.8	7.66
March	45.5	7.56
April	48.5	4.94
May	53.1	3.18
June	57.0	2.21
July	60.1	1.18
August	60.8	1.53
September	59.2	2.97
October	52.8	6.54
November	46.1	10.71
December	42.1	10.59
Annual	50.9	69.42

Storms are unusual in summer, but thunderstorms with occasional hail can occur. Winter storms are common and often generate high winds with large amounts of rain. Snowfall occurs almost yearly with an average of 4.8 inches annually in Hoquiam area. Onshore westerly winds from the Pacific Ocean are predominant year round. The prevailing wind direction in summer is from the northwest; in winter, however, southwesterly winds move air towards the Olympic Mountains, which act as a barrier that affects precipitation and weather conditions. Drier easterly and southeasterly winds are uncommon, but occur periodically each year and are often strong.

Severe storms often hit Washington's coast during the winter, bringing heavy rains, strong winds, and high waves. Storms can generate 70 to 100 inches of rain per year. Coastal storm winds regularly exceed 40 miles per hour (mph). The average annual peak speed of 55 mph can topple chimneys, utility lines, and trees (WDOE 2011).

The larger storms are considered mid-latitude cyclones and can match a Category 3 hurricane in both minimum central pressures and sustained wind speeds (Read 2015). As a strong winter storm system from the southwest approaches the Washington coast, winds created from air pressure differences in the Cascade and Olympic Mountains accelerate as the storm approaches.

A number of severe storms have hit the Pacific Northwest coast in recent years. On March 3, 1999, a coastal storm hit the Grays Harbor area with a storm surge of 4.6 feet and 49.7-mph winds, causing widespread coastal flooding, especially in nearby Ocean Shores on the western edge of Grays Harbor estuary. Wave heights exceeded 29.5 feet for over 5 hours, peaking at 34.8 feet (Read 2015, Sistek 2006). Wind Storm 2006 brought sustained coastal winds of 40 mph which generated high coastal swells augmented by high tides and considerable inland flooding. The Great Coastal Gale of 2007 brought hurricane force winds gusting to 81 mph and heavy rain for 24 hours to the Grays Harbor

area. With every major road out of Aberdeen blocked by fallen trees or mudslides, the storm caused extensive damage throughout the county (Kliem and Holden 2011).

Grays Harbor County has had six declared disasters since 2005 that included severe storms. Usually the storms are county-wide in extent with heavy wind, snow, rain, and ice, and they nearly always coincide with flood events. There is a 40 percent chance that one severe winter storm event with the potential of causing damage will take place every 2 years (Grays Harbor County 2010).

The causes of flooding in Grays Harbor County are a combination of climate, topography, and land use changes in flood-prone areas. Precipitation typically falls as rain, with virtually no snow fall. Rainwater quickly runs down out of the surrounding hills and floods the low-lying lands. River and coastal flooding are the two dominant types of flood events. These types of flooding usually happen simultaneously. For example, rivers in flood stage that flow out into the Grays Harbor estuary experience incoming tidal flooding as well. Both types of flooding can influence each other during natural disaster events. Smaller, more localized flood events in the county result from intense rainfall within a short period, saturated soils, high water tables, and heavy surface runoff. Land use changes, such as excessive historic logging within watersheds, likely affected natural runoff patterns into the estuary (Kliem and Holden 2011). Flooding in the local area has been problematic since record-keeping began in the 1900s and has continued to increase in frequency, duration, and severity. Since 1960 there have been 17 Federal disaster declarations related to flooding.

3.2.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Oceanic influence from the Pacific Ocean to the west and Puget Sound to the north buffers temperature extremes in the Black River drainage, while the Cascade Mountains to the east protect this watershed from continental air masses. This results in a mild, modified maritime climate with long growing seasons. Prevailing airflow from the ocean greatly modifies the colder winter temperatures and the heat of summer in the area.

Weather parameters representative of the Unit are measured daily at the Olympia Airport, approximately 7 air miles northeast of the Unit. The average annual air temperature between 1948 and 2012 in areas surrounding Olympia was 49.9 °F (WRCC 2015c). Monthly average air temperatures between 1948 and 2012 are identified in Table 3-2. Daily maximum temperatures in nearby Olympia are usually between 70 and 80 °F during summer, while average daily minimum temperatures in winter are near freezing. The July mean high temperature is 77.14 °F and the January mean low temperature is 31.77 °F (WRCC 2015d, 2015e). Area temperatures over 90 °F occur only about 6 days a year and temperatures over 100 °F rarely occur during summer months. Freezing temperatures occur about 83 days/nights a year in the valleys and the average frost-free period is 150 to 210 days. Higher points in the nearby Black Hills have moderately severe winters.

Thurston County has well-defined seasons, and seasonal changes are gradual. The average annual precipitation for the Olympia area from 1953 to 2012 was 50.82 inches and occurred mostly as rain during the winter months (WRCC 2015f). Average annual rainfall of 110 inches along the western county border decreases to 38 inches in the southeastern portion of the county. Olympia averages 52.3 inches per year, but the nearby Black Hills, which drain into Black River, receive considerably higher amounts (CRC 1992). Precipitation is heaviest during late fall (28 percent of yearly average) and winter (46 percent of yearly average) causing many lowlands, including the Black River area, to flood. Approximately 20 percent of the rain falls in spring, and only 6 percent in summer, thus

summers are fairly dry, averaging only 3 inches of rain. The area can expect an average of 73 clear days, 72 partly cloudy days, and 220 cloudy days a year.

Table 3-2. Olympia Area: Air Temperature and Precipitation Summaries, 1948–2012 (WRCC 2015c, 2015f).

Month	Average Temperature (Fahrenheit)	Total Precipitation (Inches)
January	38.2	8.02
February	40.7	5.63
March	43.5	5.24
April	47.7	3.33
May	53.6	2.10
June	58.7	1.57
July	63.3	0.72
August	63.3	1.12
September	58.5	2.02
October	50.1	4.70
November	43.0	8.24
December	38.7	8.12
Annual	49.9	50.82

3.2.3 Climate Cycles in the Pacific Northwest

Two climate cycles have major influences on the climate and hydrologic cycles in the Pacific Northwest: the shorter-term El Niño/La Niña/Southern Oscillation (ENSO) events, and the longer-term Pacific Decadal Oscillation (PDO) epochs (CIG 2012a). In El Niño years, average sea surface temperatures in the central and eastern equatorial Pacific Ocean are warmer than average, with weakened easterly trade winds in the tropical Pacific. La Niña years are characterized by the opposite—cooler than average sea surface temperatures and stronger than average easterly trade winds. These changes in wind and ocean circulation have global impacts on weather events. 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 6–18 months, with phases reoccurring every 2–7 years (CIG 2012a).

Like ENSO, PDO is characterized by changes in sea surface temperature, sea level atmospheric pressure, and wind patterns (CIG 2012a). PDO is described as having two phases: warm and cool. During a warm phase, sea surface temperatures near the equator and along the western 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 whereas cool phase PDO winters tend to be cooler and wetter than average. A single warm or cool PDO phase may last 20–30 years.

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

opposing effects on temperature and precipitation can cancel each other out, but not in all cases and not always in the same direction (CIG 2012a).

3.2.4 Climate Change

As guided by DOI Secretarial Order 3226 (Secretary of the Interior 2009) and the Service's Climate Change Strategic Plan (USFWS 2010), the Service considers and analyzes climate change in its decisions, long-range plans, and other activities.

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions (e.g., temperature, precipitation, wind) over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a). 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 (IPCC 2007a).

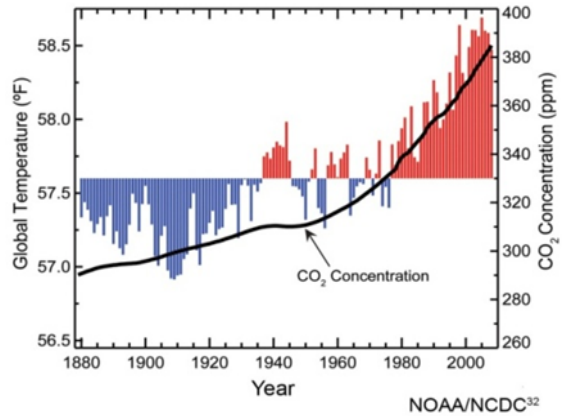
Climate-related concerns are generally focused on potential anthropogenic changes to the atmosphere that have altered Earth's "greenhouse effect" (NOAA 2012a). The greenhouse effect is a natural phenomenon that assists in regulating and warming Earth's temperature. Greenhouse gases (GHG) in the atmosphere—primarily carbon dioxide (CO_2), water vapor, methane, and nitrous oxide —absorb and emit infrared radiation from sunlight, ultimately trapping heat at the Earth's surface. Concentrations of GHGs, especially CO_2, are strongly correlated with global temperatures.

Trends and projections related to climate change are discussed in this section, and potential effects to the Refuge and the Unit are considered in Chapter 6.

Historical Trends in GHGs, Air Temperature, Precipitation, Snowpack, and Streamflow

Empirical evidence indicates that Earth's global climate has been changing rapidly during the 20th and early 21st centuries, with substantial evidence that the magnitude of climate alterations has been amplified by human activities, such as deforestation and the burning of fossil fuels (IPCC 2007, NAS 2008, USGCRP 2009). Well-documented climate variations have occurred throughout Earth's history (NOAA 2012b), but the current warming trend differs from geologically earlier climate shifts in two ways. First, recent climate changes appear to be driven primarily by human activities that have generated greater concentrations of atmospheric GHGs. Second, atmospheric CO_2 (and other GHGs) concentrations are at their greatest levels than at any time during the last 800,000 years and are increasing at unprecedented rates (Lüthi et al. 2008). Prior to the start of the Industrial Revolution around 1750, the amount of CO_2 in the atmosphere was about 280 parts per million (ppm). Current global levels are ~392 ppm and are increasing at a rate of ~2 ppm/yr (Department of Energy 2012, NOAA 2012c).

Empirical climate measurements support an accelerating change in global CO_2 concentrations and temperatures since the 1950s (Figure 3-1). Increased frequencies in extreme regional precipitation and wind events also have occurred (IPCC 2007b, Solomon et al. 2007, USGCRP 2009). These recent changes "very likely" have resulted from human-generated increases in GHGs, especially CO_2 emissions from burning fossil fuels (IPCC 2007c, Solomon et al. 2007). Huber and Knutti (2011) concluded that ~75 percent of global temperature increases since 1950 were caused by human activities.



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.

Figure 3-1. Global annual average temperature and CO_2 concentrations, 1880–2008. Source: USGCRP (2009).

In the Pacific Northwest, increased GHGs and warmer temperatures have resulted in a number of physical and chemical impacts. These include changes in snowpack, streamflow timing and volume, flooding, landslides, sea levels, ocean temperatures and acidity, and disturbance regimes such as wildfire, insects, and disease outbreaks (USGCRP 2009:135–138). Climate shifts also may exacerbate the frequency, magnitude, and intensity of extreme weather events, such as winter storms (Dominguez et al. 2012) and ocean wave heights (Ruggiero et al. 2010); both have been reported for the Pacific Northwest since the 1970s and are projected to intensify during the 21st century.

Climate observations have indicated many changes to Pacific Northwest temperature, precipitation, snowpack, and streamflow during the 20th century (CIG 2012c). On average, the region warmed about 1.5 °F; warming was greatest west of the Cascades during winter and spring (Figure 3-2). Trends in precipitation suggest moderate increases west of the Cascades (Figure 3-3); the largest relative increases occurred in eastern Washington and southern British Columbia, mainly during spring. Interestingly, one of the few recording stations where minor precipitation decreases were measured was at Aberdeen, Washington, just east of Grays Harbor Refuge.

Changes in air temperature, especially during winter months, have affected the quantity of mountain snowpack throughout the Pacific Northwest, as well as the timing of spring snowmelt. For the Washington Cascades, Mote et al. (2008) reported that spring snowpack declined 15–35 percent from the mid-20th century to 2006 (also see Figure 3-4); similarly, Casola et al. (2009) reported 8–16 percent declines during 1977–2006. The volume and timing of streamflows throughout the region have also changed; Stewart et al. (2005) reported that spring snowmelt timing was 5–20 days earlier at many Pacific Northwest sites compared with 1948 measurements (Figure 3-4). However, the streams within the coastal Washington region (including the Chehalis River) are primarily rain-dominated, and so are less influenced by snowpack and snowmelt (Mantua et al. 2010). In this area, changes in precipitation would have a greater effect on streamflow and flood timing (Hamlet et al. 2007).

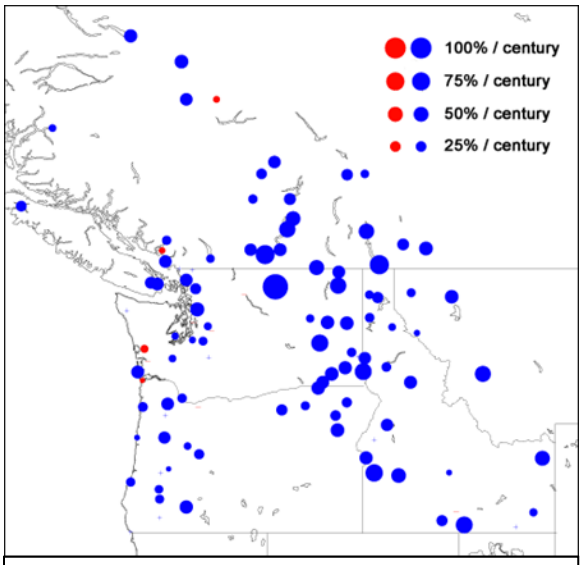


Figure 3-2. Average annual temperature trends (1920–2000) in the Pacific Northwest. Increases (decreases) are indicated with red (blue) dots. The size of the dot corresponds to the magnitude of change (CIG 2012c).

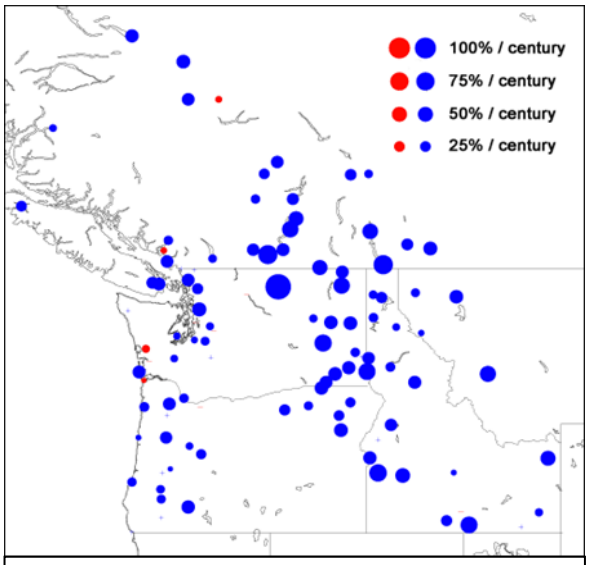
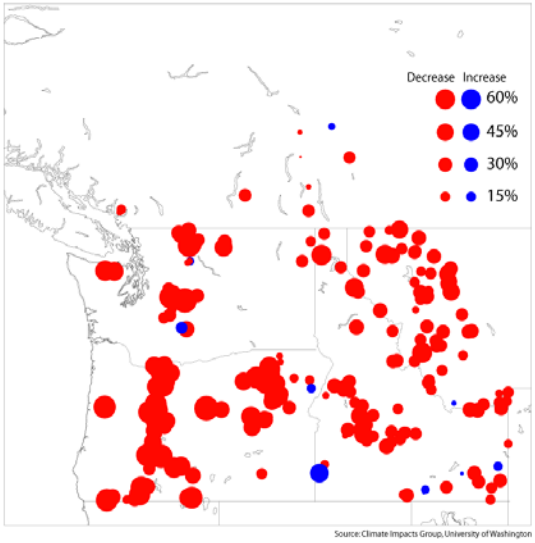


Figure 3-3. Average annual precipitation trends (1920–2000) in the Pacific Northwest. Increases (decreases) are indicated with blue (red) dots. The size of the dot corresponds to the magnitude of change (CIG 2012c)



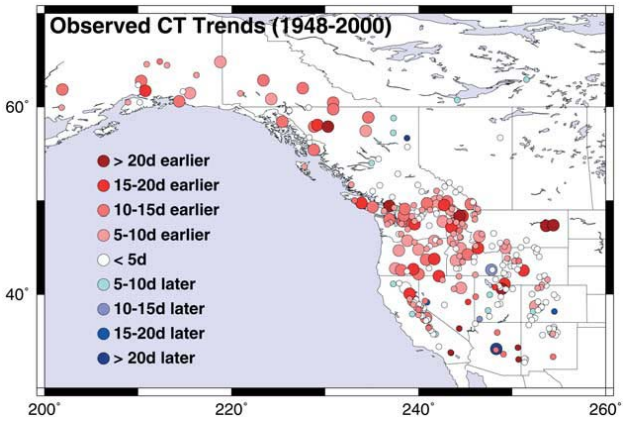


Figure 3-4. Changes in Pacific Northwest snowpack and streamflow runoff timing . (Left) Relative trend in April 1st snowpack (snow water equivalent) during 1950–2000 (CIG 2012c). (Right) Observed changes in timing of snowmelt runoff (center of mass flow) during 1948–2000 (Stewart et al. [2005:Figure 2]).

For the local Grays Harbor area, we assessed temperature and precipitation trends during 1895–2011 and 1981–2011 using Parameter-elevation Regressions on Independent Slopes Model (PRISM; Daly et al. 2002, Daly et al. 2008, PRISM Climate Group 2012) datasets generated by the PRISM Climate Group at Oregon State University. PRISM provides complete, monthly, 1895-to-present temperature and precipitation data at 4-km resolution for any point within the entire conterminous United States. The PRISM method interpolates between point data from thousands of weather stations using a digital elevation model and many other geographic data sets. The gridded estimates account for spatial variations in climate caused by elevation, terrain orientation, effectiveness of terrain as a barrier to flow, coastal proximity, moisture availability, atmospheric inversions, and topographic position (valley, mid-slope, ridge). Missing data from individual weather stations were estimated using a weighted average of values from highly correlated neighboring stations. We calculated annual (January–December) precipitation totals and mean temperatures (maximum, mean, and minimum) from the monthly PRISM data.

Air temperatures tended to increase at Grays Harbor Refuge during 1895–2011 (Figure 3-5). Based on best-fitting linear regressions, overall maximum, mean, and minimum temperatures have increased 1.27, 1.73, and 2.07 °F, respectively, during that 110-year period; the strongest trend was for minimum temperatures. However, the regressions accounted for only 1–25 percent of the variation in temperatures, suggesting that other dynamical factors affect our ability to detect any long-term trends in air temperature at the Refuge. During the most-recent 30-yr period (1981–2011) there were minor decreasing trends in all three temperature metrics (Figure 3-5), but these linear trends again accounted for <12 percent of the annual temperature variations.

Annual precipitation at Grays Harbor Refuge tended to decrease during 1895–2011 (Figure 3-6); regression analysis suggested that total annual precipitation declined 3.8 in (5.2 percent) during that 110-year period. But as with air temperatures, the linear regression model for precipitation fit the annual data poorly ($R^2 = 0.01$). The 1981–2011 precipitation trend was similar to the longer-term results (Figure 3-6).

Air temperatures tended to increase at the Black River Unit during 1895–2011 (Figure 3-7). Based on best-fitting linear regressions, overall maximum, mean, and minimum temperatures have increased 0.70, 1.28, and 1.97 °F, respectively, during that 110-year period; the strongest trend was for minimum temperatures. However, the regressions accounted for only 2–26 percent of the variation in temperatures, suggesting that other dynamical factors affect our ability to detect any long-term trends in air temperature at the Black River Unit. During the most recent 30-year period (1981–2011) there were minor, increasing trends for mean and minimum temperatures, and a minor, decreasing trend for maximum temperatures (Figure 3-7), although these linear trends again accounted for <25 percent of the annual temperature variations.

Annual precipitation at the Black River Unit tended to increase during 1895–2011 (Figure 3-8), although the regression analysis suggested that total annual precipitation increased only 0.93 in/yr (1.8 percent) during that 110-yr period. But as with air temperatures, the linear regression model fit the annual data poorly ($R^2 = 0.00$). The 1981–2011 precipitation trend suggested a minor decrease in annual precipitation, but the regression fit was poor ($R^2 = 0.01$) (Figure 3-8).

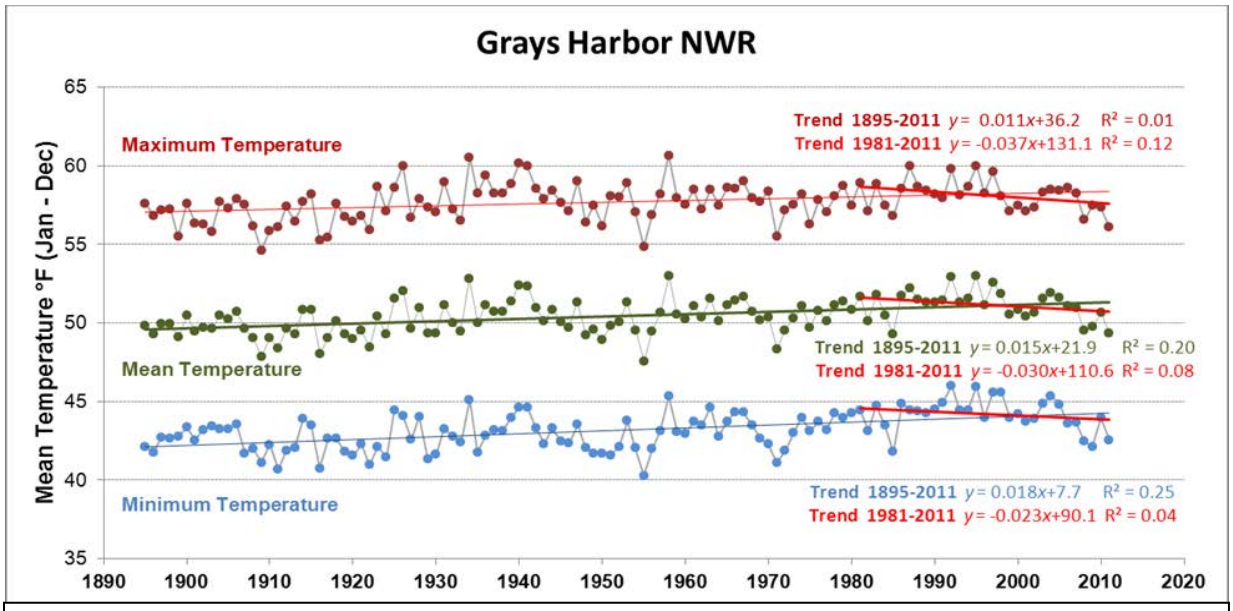


Figure 3-5. Annual mean, minimum, and maximum air temperatures for Grays Harbor NWR during 1895–2011 and 1981–2011 (red regression lines and text). Annual temperatures are the means of the 12 monthly values (January through December). Source of monthly data: PRISM Climate Group (2012).

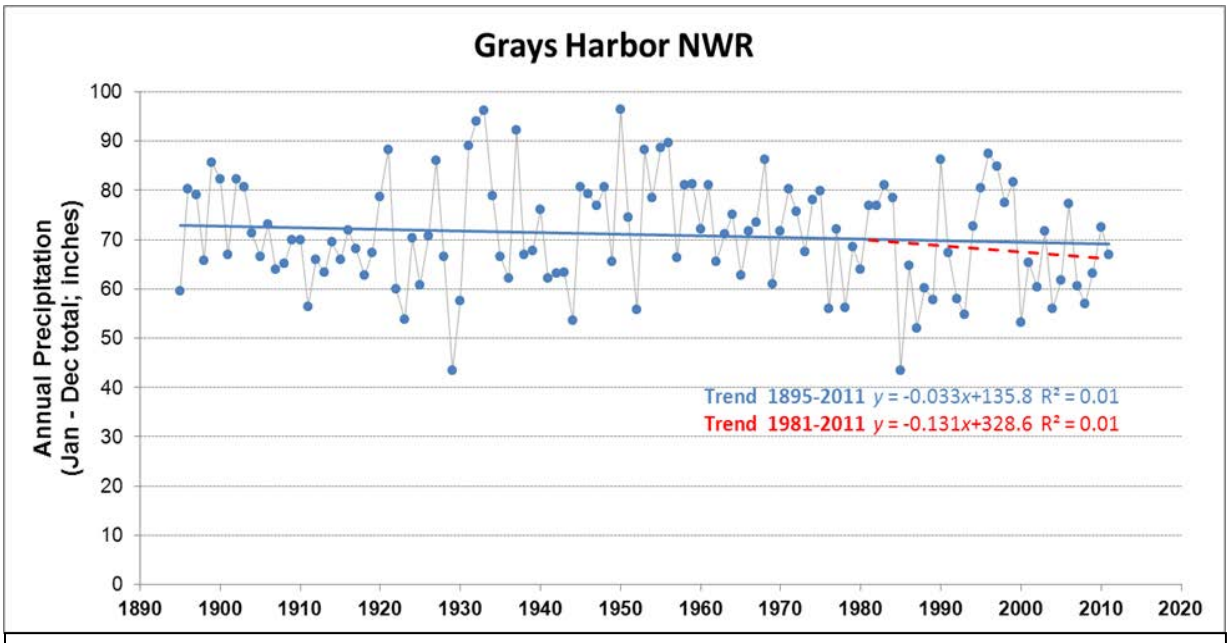


Figure 3-6. Annual precipitation (January through December) totals for Grays Harbor NWR during 1895–2011 and 1981–2011 (red regression line and text). Source of monthly data: PRISM Climate Group (2012).

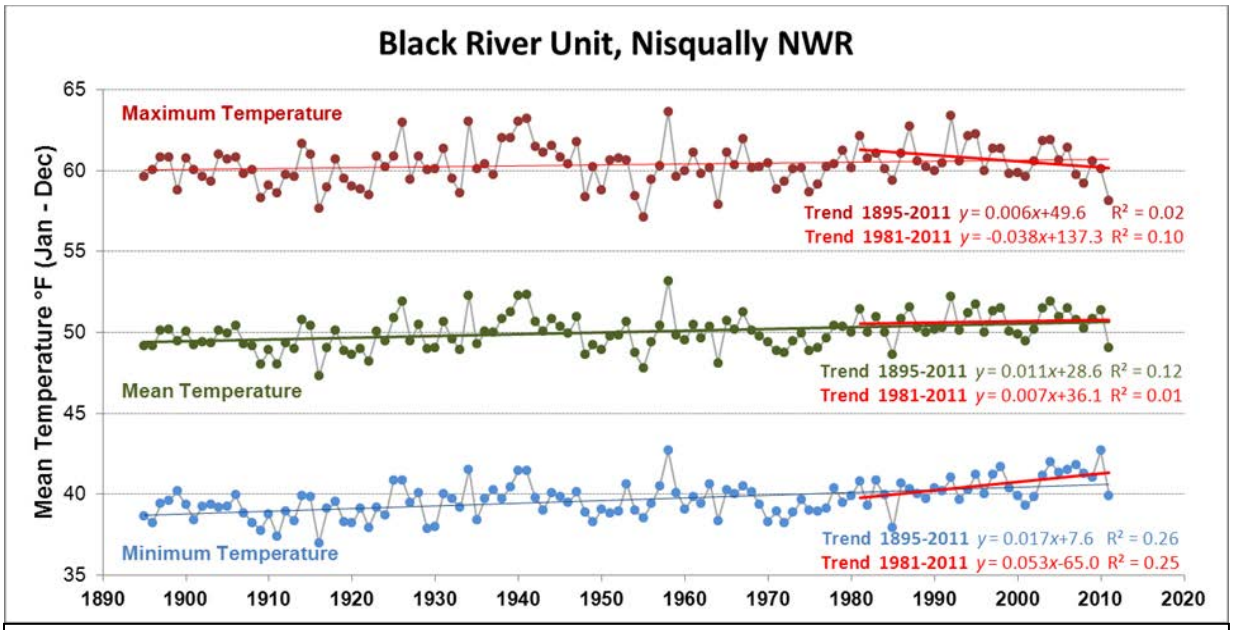


Figure 3-7. Annual mean, minimum, and maximum air temperatures for the Black River Unit, Billy Frank Jr. Nisqually NWR, during 1895–2011 and 1981–2011 (red regression lines and text). Annual temperatures are the means of the 12 monthly values (January through December). Source of monthly data: PRISM Climate Group (2012).

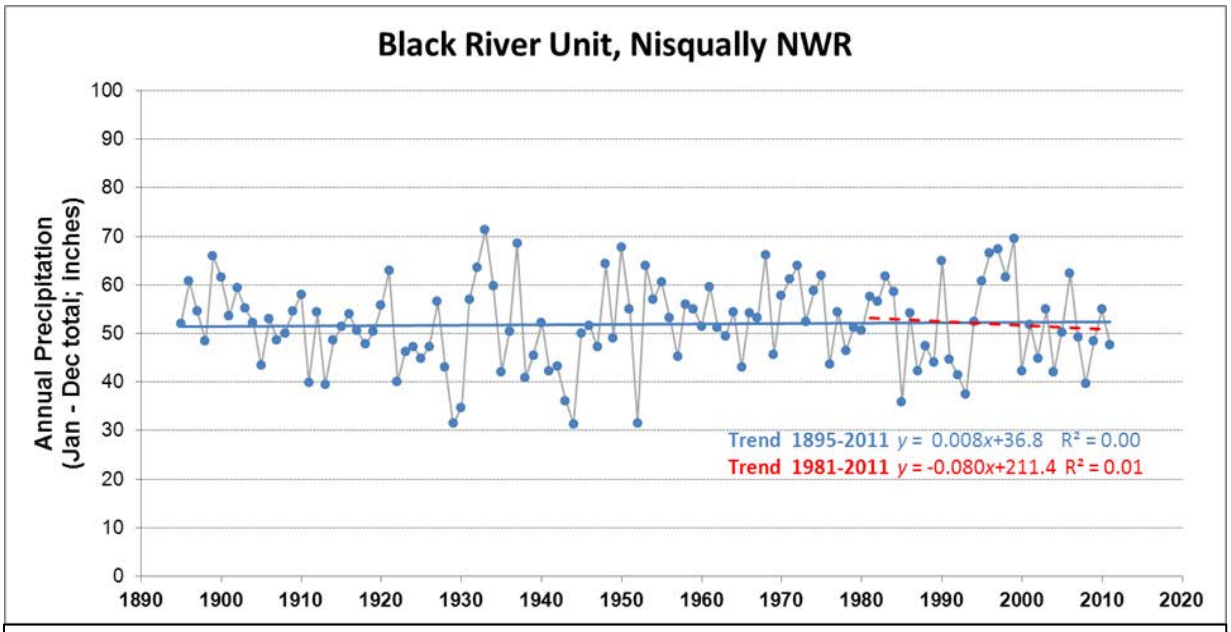


Figure 3-8. Annual precipitation (January through December) totals for the Black River Unit, Nisqually NWR, during 1895–2011 and 1981–2011 (red regression line and text). Source of monthly data: PRISM Climate Group (2012).

Future Climate Projections

Average global surface air temperature is projected to increase 3.2–7.2 °F by 2100 (~0.36 °F/decade), depending on the emissions scenario used (IPCC 2000), i.e., depending on the ultimate concentrations of GHG emissions released into the atmosphere. Interim projections for the six IPCC "marker scenarios" (B1, A1T, B2, A1B, A2, and A1FI) suggest temperature increases of 1.1–1.2 °F by 2030, 2.3–3.1 °F by 2065, and 3.2–5.6 °F by 2100 (IPCC 2007c, and see CIG 2012c:Table 2).

Precipitation projections are less certain, with overall annual precipitation generally expected to remain within the range of natural variability (Solomon et al. 2007); exceptions are for increased precipitation at high latitudes and decreased precipitation in the subtropics. Projected precipitation changes over the next century are small compared to the interannual and decadal variability observed during the 20th century (Meehl et al. 2007).

Regional temperature projections are similar to the global projections. Based on a statistical downscaling of 20 global climate models, Mote and Salathé (2010) projected an overall 0.5 °F/ decade rate of temperature increase through the 2080s. This corresponds to increases of ~2 °F by the 2020s, ~3.2 °F by the 2040s, and ~5.3 °F by the 2080s. All of these increases are greater than the historical 1.5 °F overall increase observed for the Pacific Northwest during the entire 20th century.

Regional precipitation projections suggest only small increases in annual precipitation (~4 percent by the 2080s; Mote and Salathé 2010), although there are large differences among the various model projections. As with the global projections, there is a wide range of natural variability in Pacific Northwest precipitation amounts and timing, making the relatively small climate-change-related changes difficult to distinguish except over long time scales. However, a majority of regional climate models project decreased summer (July–August) precipitation of 6–13 percent, and increased winter (December–February) precipitation of 2–8 percent (Mote and Salathé 2010, Salathé et al. 2010).

Regional snowpack is projected to decrease at accelerated rates compared to those during the 20th century, with shifts to earlier spring snowmelt occurring for snow-dominated and transient basins. Elsner et al. (2010) projected 29 percent, 44 percent, and 65 percent declines in Washington State April 1 snow-water-equivalent by the 2020s, 2040s, and 2080s, respectively (A1B SRES scenario). However, for the rain-dominated basins of coastal Washington, changes in the timing of spring runoff likely will be minimal, although the risk for lower low-flows and greater stream temperatures will increase (Mantua et al. 2010).

For the Grays Harbor area, climate and hydrologic projections were generated for 8-digit Hydrologic Unit Code (HUC4) basins by the Climate Impacts Group's Columbia Basin Climate Change Scenarios Project (Hamlet et al. 2010) and Regional Climate and Hydrologic Change efforts (Littell et al. 2011). We downloaded data via Climate Impacts Group (2012d). We averaged the projections for Grays Harbor (HUC4 17100105) and Lower Chehalis River (HUC4 17100104) basins, in order to include the entire Grays Harbor watershed.

Figure 3-9 presents seasonal summaries of average monthly temperature and total precipitation. Average projections from 10 climate models for time periods ending in the 2020s, 2040s, and 2080s are compared with the empirically based 1915–2006 estimates. Local projections are similar in magnitude to the regional projections. Average temperatures are projected to increase in all seasons (Figure 3-7); precipitation projections indicate increases during fall and winter and decreases during summer (Figure 3-9).

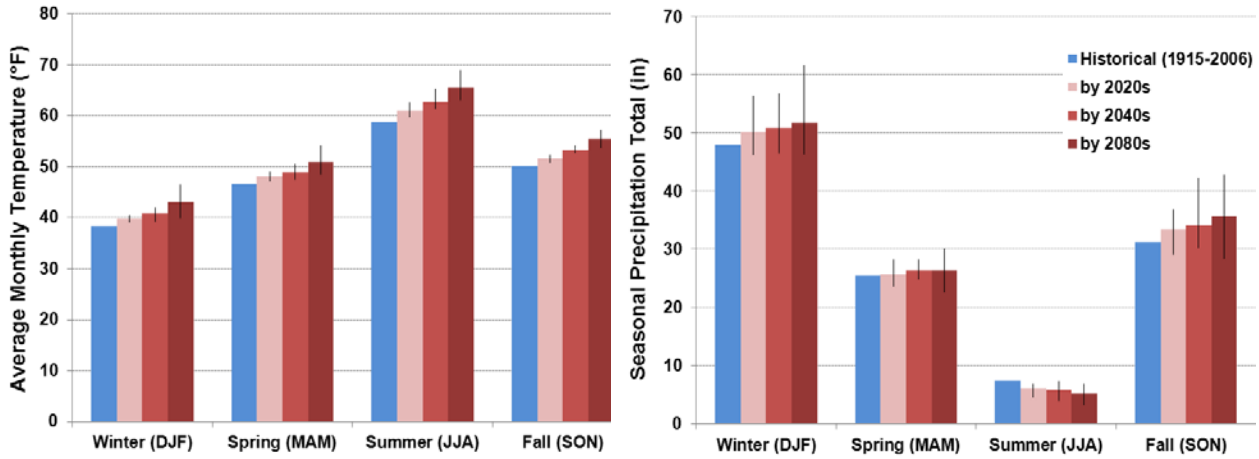


Figure 3-9. Seasonal temperatures (left) and precipitation (right) for the Grays Harbor and Lower Chehalis River HUC4 basins. Projections were for the A1B SRES Scenario. Bars and error bars represent the average and range of 10 climate models (CIG 2012b).

For the Black River area, climate and hydrologic projections were generated for 8-digit HUC4 basins by the Climate Impacts Group's Columbia Basin Climate Change Scenarios Project (Hamlet et al. 2010) and Regional Climate and Hydrologic Change efforts (Littell et al. 2011). We downloaded data via Climate Impacts Group (2012b).

Figure 3-10 presents seasonal summaries of average monthly temperature and total precipitation for the Upper Chehalis River basin (HUC4 17100103), which includes the Black River watershed. Average projections from 10 climate models for time periods ending in the 2020s, 2040s, and 2080s are compared with the empirically based 1915–2006 estimates. Local projections are similar in magnitude to the regional projections. Average temperatures are projected to increase in all seasons (Figure 3-10); precipitation projections indicate increases during fall and winter and decreases during summer (Figure 3-8).

Projections for streamflow and runoff across the Upper Chehalis River basin (Figure 3-11) closely match those for precipitation, with increasing winter flows and decreasing summer flows through the 2080s.

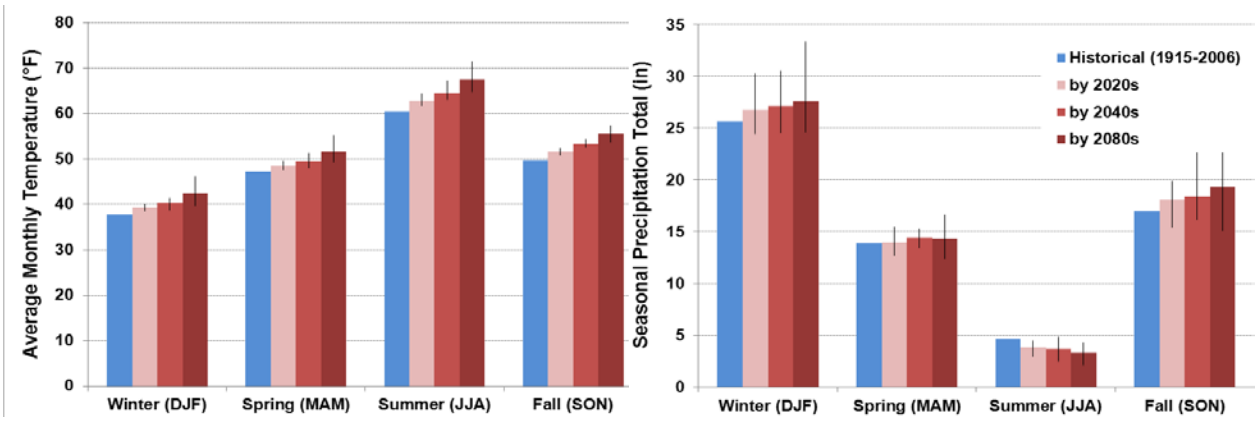


Figure 3-10. Seasonal temperatures (A) and precipitation (B) for the Upper Chehalis River HUC4 basin. Projections were for the A1B SRES Scenario. Bars and error bars represent the average and range of 10 climate models (CIG 2012b).

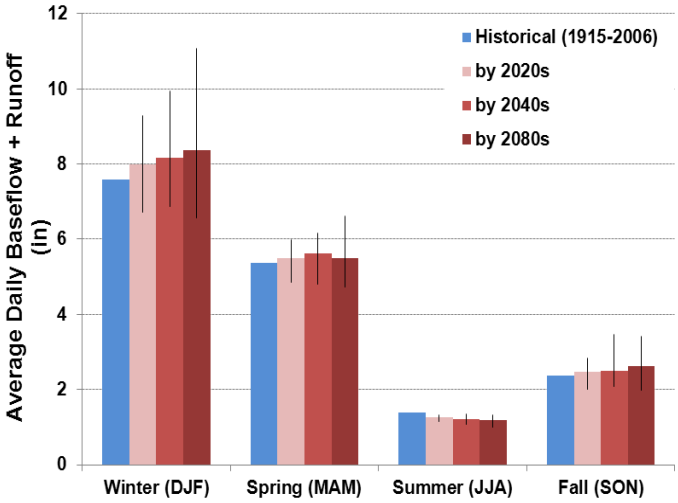


Figure 3-11. Combined average daily flows (baseflow + runoff) for the Upper Chehalis River HUC4 basin. Projections were for the A1B SRES scenario. Bars and error bars represent the average and range of 10 climate models. Runoff represents mean flow across the watershed (not routed through stream channels; Elsner and Hamlet 2010) (CIG 2012b).

Sea Level Rise

Factors Affecting Global and Washington Coast Sea Levels

Rising global sea levels have resulted from the melting of land-based ice within Earth's cyrosphere (especially the Antarctic and Greenland ice sheets, but also glaciers) and thermal expansion of ocean waters as global temperatures increase (IPCC 2007a, McKay et al. 2011). A recent National Research Council (NRC) publication summarized that 68 percent of global sea level rise measured during 1992–2008 resulted from ice mass loss, 35 percent from thermal expansion, and -3 percent from anthropogenic land water storage (Church et al. 2011, NRC 2012). The proportional contribution from ice mass loss has increased since 1993, likely resulting from greater rates of ice melt than during 1961–2003 (IPCC 2007a, Bromirski et al. 2011, Jacob et al. 2012).

In addition to these global factors, sea level heights along the Washington coast are affected by long- and short-term ocean-driven climate patterns (Mote et al. 2008) and vertical land movements (Komar et al. 2011). At longer time scales, Bromirski et al. (2011, 2012) reported that U.S. west coast sea levels are correlated with PDO, with warm-phase PDO epochs associated with suppressed rates of sea level rise. During the most recent warm-phase PDO (ca. 1980–2010), west coast sea levels were nearly static, whereas global sea level rose approximately 3 mm/yr (Bromirski et al. 2011, 2012). At much shorter time scales, ENSO events (El Niño, La Niña) can substantially affect sea levels, e.g., large El Niño events can raise local sea levels by 10–30 cm for several winter months (NRC 2012).

Local, vertical land movements result from tectonic forces and other geologic processes. Tectonic uplift is occurring at various rates along the Pacific coast approximately north of Mendcino, California, as the North American and Juan de Fuca plates collide. Vertical land movements in northern North America also result from continuing glacial isostatic adjustment since the disappearance of the North American ice sheets starting circa 20,000 years ago. Overall uplift estimates for the southern Washington coast range from 1 to 3 mm/yr (Mote et al. 2008, NRC 2012), although short-term GPS-derived information from a Pacific Northwest Geodetic Array station near the southeastern shoreline of Grays Harbor (station P398, lat-lon = 46.926, -123.916) has measured uplift of 0.1 mm/yr (±0.1 mm/yr) since 2006 (Central Washington University 2012). However, longer-term sea level data are sparsely available for much of the southwestern Washington coast, and it is possible that local dynamics may create areas of both uplift and subsidence within this larger geographic expanse (as has been reported for the Oregon coast and Willapa Bay, Washington [Komar et al. 2011]).

At the local scale, the accretion rate of sediments (here referring generically to both mineral and organic-matter sources) is a critical factor affecting the long-term persistence of coastal marshes. Marshes that receive sediment inputs sufficient to raise substrate elevations equal to or greater than the rate of local sea level rise will persist, whereas marshes with lesser sediment accretion eventually will be flooded (Morris et al. 2002, Kirwin et al. 2010). Sediment accretion rates are greater where vegetation is present (Baustian et al. 2012). Thom (1992) reported a mean accretion rate of 3.6 mm/yr (95 percent CI = 2.4 – 4.8) across six Washington and Oregon salt marsh sites; the Elk River marsh site in Grays Harbor had an annual accretion rate of 6.6 mm/yr during 1963–1991. Sediment compaction, however, results in subsidence at local areas within coastal marshes, at least partially counteracting sediment inputs; Mazzotti et al. (2008) measured annual subsidence rates of 1–2 mm in the Frazier River delta lowlands, British Columbia, Canada.

Historical Rates of Sea Level Change

Global mean sea level rose between 1.2 and 2.2 mm/yr during the 20th century (IPCC 2007a, NRC 2012). That rate increased to 3.1 mm/yr during 1993–2003 (Bromirski et al. 2011), and is currently measured at 3.2 mm/yr (NASA 2015).

There are few measuring stations with adequate recording histories to provide specific sea level information for the Grays Harbor area, e.g., the National Oceanic and Atmospheric Administration (NOAA) station at Westport, Washington (approx. 9.5 mi WSW from Grays Harbor Refuge; station ID 9441102), only has water-level data available since 2006 (NOAA 2012d). However, two linear trend analyses of data from the NOAA station in Willapa Bay (Toke Point, station ID 9440910, approximately 19 mi SSW from Grays Harbor NWR) indicated increases in relative sea level ranging from 1.09 mm/yr during 1959–2008 (Tebaldi et al. 2012) to 0.63 mm/yr (95 percent CI = -0.49–1.75) during 1973–2011 (NOAA 2012e).

Future Projections of Sea Level

Global sea levels are projected to rise 13.5 cm (range = 8–23) by 2030, 28.0 cm (range = 18– 8) by 2050, and 82.7 cm (range = 50–140) by 2100 (all relative to 2000 levels; NRC 2012: their Table 5.2). These projected values correspond to average sea level rise rates of 4.5, 5.6, and 8.3 mm/yr during the periods up to 2030, 2050, and 2100, respectively.

Accounting for local dynamical factors, NRC (2012: their Figure S.1 and Table 5.3) projected increased sea levels at the latitude of Seattle, Washington, of 6.6 cm (range = -3.7–22.5) by 2030, 16.6 cm (range = -2.5–47.8) by 2050, and 61.8 cm (range = 10.0–143.0) by 2100 (see Figure 3-12). These projected values correspond to average sea level rise rates of 2.2, 3.3, and 6.2 mm/yr during the periods up to 2030, 2050, and 2100, respectively.

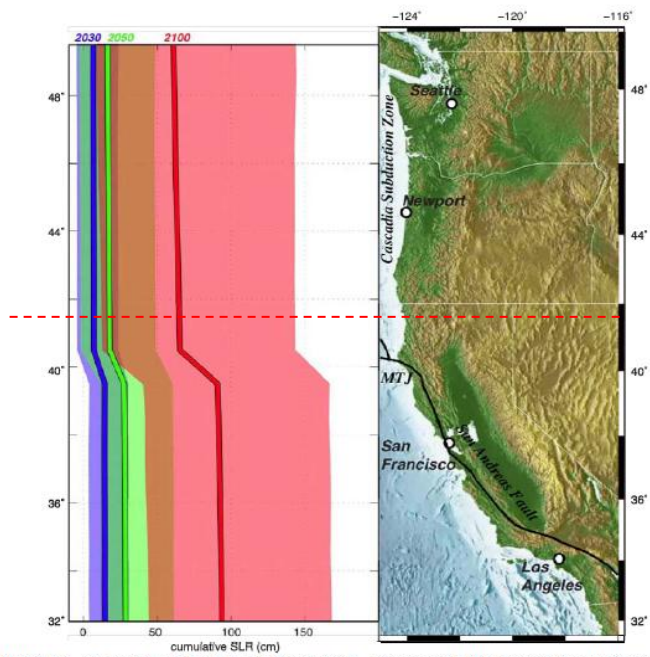


FIGURE S.1 Projected sea-level rise off California, Oregon, and Washington for 2030 (blue), 2050 (green), and 2100 (pink), relative to 2000, as a function of latitude. Solid lines are the projections, and shaded areas are the ranges. Ranges overlap, as indicated by the brown shading (low end of 2100 range and high end of 2050 range) and blue-green shading (low end of 2050 range and high end of 2030 range). MTJ = Mendocino Triple Junction, where the San Andreas Fault meets the Cascadia Subduction Zone.

Figure 3-12. Projected sea level rise for the U.S. Pacific coast for 2030, 2050, and 2100. Red dashed line added to show approximate latitude for Grays Harbor, WA . Source: NRC (2012)

Similar projections of 10-cm and 25-cm increases in sea level at Toke Point, Washington, by 2030 and 2050, respectively, were reported by Tebaldi et al. (2012). However, because these projections started with the year 2008, the corresponding average sea level rise rates by 2030 and 2050 are 4.5 and 6.0 mm/yr, respectively. These projected rates are greater than those in NRC (2012) because they do not incorporate the mitigating "fingerprint" effects of modern land ice melting (e.g., land uplift and reduced gravitational pull on near-ocean waters), which are more pronounced along the Washington coast.

Sea level projections for the entire Grays Harbor estuary were modeled using SLAMM (Sea-level Affecting Marshes Model; Clough and Larson 2010). Those analyses later were subsetted to focus on the Grays Harbor Refuge vicinity (Warren Pinnacle Consulting 2011). The SLAMM model uses input data to assess the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise: inundation, erosion, overwash, saturation, and sediment (or vertical land) accretion. Model projections for the year 2100 suggested substantial losses of tidal flats: for a 0.69-m sea level rise, tidal flats declined by 48 percent within Grays Harbor Refuge and 69 percent within the entire Grays Harbor estuary. However, these SLAMM results (especially for tidal flat habitats) should be used with caution, because the only data available for land elevation and habitat types were at very coarse scales, and the modeled acreage of tidal flats is sensitive to even very small changes in elevation. Whenever more-refined elevation, bathymetry, and habitat data are available, future SLAMM analyses would be valuable to project habitat changes both within Grays Harbor Refuge as well as the entire Grays Harbor estuary. The USGS project "Marshes to mudflats: climate change effects along a latitudinal gradient in the Pacific Northwest" in progress at Grays Harbor Refuge and several other sites, measures morphological and ecological characteristics (e.g., elevation, tidal range, vegetation) along transects crossing the habitat continuum of tidal marsh, intertidal mudflat, and subtidal shoals. The project will model vulnerability of these nearshore habitats and dependent avian indicator species to projected sea level rise and storm surge effects (John Takekawa, pers. comm., January 23, 2013, USGS Western Ecological Research Center).

Ocean Chemistry

Ocean water absorbs atmospheric carbon dioxide (CO_2); subsequent reactions with water molecules ultimately produce bicarbonate, carbonate, and hydrogen (H^+) ions (Hönisch et al. 2012). Greater inputs of CO_2 increase concentrations of both H^+ ions (which increases water acidity [= lower pH]) and carbonate ions (which decreases the saturation state of calcium carbonate [$CaCO_3$]) (Orr et al. 2005). $CaCO_3$ is a compound necessary for shell and skeleton development in many marine organisms (Hauri et al. 2009).

Since the beginning of the industrial era, global oceans have absorbed ~560 billion metric tons of CO_2 (Sabine et al. 2004, Doney et al. 2009), including ~50 percent of CO_2 released from the burning of fossil fuels (NOAA 2008). The addition of CO_2 derived from fossil fuels has increased H^+ ion concentrations ~30 percent (NOAA 2008), reducing global mean ocean surface pH by 0.1from ~8.2 to ~8.1 since 1750 (Feely et al. 2008, 2009; Bernie et al. 2010). Along the Pacific Northwest coast, Wootton et al. (2008) reported a recent, short-term (2000–2007) declining trend in ocean pH at Tatoosh Island, although daily and season variability in pH was substantial.

Ocean pH and carbonate ion concentrations vary at different ocean depths (Feely et al. 2004); deeper waters (down to 250 m) have greater acidity and reduced $CaCO_3$ saturation (Byrne et al. 2010). In the California Current System off the U.S. West Coast, Feely et al. (2008) reported that ocean waters

with high acidity and undersaturated carbonate concentrations have risen 50–100 m (164–328 ft) since pre-industrial times, and are now within the density layers that are currently being upwelled onto coasts and into estuaries. Ocean currents that cause upwelling along the Pacific coast are particularly strong in the Pacific Northwest (Hickey and Banas 2003, Feely et al. 2008), and upwelling is a substantial factor in flushing rates within Grays Harbor (Duxbury 1979).

Future Projections

Without strong global emissions mitigation, Bernie et al. (2010) projected that global surface pH will decrease to 7.67–7.81 by 2100. A pH of 7.8 by 2100, which was projected by Feely et al. (2009) using the A2 (nonintervention) IPCC scenario, would result in a 150 percent increase in ocean acidity relative to pre-industrial times.

Regional projections for the North Pacific (Feely et al. 2009) suggest that, by 2100, ocean pH will decrease up to 0.31 units from the 1990–1998 mean of ~8.1, depending on future atmospheric CO_2 levels. Similarly, carbonate ion concentrations will decrease up to 45 percent. Gruber et al. (2012) projects nearshore carbonate saturation will decrease substantially at all depths of the California Current System upwelling areas by 2050, with seafloor habitats (>120 m deep) developing year-long under-saturation within 20–30 years. Within the California Current System, the intensity of acidification may be further enhanced during the 21st century because of large-scale changes in ocean currents and circulation (Feely et al. 2012).

Other Ocean-related Factors

Climate also affects other ocean conditions, such as water temperature, waves, and upwelling currents. Natural variability in these characteristics is large, especially in dynamic ocean regions such as the eastern Pacific Ocean (Hickey and Banas 2003). In general, all of these are projected to change as global and regional climatic conditions change, but the magnitude of these changes is uncertain.

Mote and Salathé (2010) projected sea-surface temperatures to increase 2.2 °F for coastal ocean waters between 46 °N and 49 °N by the 2040s (relative to the 1970–1999 average), but seasonal differences in upwelling events (especially in summer months) cause substantial uncertainty in the magnitude of possible temperature increase; however, little change in the seasonal timing of coastal upwelling is projected (Mote and Salathé 2010). Extreme wave heights, especially during strong winter storms, have increased since the 1970s (Menéndez et al. 2008), and are projected to increase further as warmer global temperatures may cause increased frequency of intense extra-tropical cyclones (Ruggiero et al. 2010). However, these impacts will have greatest impacts to exposed coastal areas; wave effects are greatly muted at estuaries within large bays (e.g., Grays Harbor).

3.3 Hydrology

3.3.1 Grays Harbor National Wildlife Refuge

Grays Harbor is the third largest estuary of the Pacific Northwest Coastal Region. The Refuge makes up less than 2 percent of the entire estuary. Estuaries are most commonly defined as semi-enclosed coastal bodies of water having a free connection with the open sea and within which seawater is diluted measurably by freshwater from land drainage. Research shows Grays Harbor is a drowned river type of estuary (Hickey and Banas 2003, Emmett et al. 2000, GHEMPTF 1987). It is fed by the

2,550-square mile drainage within the Chehalis River Basin and provides nearly 34,000 acres of intertidal mudflats. Tributaries of the estuary include the Chehalis, Hoquiam, Wishkah, Humptulips, Johns, and Elk River basins. The Chehalis River is the major freshwater source, providing approximately 80 percent to the Harbor (GHEMPTF 1987). As a transition zone between fresh water and marine ecosystems, estuaries are highly productive areas that offer habitat of special importance to the early life stages of the many aquatic marine animals, migratory birds, and other animals.

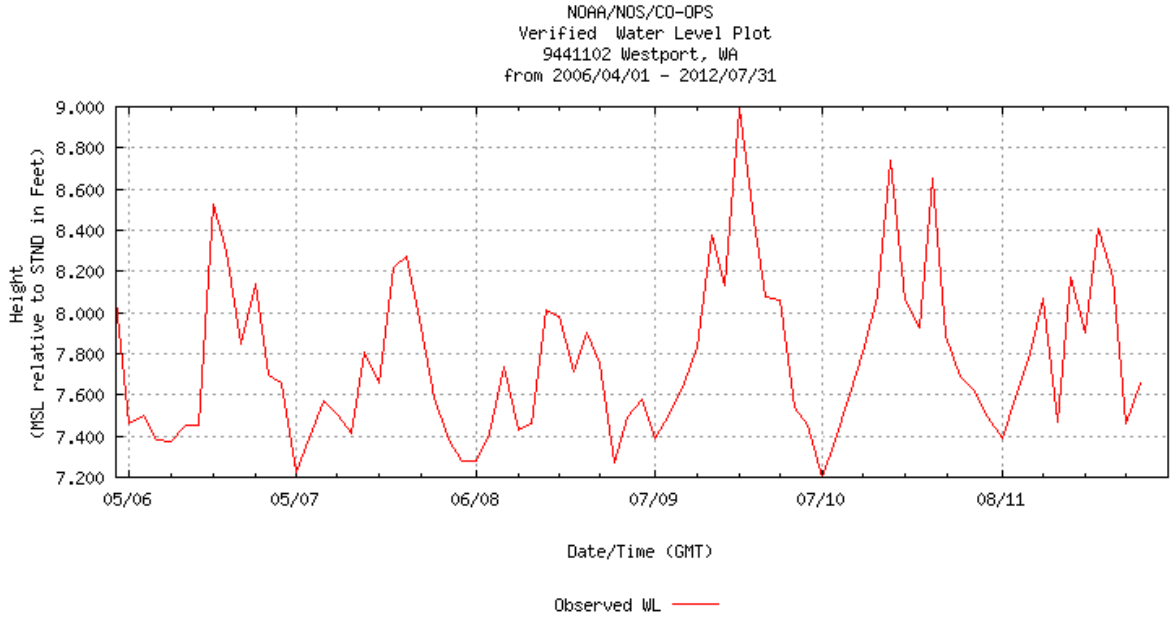
Tides

Tides in the estuary are a major part of the hydrologic influences on Grays Harbor Refuge and its habitats. The depth and width of the harbor mouth influence how much and how fast tidal water flows in and spreads across the estuary and to the Refuge. The tides generally move slowly: peak high tide at Aberdeen is 30 minutes later than the peak at the estuary mouth. The estuary is a shallow basin with depths averaging less than 20 feet. It has multiple tideland-connected channels and wide expanse of mud and sand flats. The tidal flats are important in the movement, mixing, and re-aeration of estuary waters during tidal ebb and flood. More than half of the surface area of this estuary lies in the intertidal zone with the tidal flats averaging about 1 to 2 feet above mean lower-low water (MLLW). Dredged shipping channels are approximately -38 feet MLLW (GHEMPTF 1987, Hickey and Banas 2003).

The mean daily tidal elevation range is 10 feet in the Aberdeen-Hoquiam area. Maximum mean tidal velocities in the upper harbor vary about 3 feet per second (fps) during floodtide to about 4.5 fps during ebb tide (GHEMPTF 1987). The average tidal water levels for Grays Harbor estuary from 2006 to 2012 are represented in Figure 3-13.

The Refuge is sited in what was formerly an open section of the estuary with unrestricted tidal movement. The construction of Bowerman Airfield peninsula in the 1940s restricted tidal flow and changed sediment movement and deposition. Additional uplands created by fill at the east end of the basin may have helped to further restrict tidal action and may be serving to increase the capture of sediments. Currently, Refuge mudflats are some of the last to flood and are among the first to become exposed with the falling tide.

Figure 3-13. Average tidal range recorded at the mouth of Grays Harbor estuary 2006–2012.



Salinity

Mixing of fresh water and salt water varies by season and location. Peak freshwater discharge occurs from streams and rivers in winter, especially during storms, while low freshwater input occurs in the summer months. The ocean, rather than local rivers, is the dominant source of nutrients and biomass along the Pacific Northwest coast and in this estuary (Hickey and Banas 2003). Hickey and Banas report the mid-portion of the estuary (near the Aberdeen-Hoquiam area) ranges from low salinity of 5 parts per thousand during winter to 20 parts per thousand during the summer months. Vertical salinity stratification, with a salt water wedge typical of estuarine systems, occurs only in the south channel (Simenstad and Eggers 1981). The winter salt-water wedge or upstream limit of salt water intrusion stops at the Aberdeen-Hoquiam area, and the summer upstream limit is some 10–12 miles further up the Chehalis River at Montesano (GHEMPTF 1987).

3.3.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Black River, a tributary of the Chehalis River, flows southwesterly through the western and southwestern portion of Thurston County. Originating in wetlands at the south end of Black Lake (river mile 25), the Black River begins as an extremely low-gradient river system. The slow descent for most of the river length allows an accumulation of mud, sand, and decomposing organic material that provides for abundant aquatic and semi-aquatic plant and animal life. Beaver dams throughout the northern portion of the river help to create and maintain shallow water swamps and wetlands on the Unit. The Black River features some of the largest natural freshwater wetlands in western Washington (Pickett 1994a, Foster Wheeler 2003, Caldwell et al. 2004, Napier et al. 2008, Easterly and Salstrom 2008, CRC 1992).

Within the Unit acquisition boundary, the river channel varies from 15 feet to 120 feet in width and runs approximately 7 miles in length. Dempsey Creek, Salmon Creek, and Blooms Ditch drain into the river within the current Unit boundary with Waddell Creek bordering the former Weiks Dairy

Unit and entering the river just south of the Unit boundary. There are numerous named and unnamed creeks and streams within the Unit acquisition boundary totaling approximately 23 miles (see Map 4). The acquisition boundary ends north of the town of Littlerock at approximately river mile 17.

There are two major topographic regions which affect the hydrology of the Black River Unit: the western uplands and the eastern lowlands. The Black Hills, a low, mountainous region that includes the Capitol State Forest, forms most of the western watershed. The two largest tributaries of the western watershed are Waddell Creek (10.4 miles long) and Mima Creek (7.15 miles long). There are also smaller tributaries, including Mill, Stony, Baker, Noski, Darlin, and Dempsey creeks, and several smaller unnamed creeks. The eastern lowland region includes forested rolling hills and grasslands. The eastern region of the Black River drainage also includes several lakes and numerous wetlands. Salmon, Blooms Ditch, Beaver, and Allen's Creeks drain from the east into the northern and middle aspects of the River.

The Black River was historically the primary outlet draining Black Lake, but the hydrology of the system has been radically altered through the years. Anecdotal information indicates the river channel may have been dredged or straightened in some areas in the 1800s. Additional changes to the river system began in the early 1900s when water was diverted from the lake to improve drainage north of Black Lake, including digging the Black Lake Ditch in 1922. The ditch continues to divert a large amount of water flow northward to Puget Sound through Percival Creek, instead of south into the Black River. A pipeline was installed in 1965 across the northern portion of the Black River, which appears to have created a low berm across the wetlands. Hydrological studies indicate some impacts on the direction of water flow, although drainage through the Black Lake Ditch is the greatest factor influencing the direction of flow (Foster Wheeler 2003). Many changes throughout the years have affected the natural hydrologic regime of the river system including the issuance of water rights and water withdrawals.

Flooding and Surface Water

The Black River valley is known for its wide, flat lands that rapidly flood with winter and spring season rains. Most flooding along the main stem of the river is inundation flooding with low velocity floodwater because the wetland complex buffers the flow. The main streams draining east of the river are Salmon, Blooms Ditch, Allen, and Beaver Creeks. These are slow-flowing systems that tend to cause inundation flooding with little to no velocity. The east side of the drainage is susceptible to high groundwater flooding when periods of extended rain exist (Thurston County 2012). Within the Unit boundary only Salmon Creek and Blooms Ditch drain into the river from the eastern side. From the west side of the drainage, Dempsey Creek flows into the river, is flashy, rising quickly and spreading out, and then draining rapidly.

The two roads that cross the Black River and associated wetlands within the approved boundary of the Unit act as dikes and increase water levels in wetlands directly upstream. The road dike and bridge situation prevents the channel from naturally changing course at these locations and alters flow through the restricted channel opening. The roadway approaching the 110th Avenue Bridge over the Black River is usually one of the first local roads to close and last to reopen due to surface flooding associated with typical winter rains. The 123rd Avenue roadway itself is sometimes flooded west of the bridge during these periods. All habitats on either side of the river are replenished with sediment and nutrients during periods of surface flooding.

3.4 Topography

3.4.1 Grays Harbor National Wildlife Refuge

The Refuge salt marshes lie at the base of rugged forested hills to the north of the Refuge boundary ascending to a maximum elevation of 2,400 feet. Stream drainages from these hills cut a series of valleys, which lead down to Grays Harbor with habitats transitioning from forested slopes to the lower elevation salt marshes and open water of the Refuge. Along the eastside and continuing to the south side of the Refuge boundary are constructed fill areas which are slightly higher in elevation and support an early successional alder forest. The tidal mudflats and salt marsh habitats are generally flat and become inundated with tides over 8.5 feet.

Overall, Grays Harbor estuary and the Refuge is a shallow basin with depths averaging less than 20 feet (including channel depths). It has multiple connected channels and a wide expanse of mud and sand flats. Ebbing tides and river channels have caused shallow depressions within the estuary and Refuge boundary. Nearly level mudflats and salt marshes border the open water habitat within the Refuge.

3.4.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Unit is located within the Puget Sound Trough Ecoregion with the Coastal Range Mountains to the west and the Cascade Range to the east. The Coastal Range Mountains border the western portion of Thurston County, with rolling hills and valleys lying towards the east and south. Foothills of the Cascade Mountain Range and Mount Rainier begin to rise in the southeastern portion of the County. Surrounding elevations in the immediate Black River area range from sea level at Olympia to 2,657 feet in the Black Hills west of the Unit. The Black River valley floor is approximately 200 feet above sea level.

3.5 Geology

3.5.1 Grays Harbor National Wildlife Refuge

Over millions of years, geologic forces such as earthquakes and volcanic eruptions have shaped the land in Washington State. After erosion, deposition, and plate tectonics worked the landscape in Puget Sound for approximately 60 million years, a series of glaciers advanced from what is now British Columbia into the lowlands between the Cascade and Olympic ranges (White 1997). After each advance, the glaciers receded to the north and up the valleys to higher elevations, where they persist today. Between 150,000 and 15,000 years ago, these glaciers formed a glacial drift plain of gravels, sand, silt, clays, and tills that comprise the gently undulating surface of the Puget Sound lowlands (White 1997). In lowland areas around the sound, retreating glaciers left behind a thick mantle of lacustrine and outwash sediments over bedrock as far south as Chehalis, Washington.

The Chehalis River Valley formation was created by debris left by the advance of the Vashon Glacier southward from Puget Sound some 15,000 years ago. Glacial debris can be found east of Grays Harbor and along the banks of the present channel of the Chehalis River, which drained a major portion of Puget Sound during that glacial period. The estuary is a drowned portion of the Chehalis River Valley, and is continually being filled in with river-borne sediments and oceanic materials. The

surrounding uplands are composed of unconsolidated Pleistocene silt, sand, and gravel, which are sedimentary, and volcanic rocks of the Tertiary Age that form low relief hills. The predominant physical feature of the estuary is the vast amount of intertidal mud and sandflats (GHEMPTF 1987).

3.5.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Black River is located within and below the maximum southern extent of Pleistocene continental glaciations west of the Cascade Mountains. The north end of the Black River drainage, including Black Lake and the upper reaches of the river, were under ice during the last glacial maxima. During early glacial retreat, meltwater was blocked by ice from flowing northward, and glacial meltwater from much of the entire lobe was channeled southward through a shifting series of outwash channels, including the Black River channel, to the Chehalis drainage, and then out to the Pacific Ocean. Routes of the outwash channels were controlled by the slowly retreating glaciers, the underlying outcrops of Eocene sandstone and basalt in the area, and the overlying topography of moraines and glacial till. Fine-textured sediment deposited during this process blanketed portions of the landscape. Sand was also deposited by overbank deposition during flood surges caused by hydraulic damming associated with the sandstone and basalt bedrock in the channel-ways (Easterly and Salstrom 2008).

The combination of huge volumes of meltwater and blockages by earth and ice caused the water to pond and form a series of temporary lakes, including Lake Russell (Bretz 1913, cited by Easterly and Salstrom 2008), which extended over the southern inlets of what became Puget Sound. Lake Russell had a spillway over a low divide from Budd Inlet to the head of the valley of the Black River. The volume of water that was carried south over the spillway was considerable and became a large erosional force all the way to the mouth of the Chehalis River (WCC 1933). Within flood channels, the flow of meltwater sorted outwash sediments, leaving gravel. The outwash events created, eroded, and reshaped terraces in the massive amount of sediment in the outwash channels. The resulting Black River occupies a channel that is oversized and has a very low gradient (average of 9 inches/mile). Associated with this channel are a series of terraces that are likewise low-gradient, some including perched wetlands on outwash terraces above the Black River channel. Overbank deposition of sand from the outwash events is primarily perched on or above remnant terraces on the edges of the immediate area, as at Olympia Airport and south of Maytown (west of Tilly Road). Mima mounds on both sides of the river appear to be related to/associated with some “middle” terraces of the outwash channels. The oversized drainage basin creates a broad wetland zone along much of the river, especially in the upper reaches. The low-gradient side-slopes produce an overall relatively stable landform, and landslides are rare along the main stem of the river (Smith and Wenger 2001, Easterly and Salstrom 2008).

3.6 Soils

3.6.1 Grays Harbor National Wildlife Refuge

Soil types vary widely within the estuary. Sandy soils dominate the estuary entrance from the Pacific Ocean, while peat-lined, clay-type soils occur near the mouth of the Chehalis River. River drainage areas are primarily of the clay type.

The bed of the estuary is composed of sediments transported into Grays Harbor from the ocean and tributary streams. Most of the sediment in the central and lower third of the estuary is of marine

origin; this area contains less silt and a higher sand content. The North Bay, South Bay, and upper two-thirds of the estuary contain a mixture of marine and river sediments (GHEMPTF 1987).

Tide flats substrates contain silt and clay composition deposited by water flow from storms, river runoff, and dredging. The alluvial soils are deep and poorly drained with no single profile. One commonly observed soil sample is dark olive gray, very fine sand on the surface with gray loamy, very fine sand below the 6-inch depth (GHEMPTF 1987).

In 1987 it was estimated that the Chehalis River transported about two million cubic yards of sediment into the estuary per year. Most of the sediment transport takes place during the winter high-flow months. A similar amount of marine sediments enter the harbor from its mouth per year. The upper portion of the estuary where the Refuge is located contains a mixture of marine and riverine sediments (GHEMPTF 1987).

Bowerman Airfield was constructed by placing dredge spoils within the confines of a bulkhead. After the 1940s, additional unconfined dredged material was placed to connect the airfield to the mainland and to create an east-west lying peninsula. The disposal has covered what later became the Grays Harbor Refuge with a layer of predominately fine-grained materials dredged from the inner harbor channel and over time has converted what was a mix of sand and mudflats to mudflats.

Currently the mudflats are higher in elevation than most others in the greater estuary. The elevation of the Refuge (formerly Bowerman Basin) has been raised because of nearby discharges of unconfined dredged material (GHEMPTF 1987) and tidal action movement of sediments into the basin. The Refuge mudflats are protected from major wave action by the peninsula, and the tides have carried the material back and forth, depositing them at slack tides (GHEMPTF 1987, USFWS 1988). Storm events tend to move sediment into the closed-ended basin and push heavy woody debris into the higher salt marsh areas potentially trapping sediment. Additional fill sites were established and used until 1975. Those areas contain a combination of dredge materials and hillside fill of clay and rock composition (USFWS 1988).

3.6.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Soils in the Black River drainage range from slightly to strongly acidic at the surface, but become more neutral with depth. Glacial deposits range from porous sands and gravel to till which consists of clay and silt mixed with coarser materials. These deposits are composed chiefly of granite and quartzite. Some soil types were derived from bedrock, valley deposits, lake sediments, and alluvial deposits, while others are highly or purely organic. In the lowlands of this drainage, organic soils are common. They consist of decaying wetland vegetation in various stages of decomposition.

The soil types are diverse and interspersed in an irregular pattern. Using NRCS web soil surveys, over 31 different soil units were identified within the approved acquisition boundary, including 20 hydric and 11 nonhydric units. The floodplain soils are nearly level, very deep, and well drained. They formed in alluvium derived from mixed sources. (USDA 2012, USDA 1990).

Riggs (1958) conducted a detailed soil profile study for peat between the upper reaches of the river to 123rd Avenue. Generally, the quantity of peat decreases from 35 feet deep in the north to 10 feet deep in the south, the river flows over the deepest part of the peat deposit, and fibrous and woody peat form the major part of the deposit. Approximately 1,465 acres of various kinds of peat, including 15

acres of sphagnum, were reported. Sphagnum peat was described as raw and wet, implying little decomposition, and its presence correlates to the presence of bog vegetation. Diatomite shows past diatoms and phosphate presence (Riggs 1958). The soil types, maturity, and depth directly correlate to plant communities found within the Unit boundaries.

3.7 Air Quality

Air quality refers to the cleanliness of the atmosphere. Clean air is vital to human health and is a resource protected by Federal, State, and local regulations because it is a natural resource without boundaries. Pollutants in the air can negatively affect plants, animals, and humans. Air quality is affected by climate, topography, and meteorological conditions.

The Environmental Protection Agency (EPA) has the lead responsibility for air quality in the United States; through the 1990 Clean Air Act, the agency sets limits on the amount of pollutants that can be discharged into the air. According to the EPA, more than 170 million tons of pollution are emitted annually into the air within the United States. The Washington Department of Ecology (WDOE) is responsible for protecting the air quality within the State.

3.7.1 Grays Harbor National Wildlife Refuge

The Olympic Region Clean Air Agency in Aberdeen, Washington, records site-monitoring of ambient air pollutants, meteorological parameters, and other air-related data near the Refuge. Local human activities on and adjacent to the Refuge boundary that can affect air quality include stationary sources, industrial activities, lumber mills, and paper mills. Individuals may also affect air quality through the use of vehicles, motorized boats, equipment, wood stoves and fireplaces, and operation of gas-powered machines. Most Refuge visitors drive their automobiles to participate in wildlife observation and educational activities. Refuge staff may utilize vehicles, heavy equipment, and small gas-powered equipment for various resource management and one-time construction projects.

3.7.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Air quality at the Unit is susceptible to gravel mining dust, woodstoves, vehicle exhaust, tractors, motorboats (e.g., gasoline-powered engines/equipment), and outdoor burning. Habitat and public use improvement projects, including monitoring activities, may include the use of heavy equipment and the operation of trucks, tractors, or motorboats to access portions of the Unit for management purposes.

3.8 Water Quality and Quantity

3.8.1 Grays Harbor National Wildlife Refuge

The Chehalis River Basin (Basin) drains more than 2,700 square miles of land (Map 1); it is the largest river basin in western Washington. The Basin's land base supports a growing population of more than 141,000 people (U.S. Census 2000). Forest management activities account for approximately 87 percent of the land uses, while only 11 percent are in agriculture, urban, or industrial uses (CBP 1998). Urban centers within the Basin include the cities of Chehalis, Centralia, Aberdeen, and Hoquiam. The Chehalis River is the primary tributary of Grays Harbor estuary and the

largest freshwater source, providing approximately 80 percent of the freshwater to the harbor (GHEMPTF 1987). Other large tributaries of the estuary include the Hoquiam, Wishkah, Humptulips, Johns, and Elk Rivers.

Protecting water quality within the Basin and the ocean remains a priority for many agencies and communities. The cleanliness of the tributary waters discharging into the estuary ultimately affects the quality of the water available for Refuge wildlife resources. Anadromous fish species such as fall Chinook, coho, chum, steelhead and bull trout, Pacific lamprey, eulachon, and green sturgeon are dependent on the estuary for rearing habitat and on the Basin's clean rivers for spawning habitat. Grays Harbor estuary is important to the health of many species of wildlife that need clean water to survive and thrive. Clean water supports prey species which in turn supports shorebirds that feed upon and depend upon invertebrate species during their long migrations.

WDOE is the agency responsible for ensuring that the streams and rivers are within the standards of the Federal Clean Water Act of 1972 (CWA). Over the years, many streams and rivers within the Basin have incurred impaired water quality status due to various levels of point source and nonpoint source pollution.

According to WDOE, the greater Grays Harbor estuary was listed in 1996 under section 303(d) of the CWA as not meeting water quality standards for fecal coliform bacteria (found in human and animal waste) because of inadequate controls of point or nonpoint sources of pollution (WDOE 2010a). Fecal coliform enters the harbor from a variety of sources; contributors were traced to the Chehalis River due to storm water runoff, including the sewage treatment plants in the cities of Aberdeen, Hoquiam, Ocean Shores, and Westport. Identifying, monitoring, and addressing pollution sources containing fecal coliform bacteria within the Basin is a high priority for WDOE. In 1989 WDOE identified eight pulp mills around the harbor including one in Cosmopolis and one in Hoquiam listed as violating water quality standards for the priority pollutant TCDD, a dioxin (WDOE 2010b).

Over the years, a small number of investigations have linked effects of water quality to the health of the estuary and wildlife on the Refuge. A contaminants investigation in 1987 conducted on shorebirds within Grays Harbor estuary found shorebirds contained high tissue burdens of DDE and PCBs. This study included spring migrant and overwintering birds collected within the Refuge boundary. The study noted that shorebirds along the Washington coast were accumulating toxins in their bodies from organochlorine contamination and that shorebirds could be a pathway for organochlorines to accumulate in raptors that feed on shorebirds (Schick et al. 1987). In 1990, the Service's Ecological Services Program conducted an investigation of sediments on the Refuge, which identified high levels of toxins (dioxin and furan) in amphipods. The results of this study have raised concerns because amphipods are an important food source for migrating shorebirds and fish species including salmon (Momot and Mahaffy 2004). WDOE participates in the National Coastal Condition Assessment and Environmental Monitoring and Assessment Program. The 2002 data show samples collected within the Refuge boundary have elevated concentrations of chromium (Partridge, V. 2011, pers. comm.).

State agencies, private groups, and researchers within the Basin, Refuge, and the greater estuary have conducted water quality testing and monitoring. The Chehalis Basin Partnership (Partnership) was formed in 1998 under the State's Watershed Management Act to provide a framework for local citizens, interest groups, and government organizations to work collaboratively to identify and solve water-related issues. Over the years, they have developed a Watershed Management Plan (2004), the

Implementation Plan (2007) and the Progress Report (2011) to address those issues. Refuge staff coordinates with several of the organizations active in the Partnership, participates in outreach efforts, and coordinates with Service staff representing the Service in Partnership issues.

Water quality is a vital component of the local community's health, economy, and the health of the Refuge's wildlife. Refuge managers recognize the need to conduct further research within the Refuge boundary regarding water quality issues (see Objective 2.4.3). They also recognize the need to work with partners in the Chehalis River Basin and throughout Grays Harbor estuary to address issues affecting water quality and to provide education about what can be done to improve it (see Objective 2.3.1 and 2.3.2).

3.8.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Water quality and pollution is a problem in the Black River and its tributaries (Yake and Bernhardt 1989, Pickett 1991). Nonpoint source pollution is a problem in the Black River basin. Stormwater runoff at commercial, light industrial areas and construction sites can produce potential pollutants, especially in the rapidly growing upper basin. Streets, roads, and highways, including Interstate 5, could discharge pollutants in stormwater or potentially spill into Black River tributaries. Water pollution from adjacent residential septic systems, recreational uses, and agricultural runoff continues to be a problem to be resolved by Federal, State, and local governments. Regional growth in the Black River basin will likely put pressure on the groundwater resource, from both withdrawals and pollutant inputs (Pickett 1994a)**.** The current trend towards increasing numbers of residential developments being serviced by individual septic systems overtaxes the area's capability to naturally treat residential wastes, resulting in ground- and surface water pollution.

Prior to 1989 the Black River had not been studied extensively. The Black River system was poorly understood but appeared to be sensitive to environmental impacts and under pressure from several different land uses and projected regional population growth. In 1989, a large fish-kill in the mid to lower portions of the river indicated poor quality water in the river, which stimulated more in-depth studies. Most studies took place in the 1990s and focused on the middle and lower sections of the river, but some of these established a few sampling points in the northern reaches of the river which are relevant to Unit management.

In 1994, two studies of the Black River were undertaken: one on dissolved oxygen and phosphorus, and one on fecal contamination and nonpoint source pollution. The areas of the river that were sampled (near 110th Avenue, 123rd Avenue, and River Road bridges (upper river)) (Pickett 1994a, 1994b) generally had acceptable temperatures, especially in winter, but late summer temperatures were above the standard of 64 °F (18 °C). The upper river pH levels were generally acceptable, but organic sediments reduce pH near the bottom of the river, while photosynthesis in the submersed vegetation increases pH levels near the water surface. Pickett (1994a, 1994b) suggests the low pH levels near the riverbed appear to be a natural condition, and not a violation of water quality standards.

Dissolved oxygen (DO) levels in Waddell Creek, measured during a significant flow period, were acceptable. However, none of the DO levels in the upper river were high enough to meet the standard of 8.0 mg/L and all samples were below standard saturation levels. Pickett cites Lee et al. (1975), who noted that high organic-matter content in the discharge from marshlands produces low DO levels and high color and that the DO level may be the result of natural processes. Two years of fecal

coliform tests showed no presence at 110th Avenue, but at the River Road site immediately north of Littlerock, testing showed higher concentrations. The likely sources of contamination between 110th Avenue and River Road were thought to be storm water, onsite septic systems, agriculture, and wildlife (Pickett 1994a, 1994b). Since that study was completed, a large dairy farm between 110th Avenue and River Road is no longer operational, reducing the potential for fecal contamination.

Between September 2007 and June 2009, a water quality study had 94 test sites on the Chehalis Rivers and its tributaries. Standard water quality tests included pH, DO, fecal coliform, turbidity, and water temperature. The criteria used to evaluate water quality were based on Washington State standards (173-201A WAC). The rationale for these standards is that water quality meeting the standards provides for the habitat needs of fish and other aquatic life, provides a safe environment for people engaged in water recreation, and provides for the production of healthy and safe seafood (Green et al. 2009).

Two sampling sites from this study are relevant to the Unit: one on the Black River at Black Lake and another at 110th Avenue. All the data collected from the two stations fell within the standard range for pH. The standard for DO is ≥8mg/L and the north-most site showed excellent DO quality with only 1 sample below the standard, but the 110th Avenue site had 16 of the 29 samples (61 percent) below the standard. Again, an explanation for the sub-standard levels could be that the Black River is a relatively low-gradient river that flows through shrub swamp with mostly agricultural lands or forests in nearby uplands, and these lands and fertilizers may create high nutrient inputs into the river. However, this slow-moving river also accumulates organic debris, such as peat soils and rotting leaves that fall from vegetation along the banks.

The river has dense underwater vegetation and algae above the 110th Avenue sample site. The upper reaches of the river contain shrubs rather than taller trees, resulting in full sun exposure. Decomposing algae, aquatic vegetation, and organic debris in water bodies reduce DO in the water due to cellular respiration of the bacteria and fungi that act as decomposers. These natural processes may be contributing to lower DO in the Black River. No fecal coliform was detected in 28 samples in the Black River at the Black Lake site, in 27 samples at 110th Avenue, nor in 28 samples from the Littlerock boat launch site located south of Littlerock. This shows significant improvement from the 1994 study. One sample of 28 and one sample of 27 showed turbidity over the 7 nephelometric turbidity unit standards at the north-most sample site and from the 110th Avenue location, respectively (Green et al. 2009).

Another factor affecting water quality is the growth of macrophytes and periphyton in the Black River. Pickett noted from Hill (1986) that sediments provide much of the nutrient supply for macrophytes, macrophytes transfer large amounts of nutrients back to the sediments, and that macrophytes could release sediment-derived nutrients into the water column. Furthermore, as macrophytes utilize particulate matter and dissolved nutrients from the water column, nutrients are cycled between the living tissue and the sediment, creating a self-sustaining system. Pickett noted that if an effort was made to reduce nutrient levels and phytoplankton in the water column, the plants would have a sediment nutrient source, and macrophyte reduction would occur very slowly, if at all, and the cycle would continue (Pickett 1994a, Green et al. 2009).

In the northern portion of the river, dense growth of submerged plants is currently thought to be primarily native species, although surveys need to be conducted to verify this. Currently submerged plant colonies grow very thick, providing cover and food sources for amphibians and fish. Nonnative reed canarygrass grows densely along the banks and then roots into submersed plants in the

mainstem of the river. This dense plant growth can limit light penetration, causing less oxygen to be generated within the water column. Later, decomposition of the decaying vegetation further depletes oxygen levels to the point of excluding fish, mammals, and invertebrates from those areas with the densest growth. The river's anaerobic bacteria can live in low- to no-oxygen water and produce sulfuric waste products, causing the lake and sediments to release gas and odors (SBLC 2012). Algal mats develop on the river during warm summer temperatures and also when water flow is greatly reduced. Algal growth may be enhanced by artificial nutrient sources, inputs from fertilizers, and leaky septic systems. The algal mats grow on the submersed plants, cover them, and form a thick surface scum layer. This quantity of algae may have detrimental effects on water quality. Although river water quality testing took place in the 1990s, recent information on water quality in the upper reaches of the Black River has not been collected.

Napier et al. (2008) notes concerns in the Black River Management Unit (watershed) that poor water quantity exists naturally due to the river's general character; however, the situation may be exacerbated by loss of water flow resulting from the pipeline crossing along with increasing water withdrawals. General actions to help increase water quantity include reducing water withdrawals from surface sources, determining if water withdrawals are followed according to current water rights, and conducting a study on unregulated/regulated withdrawals. Increasing sediment load in the river mainstem also contributes to poor water quality. Suggestions to reduce sediment loading in the river include reducing road densities (abandon/decommissioned) in upland forests and further identifying sources that are contributing to sediment loading (Napier et al. 2008).

In 2010 and 2012, Black Lake, the headwaters for the river, was temporarily closed to swimming and water sports due to a blue-green algal bloom. Black Lake is infested with nonnative plant species including Eurasian watermilfoil and yellow flag iris. Save Black Lake Coalition is a nonprofit organization formed in 2010 in response to the lake closure. The goal of the coalition is to educate landowners about lake water quality and improve water quality by reducing invasive plants and reducing or eliminating algal blooms.

3.9 Surrounding Land Use

3.9.1 Grays Harbor National Wildlife Refuge

The land use patterns surrounding the Refuge are primarily forestland dedicated to commercial timber production and a mix of urban areas, including the cities of Aberdeen and Hoquiam. To the north of the Refuge boundary is Highway 109 and many rural residential properties. Highway 109 has been designated as a State Scenic Byway. Directly to the east of the Refuge are upland properties, managed by the Port of Grays Harbor as industrial sites, and formerly a log-storage and shipping yard that has been considered for a variety of uses. In 2012 a coal transfer operation was planned but terminated. Currently a crude oil tank farm and transfer operation is being considered for development. South of the Refuge boundary, the City of Hoquiam runs their water treatment facility and the Port operates Bowerman Airport. The Bowerman airfield operates 24 hours a day, providing jet capable access, air cargo, and hangars. Lands currently not acquired within the Refuge acquisition boundary include approximately 309 acres of intertidal mudflat and open water habitat.

3.9.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Land use in the Black River basin includes undeveloped wetlands, agriculture, and a mixture of residential and commercial development. The uplands are generally commercial timberlands and expanding low- to high-density residential developments. Land use activity in the Black River basin has been transitioning from agriculture to rural residential. A number of dairies in the past have been located in the basin, but most have closed down. Poultry operations, a silviculture nursery, and turf and berry farms have operated in the basin (Pickett 1994a). Timber harvest and management activities currently occur throughout the basin, especially in the Black Hills by WDNR on Capitol Forest lands.

Lands within the Refuge acquisition boundary include approximately 2,293 acres of privately owned tracts, many utilized as residential properties. Two large tracts within the boundary are managed for commercial timber purposes.

Residential housing developments and farms lie outside the Refuge acquisition boundary. A local gravel mining operation lies directly on the northeast side of the Refuge boundary, located both inside and outside of the approved boundary. Interstate 5 is within 5 miles of the boundary and provides access to neighboring cities and communities. Within Thurston County there are a number of recreation areas, parks, and open spaces that benefit wildlife and are open to public access. Some examples are Chehalis Western Trail, Woodard Bay Natural Resources Conservation Area, Capitol State Forest, Mima Mounds Natural Area Preserve, and Glacial Heritage Preserve (see Chapter 5). Thurston County owns the railroad right of way east of the Refuge and is planning the Gate Belmore Trail on the old railroad bed. The State offers approximately 25 areas opened to fishing within the county. The State also offers hunting opportunities throughout the county, which include big game, upland game birds, and waterfowl.

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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 the Refuge and the Unit. 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 focuses on the presentation of pertinent background information for habitats used by each of the priority Resources of Concern (ROCs) and other benefitting species identified in the CCP (see Tables 4-1a and b).

ROCs are plant and animal species and their habitats that have been identified by a refuge through its refuge purpose or other conservation plan to receive special or enhanced management attention; these become the conservation targets for the CCP's goals, objectives, and strategies. A priority ROC requires an even higher level of attention and management. Focal resources are species or species groups sharing the same or similar conservation needs as the priority ROC and selected by a refuge as representatives for the overall condition of the priority ROC. Species of concern (SOCs) are plant and animal species that are declining or appear to be in need of conservation. Their status is determined by the Service's fish and wildlife office in a particular state, but the category is informal and confers no legal status under the ESA.

The background information includes descriptions, conditions, and trends of habitats and identifies threats (stresses and sources of stress) to the habitats or associated ROCs. This information was used to develop goals and objectives for the CCP.

4.1 Biological Integrity, Diversity, and Environmental Health

The National Wildlife Refuge System Improvement Act of 1997 directs the U.S. Fish and Wildlife Service to ensure that the biological integrity, diversity, and environmental health of the National Wildlife Refuge System (Refuge System) are maintained for the benefit of present and future generations of Americans. To meet this mandate, the Service developed a Biological Integrity, Diversity, and Environmental Health (BIDEH) Policy to provide implementation guidance (see policy 601 FW 3).

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 provides guidance for consideration and protection of the broad spectrum of fish, wildlife, and habitat resources that represent BIDEH on refuges and in associated ecosystems. This policy provides refuges with a process for evaluating the best management direction to prevent the additional degradation of environmental conditions and to restore lost or severely degraded environmental components. It also provides guidelines for dealing with external threats to the BIDEH of a refuge and its ecosystems. The Refuge and the Unit developed BIDEH tables to examine the habitats supporting key fish and wildlife species (see Appendix E for the BIDEH tables).

4.1.1 Historical Land Use and Conditions

Grays Harbor National Wildlife Refuge

The Refuge manages approximately 1,500 acres within the 60,160-acre Grays Harbor estuary. Grays Harbor estuary is located between the mouth of the Chehalis River and the Pacific Ocean. The Refuge encompasses Bowerman Basin and is bounded to the north by uplands and rip-rap along State Highway 109, the south by Bowerman Airport, and the east by industrial lands. The primary habitat type is an estuarine ecosystem composed of open water, intertidal mudflats, salt and brackish marsh, and surrounding forest habitats (Map 2).

The biological integrity and health of the entire estuary has been significantly influenced by human activities. Prior to 1941 and the construction of Bowerman Airfield, the area was a contiguous part of the larger estuary. In the wide-open intertidal mudflats and open water was Moon Island; Mini-moon Island did not exist, nor did Paulson Road or Airport Way. Salt marshes surrounded the edge of the mudflats.

In order to construct Bowerman Airfield in 1941 and 1942, a long bulkhead connecting to Moon Island was filled with rocks, soil, and dredge spoils. Fill continued to be placed on the mudflats east of the bulkhead converting it to higher elevation land. The constructed bulkhead and fill created a peninsula and transformed open water and intertidal mudflats into a protected basin. An industrial area was subsequently developed (CH2M HILL 1979) to the east and southeast. Unconfined dredge spoil disposal continued near Paulson Road until 1972 (Cooper 1989). A berm was constructed extending from State Highway 109 near Bi-Pass Road toward Paulson Road and Airport Way to confine dredge deposits placed between 1973 and 1976 on what were then City of Hoquiam lands (Cooper 1989, NOAA 1987). The dredge fill and resulting airport peninsula confined water entry and exit to the western end of the basin (Kunze and Cornelius 1985, Cooper 1989). Long-term impacts from these significant changes in the landscape require further information and research.

Historically, dioxin and fecal coliform bacteria are contaminants identified as problematic in the greater estuary. Eight pulp mills violated water quality standards by discharging dioxin-contaminated effluent and sludge (USEPA 1992). The Refuge is located in a site where contamination may have occurred from dredge spoils, industrial waste, ship discharges, urban waste, agricultural residue, and general runoff (Chapter 3.8).

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Black River is a 25-mile long tributary of the Chehalis River, which drains a 144-square-mile basin. It flows from Black Lake at an elevation of 144 feet to the confluence with the Chehalis River at an elevation of 125 feet (Smith and Wegner 2001). The river has a very low gradient (averaging 9 inches/mile) within an oversized channel (Easterly and Salstrom 2008).

The Unit manages over 1,300 acres within the 3,900-acre approved boundary encompassing the upper third of the river, extending from the southern edge of Black Lake to approximately river mile 17.5 just south of 123rd Avenue. Habitats include approximately 7.5 miles of river channel, 6 to 16 miles of tributary channels; bog; shrub swamp; riparian forest; emergent marsh; seasonally flooded, nonnative grasslands; dry, nonnative grasslands; and mixed forest (see Map 5). The surrounding

landscape is primarily rural and includes large areas of commercial forest and agriculture, areas of low- to high-density development, and some small industrial development.

The lands within the approved Unit boundary appear relatively less impacted by human activities compared to other low-elevation river systems in the Puget Trough region. However, human activities since European settlement have substantially affected many of the habitats within and adjacent to the current boundary.

Some historically forested habitats were modified for agricultural purposes. For example, within the current Unit boundary, some uplands historically dominated by Douglas-fir and western hemlock forest were modified for agricultural purposes and converted to pastures, hayfields, and crop fields. Several of these areas were former dairy farms at the time of Unit acquisition (Easterly and Salstrom 2008).

The Black River originates from Black Lake, but its historic regime has been altered. In 1922, an approximately 3.4-mile ditch was constructed to connect the north end of Black Lake to what is now Capital Lake, at the southern end of Puget Sound. This additional drainage, which has continued to deepen through subsequent excavations, has lowered the lake level by 2 feet and altered the flow such that the lake seldom drains south into Black River. This loss of water has reduced the flow in the river, especially from October through March, which in turn increases water temperature, decreases DO levels, and concentrates toxins (Smith and Wenger 2001).

In the 1960s a gas pipeline was excavated across the Black River and its riparian zone about 1.5 miles downstream from the lake. Excavated spoils were sidecast. The line of spoils has supported altered vegetation, which in turn encouraged beaver dam building activity and debris accumulation. The berm may have created a blockage for fish access upstream from this point, as well as contributed to the reversal of flow in the wetlands of the upper Black River (Smith and Wenger 2001). Documentation of river dredging was not found, but anecdotal information described deepening of the river both above and below Littlerock to allow ferrying of people and products in the early 1900s (Westby, L. 2011, pers. comm.). Currently the river appears to be over 10 feet deep in areas with very steep, undercut sides that are unstable.

Two public roads cross the northern third of the Black River and associated wetlands within the approved boundary: 110th Avenue SW and 123rd Avenue SW. In both cases, the roads constrict the river's flow. This alters both water flow and connectivity within the wetlands. The roads may influence water quality by increasing sediment and pollutant delivery and can be points of introduction for nonnative species. The physical changes imposed on various parts of the river can be observed, but the effects on the biological integrity and environmental health may not be easily observed or understood without further research and monitoring.

Surface and groundwater availability have also been altered in the Black River system. Various parts of the floodplain have been ditched, drained, cleared, and/or filled in the past primarily in connection with agricultural use. Blooms Ditch drains into the river on the Unit from the east. The implications of such ditches to the habitat are that they reduce surface flooding during the rainy season and effectively reduce seepage into the aquifer. Overall, they may alter the quantity and timing of surface flow into the river, its tributaries, and riparian systems.

Some forestry practices to the west and some agriculture practices to the east of the river may have increased sediment and nutrient loads. These activities have impacted native habitats and may have introduced populations of invasive, nonnative species.

Land use near the Unit has been changing, with increased residential and commercial development. These changes likely will result in greater amounts of well drilling and groundwater removal from the system.

4.2 Selection of Priority Resources of Concern

In preparing this plan, the planning team reviewed other local, regional, and national plans that pertain to wildlife and habitats within the Chehalis River Basin and southwest Washington. The team also sought input from Washington State conservation agencies, NGOs, and the public (see Appendix J). As a result of this information-gathering and review process, certain species and habitats were identified and listed in Biological Resources of Concern and BIDEH tables (see Appendix E). Wildlife and habitat goals and objectives in Chapter 2 were designed directly around the habitat requirements of species designated as priority ROCs (see Tables 4-1a and b).

ROCs are described as conservation targets in conservation planning methodologies used by other agencies and NGOs. In developing objectives, the team followed the process outlined in the Service's *Identifying Refuge Resources of Concern and Management Priorities: A Handbook* (USFWS 2010a). 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" (620 FW 1).

Therefore, ROCs for a refuge may be a species or species group, or the habitat or plant community that supports a priority species or species group.

In further refining the extensive ROC tables and using the BIDEH table to create the priority ROCs with focal resources (see Tables 4-1a and b), the planning team analyzed the ecological attributes of the habitats to meet the life history requirements of ROCs. Those attributes are therefore critical to sustaining the long-term viability of the priority ROCs and other benefitting species. These provide measurable indicators that strongly correlate with the ability of a habitat to support a given species. Tables listing the habitat types found on the Refuge incorporate "desired" conditions based on scientific literature review and team members' professional judgment. These desired conditions for specific ecological attributes were then used to help develop habitat objectives, as presented in

Chapter 2. However, other factors, such as feasibility and 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. The ultimate design of habitat objectives was subject to further discussion and consideration.

Additionally, the planning team refined the species or species groups included in the ROC tables by selecting not only species mentioned in establishing documents for the Refuge and the Unit, but also species that captured the ecological attributes of habitats required by larger suites of species (see "Other Benefitting Species," Tables 4-1a and b and in Appendix E). Priority ROCs may be species, species groups, or features that the Refuge and the Unit will actively manage to conserve and restore during the life of the CCP. Negative features of the landscape, such as invasive plants, may demand a large part of the Refuge's and the Unit's management efforts, but are not designated as ROCs.

Limiting factors were 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. In some cases the structure of plant communities utilized by ROCs can be created, rather than restoring the original native species composition. For example, management of nonnative vegetation by mowing and/or grazing may be necessary to maintain a desirable vegetation structure, when restoring native grassland communities may be impractical. Through the consideration of BIDEH, the Refuge and the Unit will provide for or maintain all appropriate native habitats and species. Refuge and Unit management priorities may change over time, and because the CCP is designed to be a living, flexible document, changes will be made if needed.

The main criteria for selecting priority ROCs included the following requirements:

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

Other criteria considered in the selection of the ROCs included the following:

- Species groups and/or Refuge or Unit features of special management concern;
- Species contributing to the BIDEH of the ecosystem;
- Species where it is feasible to estimate population size (needed for future monitoring and adaptive management).

Table 4-1a. Priority Resources of Concern with Focal Resources and Other Benefitting Species—Grays Harbor Refuge

Priority Resources of Concern	Focal Resources	Other Benefitting Species
Tidal Open Water (723 acres)	Bufflehead	Concentrations of diving waterfowl such as scaup species, red-breasted and common merganser, goldeneye species, scoter species; some dabbling ducks such as northern pintail, mallard, gadwall, green-winged teal, northern shoveler; geese such as Canada, cackling, white-fronted, brant; waterbirds such as loon species, cormorant species, grebe species, brown pelican, gull species; bald eagle, osprey; many fish species such as juvenile and adult flat fish, forage fish, salmonids, green sturgeon, bull trout, eulachon; mammals such as harbor seal, marine invertebrates, zooplankton, phytoplankton, algae
	Native eelgrass	Fish species, especially those laying eggs on eelgrass, juvenile salmonids; benthic and other marine invertebrates including Dungeness crab, soft-shell clams; brant
Intertidal Mudflat (497 acres)	Western sandpiper	Slightly probing shorebirds such as dunlin, least and semipalmated sandpiper; raptors such as peregrine falcon, merlin, bald eagle; benthic and water column invertebrates
	Short-billed dowitcher	Moderately deep-probing shorebirds such as red knot, whimbrel, marbled godwit, long-billed curlew, yellowlegs species, long-billed dowitcher; raptors such as peregrine falcon, merlin, bald eagle; benthic and water column invertebrates
	Semipalmated plover	Visually foraging shorebirds such as black-bellied plover, golden plover species; raptors such as peregrine falcon, merlin, bald eagle; benthic and water column invertebrates
	Benthic invertebrates	Shorebirds; waterbirds; mink; otter; fish
	Caspian tern	Gull species including glaucous-winged, western, mew, ring-billed; raptors such as peregrine falcon, merlin, bald eagle, osprey; fish species; benthic and water column invertebrates
	American wigeon	Concentrations of dabbling waterfowl such as

Priority Resources of Concern	Focal Resources	Other Benefitting Species
		northern pintail, mallard, gadwall, green-winged teal, northern shoveler; geese such as Canada, cackling, white-fronted; waterbirds such as double-crested cormorant, gulls; harbor seal; juvenile and possibly adult fish including salmon species; benthic and water column invertebrates
Salt and Brackish Marsh (156 acres)	Marsh wren	Long-tailed weasel, river otter; garter snake; shorebirds such as least sandpiper, western sandpiper, dunlin; dabbling waterfowl such as American wigeon, mallard, northern pintail, green-wing teal; geese including Canada, cackling, white-fronted; marshbirds such as great-blue heron, sora, Virginia rail, American bittern; northern harrier; red-winged blackbird, common yellow-throat, song sparrow; terrestrial insects; benthic and water column invertebrates; possibly Newcomb's littorine snail
	Fish	Juvenile fish such as flat fish, forage fish, salmonids, eulachon, bull trout, green sturgeon; terrestrial insects; benthic and water column invertebrates
	Sweetgrass (3-square bulrush)	Native salt marsh vegetation; juvenile fish; benthic and water column invertebrates; possibly Newcomb's littorine snail
	Representatives of High, Mid & and Low Salt Marsh plant species. High = cow parsnip Mid = Pacific silverweed or Lyngby's sedge Low = pickeleweed or sand-spurry species	All plant species of the salt marsh; benthic and water column invertebrates; juvenile fish; passerines; shorebirds; waterfowl; waterbirds
Forest (95 acres)	Yellow Warbler/Yellow-rumped Warbler	Downy woodpecker, rufous hummingbird, willow flycatcher, Pacific-slope flycatcher, black-capped chickadee, tree-, barn-, and violet-green swallows, Bewick's wren, Wilson's and orange-crowned warblers, common yellowthroat, American robin, cedar waxwing, song and fox sparrows, American goldfinch;

Priority Resources of Concern	Focal Resources	Other Benefitting Species
		Cooper's and sharp-shinned hawk; long- and short-tailed weasel; black-tailed deer; garter snake species; Pacific chorus frog; amphibians; invertebrates; insects

(All habitat types are GIS acres)

Table 4-1b. Priority Resources of Concern with Focal Species and Other Benefitting Species—Black River Unit

Priority Resource of Concern	Focal Resources	Other Benefitting Species
River Channel and Tributary Channels with mud bottom (7.5 miles of river and 3 to 13 miles of tributaries)	Olympic mudminnow	Oregon spotted frog, red-legged frog, rough-skinned newt, northwest and long-toed salamanders; pied-billed grebe; belted kingfisher, green heron; three-spined stickleback, prickly sculpin; benthic and aquatic invertebrates, including freshwater mussels; insects such as Pacific clubtail dragonfly; freshwater sponge species; bat species; mink, muskrat, otter, beaver; possibly water howellia
Tributary Channel with cobble bottom (<3 miles)	Coho salmon	Cutthroat and steelhead trout, Chinook salmon; benthic and aquatic invertebrates, including freshwater mussel species; insects
	Native crayfish	Bat species; great blue and green herons; mink, muskrat
Bog (56 acres)	Bog plants such as Labrador tea/sphagnum moss	Western bog laurel, bog cranberry, sundew, bog orchids, cotton grass, possibly water howellia
		Bog specialists including invertebrates such as Beller's ground beetle, Hatch's click beetle, Queen Charlotte's copper butterfly
Shrub Swamp (512 acres)	Willow/Pacific slope flycatcher	Downy woodpecker, marsh wren, flycatcher species, warblers such as McGillivray's-, Wilson's-, orange-crowned-, yellow-rumped, and common yellowthroat; song sparrow; belted kingfisher; pollinator insects
	Olympic mudminnow	Pacific chorus frog, rough-skinned newt, northwest and long-toed salamander
	Muskrat	Bat species; mink, otter, beaver, raccoon; benthic and aquatic invertebrates; possibly water howellia

Priority Resource of Concern	Focal Resources	Other Benefitting Species
Riparian Forest (265 acres)	Yellow warbler	McGillivray's-, Wilson's-, orange-crowned, black-throated gray, and yellow-rumped warblers; warbling vireo, American robin, spotted towhee, purple finch, song and fox sparrows, black-headed grosbeak, Bewick's and winter wrens, cedar waxwing, red-breasted sapsucker; wood duck, hooded merganser; sharp-shinned and Cooper's hawks; rufous hummingbird; belted kingfisher; pollinator insects
	Swainson's thrush/ Downy woodpecker	Bat species; mice, shrew, vole, mole, flying squirrel, mink, raccoon, long and short-tailed weasel, opossum; red fox, coyote, bobcat, black bear, cougar
	Pacific chorus frog	Rough-skinned newt, western red-backed salamander, northwest and long-toed salamanders; garter snake species; aquatic invertebrates; possibly water howellia
Emergent Marsh (34 acres)	Oregon spotted frog/Northwestern salamander	Benthic and aquatic invertebrates; pollinator insects; possibly water howellia; possibly Olympic mudminnow; bat species; mink, muskrat; Pacific chorus frog, red-legged frog, rough-skinned newt, northwest, and long-toed salamanders; garter snake, other snake species
	Marsh wren	American bittern, Virginia rail, sora, Wilson's snipe, great blue and green heron; pied-billed grebe; northern harrier; swallows, red-winged blackbird; dabbling waterfowl such as mallard, American wigeon, northern shoveler, northern pintail, American green-winged, blue-winged, cinnamon teal, coot, geese
Seasonally Flooded Nonnative Grasslands (82 acres)	Red-legged frog	Rough-skinned newt, northwest and long-toed salamanders; benthic and aquatic invertebrates; bats; mink, muskrat
	Mallard	Dabbling waterfowl such as American wigeon, northern shoveler, northern pintail, American green-winged, blue-winged, and cinnamon teal, coot, Canada and cackling geese; purple martin, tree- violet-green, and rough-winged swallow; northern harrier; red-winged blackbird; sora, Virginia rail, American bittern

Priority Resource of Concern	Focal Resources	Other Benefitting Species
	Killdeer Killdeer in moist, short-grass areas	Wilson's snipe, greater yellowlegs; migrating shorebirds; northern harrier; cackling and Canada geese; mice, shrew, vole, mole; bat species; garter snake species; freshwater and terrestrial invertebrates
Dry Nonnative Grassland (163 acres)	Savannah sparrow	Western meadowlark, lazuli bunting, western bluebird; killdeer; common nighthawk, red-tailed hawk, American kestrel; Canada and cackling goose; western screech owl, barn owl, possibly short-eared owl, possibly northern shrike
	American kestrel	Bat species; mice, vole, mole; weasel, spotted skunk; snake species, northern alligator lizard; pollinator insects; Roosevelt elk, black-tailed deer; coyote
Mixed Forest (394 acres)	*Early–mid successional forest without understory* Black-capped chickadee	Yellow-rumped and orange-crowned warbler, white-crowned and song sparrow, rufous-sided towhee, dark-eyed junco, Steller's jay, crow species; butterfly and moth species; garter snake species, northern alligator lizard; western red-backed salamander; mice, shrew, vole; bat species; weasel, opossum, raccoon, spotted skunk; coyote, bobcat, black bear, cougar; Roosevelt elk, black-tailed deer
	Mid–mature successional forest with understory: Chestnut-backed chickadee/ Pileated woodpecker/ Douglas squirrel/Varied thrush	Band-tailed pigeon; bald eagle, Cooper's and sharp-shinned hawk, western screech-, northern saw-whet-, and great horned owl; Vaux's swift, winter wren, Pacific-slope flycatcher, brown creeper, Townsend's warbler, hermit thrush, Steller's jay; snake species; Townsend's chipmunk, Douglas squirrel, flying squirrel; spotted skunk; bat species; weasels; mice, shrew, voles; opossum; coyote, bobcat, black bear, cougar; Roosevelt elk, black-tailed deer; Northern possibly spotted owl

(All habitat types are GIS acres)

4.3 Habitat Types

Grays Harbor National Wildlife Refuge

4.3.1 Tidal Open Water

Overview

Approximately 723 acres of tidal open water habitat is located in the western portion of the Refuge. This habitat is inundated continually with marine waters, regardless of tide level. Salinity ranges from 10 to 25 ppt depending upon the time of year. In winter during intense rain events, salinity levels can drop because of large freshwater inputs from rivers and tributaries as well as from direct precipitation. In summer during periods of little rain, salinity rises due to decreased watershed drainage and increased evaporation. Phytoplankton, zooplankton, algae, and invertebrates thrive within this habitat.

Native eelgrass beds may exist where physical substrate characteristics are appropriate. However, rooted aquatic plants can be scarce in the main channels because of water depth, difficulty in photosynthesizing in turbid conditions, and strong, erosive currents.

Submerged tidal channels deliver oceanic nutrients and plankton to the tidal flats during high tides. The channels provide a route for fish to access the intertidal mudflats and cover from large predators during low tides (Coastal Resources Alliance 2007). Large woody debris (LWD), such as entire trees, branches, or root wads carried by tides and rivers, is distributed in the open water and may become waterlogged and sink to the bottom; such woody debris captures sediments and provides underwater cover for fish and invertebrates.

Ideally, water quality should be high, relatively free of contamination, pollution, and turbidity. Nonnative or invasive animals and plants should be at a minimum.

Regional Distribution, Conditions, and Trends of Tidal Open Water

Along the Pacific coastline, Grays Harbor is a 94-square-mile coastal estuary of hemispheric significance to migrating shorebirds and regional importance to a variety of fish and wildlife species (see Special Designation Lands 1.8). The tidal open water of the Refuge provides 723 acres for thousands of migrating birds needing food and rest. Tidal open water habitat accounts for nearly 50 percent of the overall Refuge area.

Water quality, invasive species, and climate change have and could compromise the ecological integrity of this habitat and its inhabitants. The primary threats to this habitat come from nearby pollution sources; heavy industries may contribute air and noise pollution, but water pollution is the largest threat. Ocean-going shipping vessels and barge traffic pass next to the Refuge and present a potential for grounding or possible fuel spills. Upstream, heavy industries, such as a pulp mill and storage facilities for oil and gas, may release pollutants or cause an accident that could impair the open water habitat. Ship hulls provide growing surfaces for plants and invertebrates from other areas of the world, and ballast water may include nonnative plankton, algae, and invertebrates. Establishment of nonnative plants and animals in Refuge open water habitat is likely and would

negatively impact native habitat, fish, and wildlife species. Sea level rise will increase this habitat coverage on the Refuge.

Key Species Supported

The open water of the Refuge provides habitat for juvenile and adult fish, wintering and migratory birds, a variety of invertebrate animals, and aquatic plants. Although specific species occurrence data is lacking for Refuge waters, these estuarine areas likely serve as foraging areas for adult salmon, eulachon, lamprey, sea-run cutthroat trout, and steelhead migrating upriver to spawn, and for juveniles moving downstream to the ocean. Sturgeon, forage fish, and ground-feeding fish may forage in the deeper channels and holes.

Oceanic nutrients, phyto- and zooplankton, and algae found in this habitat provide prey for fish. Specific occurrence information is lacking for Refuge waters, but likely clams, oysters, mussels, aquatic worms, amphipods, and other small organisms live along the bottom of the estuary and serve as a valuable food source for many species. Federally listed eulachon, green sturgeon, and bull trout (NFSC 2008, USDC 2009, Jeanes and Morello 2006, Chan, J. 2013, pers. comm.) juveniles may use this habitat. Many fish species that spend their adult life in the ocean spend time as juveniles in the estuary. The size of fish populations or stability of listed species using this habitat is unknown.

Open water provides necessary resting and foraging habitat for hundreds of waterfowl such as bufflehead, greater and lesser scaup, ring-necked ducks, and merganser species; waterbirds such as gull species, pelagic and double-crested cormorants and grebe species; prey for raptors such as osprey, and bald eagle during migration, breeding, and wintering periods. State-listed species are also dependent on this habitat.

4.3.2 Intertidal Mudflat

Overview

Intertidal mudflats are those areas of exposed mud, sand, and silt affected by rising and falling tides. This habitat is completely inundated at mean higher high water tidal levels and completely evacuated at lower tides, exposing approximately 64 percent (497 acres) of the Refuge. A large area of the intertidal mudflat habitat is free of rooted vegetation and supports algae growth. Twice daily, tidally driven marine waters flood the Refuge up to 12.5 feet deep and transport nutrients and a variety of animal life: zooplankton, phytoplankton, algae, and fish. Patches of native eelgrass, growing in slough channels at lower elevations, may be exposed briefly during extreme low tides. LWD is distributed across intertidal mudflats with tidal changes.

Intertidal mudflats within the Refuge boundary are at slightly higher elevation than those in the rest of Grays Harbor and are one of the last areas to be covered by rising tides. Because of this, the Refuge habitat provides exposure of benthic and epibenthic invertebrate populations for shorebirds to prey upon for 1 to 2 hours longer than at other areas of the harbor. This area also functions as an important roosting and loafing site for migrating and wintering shorebirds.

Regional Distribution, Conditions, and Trends of Intertidal Mudflat

In the Pacific Northwest large portions of estuarine habitat have been lost to diking, channeling, dredging, and filling. Washington is estimated to have lost between 45 and 62 percent of its pre-settlement estuarine habitat (Aitkin 1998).

Tidal marine waters carry zooplankton, phytoplankton, algae, seeds, and fish throughout the estuary and sustain epibenthic and benthic invertebrate populations. Organisms inhabiting intertidal flats must cope with the stress of currents, varied wave action, tides, and air exposure. Intertidal life is affected by light level, temperature change, amounts of oxygen and salinity, air exposure, wind, sediments, and turbidity (McConnaughey and McConnaughey 1985). Intertidal organisms may be negatively affected by invasive plant and animal species.

The Refuge intertidal mudflat is trending toward higher elevations. However, the sedimentation rate is not well understood. As soil elevations have increased, patches of pioneer plants have established on slightly higher elevation mudflats, the roots then stabilize the mud and trap more sediment, allowing more and larger plants to colonize. The loss of important tidal mudflats and the negative ramifications of shorebird foraging habitat needs to be closely examined and weighed against potential sea level rise predictions to make management decisions (see Chapters 2 and 3).

Another relatively new change to tidal mudflats on the Pacific coast is the establishment and spread of Japanese eelgrass, a nonnative, tidally dependent seagrass. It grows in greater Grays Harbor, including the Refuge, and is covering the intertidal mudflats where it can survive extended periods of air exposure (GHEMPTF 1987). Nonnative eelgrass could potentially cover large portions of the Refuge intertidal mudflats and likely negatively affect shorebird foraging habitat. Additional threats to the Refuge mudflats come from potential nearby pollution sources that could contaminate air, water, and sediments (see 4.3.1 Tidal Open Water). Climate change may bring warmer temperatures, which may create large algal mats on the mudflats and toxic algal blooms in the water. Climate change-induced sea level rise could convert mudflat to tidal open water or sub-tidal habitat which would reduce foraging habitat for shorebirds.

Key Species Supported

As many as 24 species of migratory shorebirds have been known to use the greater Grays Harbor intertidal mudflats as an important stopover site to forage and rest on extended migrations to and from South America and Alaska (USFWS 1990). The most frequently observed shorebird species at the Refuge include western and least sandpiper, dunlin, semipalmated and black-bellied plover, short- and long-billed dowitcher, and red knot (Appendix K). Approximately five to six thousand shorebirds (mostly dunlin) also use this habitat during winter season.

Shorebirds depend upon stopover sites such as the Refuge where large amounts of prey are readily available and where they can quickly build up fat reserves to provide energy along their northward migration to breeding grounds in Alaska. Generally, intertidal flats support an abundance of invertebrates including amphipods, polychaete and oligochaete worms, insect larvae, and nematodes (McConnaughey and McConnaughey 1985, Wolfe, Moore, and Cameron 1974). Specifically, invertebrate populations at the Refuge are composed of polychaete and oligochaete marine worms, bivalves, crustaceans, and insects (Buchanan et al. 1985, Warnock et al. 2004). A winter study at the Refuge on dunlin prey items showed 94 percent of dunlin stomach contents were tiny crustaceans

such as cumaceans and amphipods (Brennan et al. 1990). Algal biofilm growing on intertidal mudflats has recently been found to be an important food source for shorebirds (Kuwae et al 2008).

Raptors such as peregrine falcon and merlin prey upon dense flocks of birds. Because higher elevation intertidal mudflats remain exposed for long periods, many thousands of shorebirds move into the Refuge and the dense flocks provide a greater probability of these raptors successfully capturing shorebird prey.

During higher tides, forage fish, ground fish, and most likely other fish species such as sculpin, stickleback, shiner perch, juvenile or sub-adult salmonids, juvenile eulachon, or juvenile green sturgeon forage on invertebrates, zooplankton, phytoplankton, and algae in the marsh habitats. Because fish use salt marsh habitats (Seliskar and Gallagher 1983), it is assumed the same species must travel through and forage in flooded intertidal mudflat habitat as well.

4.3.3 Tidal Salt and Brackish Marsh

Overview

The Refuge encompasses 156 acres of tidal salt and brackish marsh habitat that support a diverse array of species including birds, fish, and invertebrates. This habitat provides a major source of nutrients and detritus supporting both aquatic and terrestrial food webs.

Salt marshes on the Refuge are generally found within the tidal range of 9 to 11 feet NGVD where the ground is high enough to support emergent herbaceous plants but too low, wet, and saline to support shrubs or trees. Water salinity ranges from 10 to 25 ppt and varies seasonally. Less-saline (≤10 ppt) brackish marshes exist where freshwater drains from hillsides into the estuary. Vegetation density varies based on the duration and frequency of tidal inundation.

The productivity of the marshes is critical to the health of the estuary. Salt marshes provide a major source of nutrients for estuarine and terrestrial wildlife and help keep the estuary functional. Plants filter pollutants from the water. Marsh plants provide food in the form of seeds, roots, tubers, and leaves for ducks and geese, and uneaten plant matter eventually breaks down and is transported by tidal action into the greater estuary. Larger organisms, including filter feeders like clams and oysters, feed upon the decaying remains of plants and smaller invertebrates consume the detritus.

Regional Distribution, Conditions, and Trends of Tidal Salt and Brackish Marsh

Salt and brackish marshes are an important component of a functional estuary. In the Pacific Northwest, a large portion of estuarine habitat has been lost to diking, channeling, dredging, and filling. The state of Washington is estimated to have lost between 45 and 62 percent of its pre-settlement estuarine habitat (Aitkin 1998). Within Grays Harbor, approximately 3,840 acres of salt marsh habitat was lost to dredge material disposal (StreamNet).

Laws, rules, and regulations have been put into effect to protect wetlands, including estuarine marshes. Recent regional restoration efforts are helping to recover some of these lost habitats. Some have been successful in restoring a portion of this important habitat. At Billy Frank Jr. Nisqually National Wildlife Refuge, over 700 acres of estuary have begun to reestablish after removal of agricultural dikes. Similar restoration efforts are happening in northern Puget Sound, Willapa Bay on the Willapa National Wildlife Refuge, and along the Oregon coast.

Over time, successional changes will involve the transition of salt marsh to shrub-scrub habitat as sediment aggradation occurs. Conversely, sea level rise may cause salt and brackish marshes to flood enough to convert into mudflats and eventually convert into open water habitats. This conversion would not be beneficial to the wildlife species evolved to thrive in marsh habitat, including shorebird species. The native sweetgrass plant community is highly susceptible to mudflat elevation changes and climate change-driven sea level rise and is anticipated to have limited resilience. New sweetgrass development will be limited on the Refuge north side because of the proximity to State Highway 109.

Key Species Supported

Invertebrates such as true bugs and flies, mites and ticks, round and flat worms, benthic species, and mollusks need intertidal mudflats and salt marsh to have healthy populations. A diverse array of bird species including American wigeon, northern pintail, green-winged teal, gadwall, northern shoveler, mallards, and geese (cackling, Canada, and greater white-fronted) eat salt marsh plants and invertebrates. Waterbirds such as great blue herons, Virginia rails, soras and American bitterns; shorebirds such as least sandpipers, western sandpipers, and dunlin; and passerines such as common yellowthroats, marsh wrens, and song sparrows all eat invertebrates found within the salt marsh. Raptors such as northern harriers forage for small rodents in this vegetation. Raptors and other predators such as weasels are attracted to the abundance of life in these marshes.
Refuge plants adapted to some of the most difficult conditions nearest the transition to intertidal mudflats include sand-spurry, pickleweed, seashore salt grass, jaumea, sea arrowgrass, and seaside plantain. Plants needing lower salinity or less-frequent inundation grow at slightly higher elevation and include tufted hairgrass, Pacific silverweed, saltmarsh bulrush, and Lyngby's sedge. High saltmarsh plants include kneeling angelica, cow parsnip, sea watch, yarrow, owl-clover, and Douglas aster. Common plants on the Refuge that can live in brackish conditions include cattail and common rush. Sweetgrass (see Appendix E for other names) sedge seems to be associated with lower salinity levels and more dynamic conditions.

Fish are known to use salt and brackish marshes during high tides (Seliskar and Gallagher 1983). In Grays Harbor estuary and the Refuge it is likely that forage fish, ground fish, sculpin, stickleback, shiner perch, juvenile salmonids, juvenile eulachon, juvenile green sturgeon, and juvenile bull trout forage on invertebrates, zooplankton, phytoplankton, and algae that are present in the marshes. Both the larger- and smaller-sized fish find an abundance of food and rely on the variety of plants for cover and protection from strong currents and predators. In addition, these areas provide resting cover and roosting sites for bird and other animal species.

4.3.4 Forest

Overview

The Refuge protects approximately 95 acres of forest habitat. With the development of Bowerman Airstrip in the 1940s, the deposit of dredge spoils created higher-elevation lands, which supported the establishment of shrubs and trees in what was mudflat. The forest vegetation on Moon Island, the edges of the airstrip peninsula (including portions of Sandpiper Trail), and uplands near Paulson Road originated from bare ground (salty dredge spoils).

This newly developed forest surrounds the existing mudflats and may provide cover for falcons, which are important shorebird predators, and may negatively affect shorebirds' ability to view avian predators.

Regional Distribution, Conditions, and Trends of Forest Habitat

Regionally, the forests in Grays Harbor County have been cut and replanted, are managed for timber production, and are of great importance in the sustainable timber industry to the regional economy. The small Refuge forest is in an early successional deciduous stage, but could eventually mature into longer-lived species such as big leaf maple and perhaps Sitka spruce.

Knotweed has invaded the forests and salt marshes in Grays Harbor County. Along Highway 109, on the north side of the Refuge, it has become well established. Coordination with the county is needed to control this invasive species.

If sedimentation accumulation and higher elevations develop in the adjacent saltmarsh, the forest trees and shrubs may expand out to cover more acreage. Conversely, in time, sea level rise and salt water inundation may occur, causing the trees and shrubs to decline and salt marsh to develop. Over a long period of sea level rise, extended tidal coverage may eventually cause a mudflat to develop.

Key Species Supported

Tree species in the forest habitat include red alder, native willows (Hooker's, Sitka, Pacific, and Scouler's), cascara, Pacific crabapple, Oregon ash, and other small, relatively short-lived trees. The forest's mid-story shrub composition includes osoberry, salmonberry, thimbleberry, red elderberry, twinberry, and other native shrubs. A thick understory of waterleaf, coltsfoot, water parsley, skunk cabbage, sword fern, sedges, rushes, grasses, and horsetails completely covers the substrate in some areas and open, exposed soils exist in others.

The forest also provides important habitat for landbirds such as Pacific-slope and willow flycatchers; yellow, orange-crowned, and yellow-rumped warblers; American goldfinch; black-capped chickadee; rufous hummingbird; and other birds and wildlife. This habitat provides passerines and other landbirds with dense cover and foraging opportunities for insects, nectar, and seeds. The forests may be important for early migrating landbirds. Other wildlife also benefiting from this habitat are black-tailed deer, weasels, snakes, and rodents.

Falcons have been observed using the forest as cover to surprise their shorebird prey.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

4.3.5 Channel Habitat

Overview

Within the Unit acquisition boundary, approximately 7.5 miles of free-flowing river channel habitat serves as a vital migration pathway and provides limited spawning grounds and rearing habitat for salmonids, resident fish, and amphibians. The river channel flows within the confines of the riverbanks and includes nearby edges of the sloped bank. The Black River channel is relatively narrow, ranging from 10 to 25 feet wide, with water depths ranging from 2 to 10 feet deep. Annual high water events spread water out over the floodplain in winter and spring. Currently, the river channel is indiscernible starting at Black Lake and remains indistinguishable due to the shrub swamp habitat above the pipeline berm. South of the pipeline berm, the river flow is visible, but due to the

dense stands of reed canarygrass, the channel can be difficult to identify. At approximately river mile 2 south of Dempsey Creek, the channel becomes easily visible.

Regional Distribution, Conditions, and Trends of Channel Habitat

Historically, water from Black Lake flowed down the Black River into the Chehalis River. However, today the start of the flow path is no longer evident. In 1922, the Black Lake ditch was dug to drain the wetlands north of Black Lake and stabilize water levels to allow shoreline development (Smith and Wenger 2001). The lake level is thought to have dropped almost 2 feet through ditch drainage and repeated dredging to maintain the ditch channel. In the 1960s a gas pipeline was dug by Williams Pipeline Company across the north end of the river approximately 1.5 miles south of Black Lake.

Conventional belief is that pipeline construction left spoils in the stream which, along with beaver dam debris accumulation, resulted in vegetation growth (Washington State Conservation Commission in Foster Wheeler 2003). An additional pipeline was placed in the same location using horizontal directional drilling techniques below the riverbed. In 2002, Foster Wheeler Environmental Corp. conducted a study to understand issues of water flow directionality in the Black River. Due to a complex set of issues including topographic effects of the lake, the Black Lake ditch drainage, the pipeline berm, and potential groundwater upwelling in between the lake and pipeline berm, the river flow has been significantly altered (See Chapter 3.3).

A tributary of the Chehalis River, originating in wetlands at the south end of Black Lake, the Black River begins as an extremely low-gradient river system. Its unique features include some of the largest natural freshwater wetlands in western Washington (Pickett 1994, Foster Wheeler 2003, Caldwell et al. 2004, Napier et al. 2008, Easterly and Salstrom 2008, CRC 1992). The slow descent for most of the river allows an accumulation of mud, sand, and decomposing organic material, providing for abundant aquatic and semi-aquatic plant and animal life. Beaver dams help to create and maintain shallow water swamps and wetlands.

Threats to the river and channel include a significantly altered hydrologic regime. A reduction in water flow related to the Black Lake ditch (Foster Wheeler 2003) has most likely reduced water velocity. Other threats include demand for more water from increasing residential and commercial development, including the adjacent gravel mine, and increasing threats of water pollution and contamination.

Anecdotal information indicates the river channel was dredged in some areas. It appears some channel areas within the boundaries were straightened or deepened. Some indications of dredging include removal of natural stream meandering by straightening steep, undercut, and unstable channel edges and in some areas a >10 foot deep channel with a thick silt or muck substrate. The deep U-shaped channel is not usually associated with a slow-moving river and is in contrast to the more natural river channel south of downtown Littlerock, where the channel is cobble-bottom and much shallower. The deep, channeled, tannin-stained, dark water limits light penetration, and in combination with unconsolidated Semiahoo muck, bottom-rooted plant growth in the river bottom can be limited in some areas. Also important to understanding the ecological conditions of the river channel is a comment by a Black River resident who recalled a time when the “Black River ran thick with silt because of logging in the Black Hills … and that went on for years and years” (TESC 2001). Historical impacts of high-nutrient water runoff from agriculture fields, silt runoff from logging, and perhaps dredging projects are likely still affecting river conditions.

Nonnative fish and bullfrogs pose significant threats to native amphibians, small native fish, and natural wetland function. They also compete against native animals for prey resources (See Chapter 4.6.2).

Nonnative and invasive plant species (see Chapter 4.6 and Appendix L) also contribute significant threats to the river channel system by choking water flow, reducing native plant growth, and reducing food resources for wildlife. Reed canarygrass has infested the channel and channel edges to the point of compromising river function. Reed canarygrass establishment has eliminated most exposed mud patches along the river, impeded sunlight penetration, and restricted animal access through the understory. Reed canarygrass also roots on emergent plants within the channel and can grow over the surface of the channel and into the bank. Small, native, understory wetland plants growing along the river and in shrub swamp edge are unable to compete against this thick, tall grass.

Submersed exotic aquatic plants such as hydrilla, elodea, and parrotfeather are expected to colonize the Unit channel habitats at some point, as these invasive plants can be found in the watershed. These submersed exotic and invasive plants choke water flow, impede sunlight penetration, change the natural conditions of the river and tributary channels, limit animal (e.g., amphibian and fish) movement, and out-compete native submersed plants.

Key Species Supported

Key species include the State-endangered and federally threatened Oregon spotted frog, which lives its entire life in the wetland habitats. Oregon spotted frogs depend on the permanent, slow-moving, and almost still channel water during summer months when water levels drop in nearby marshes.

Additionally, specific and unique characteristics of the channel are critical to the endemic Olympic mudminnow, which lives its complete life cycle in densely vegetated, relatively low-oxygenated, tannin-stained water and mud bottom. This fish has evolved to survive warm water conditions and survive in habitats where many native cold-water fish cannot.

Coho salmon, Chinook salmon, cutthroat trout, and perhaps steelhead utilize channel habitat as a migration pathway to upstream tributary spawning grounds. The river provides a rich rearing habitat for juvenile salmonids, resident small fish, and amphibians. Freshwater sponges and freshwater mussels are found in the channel, but species distribution in the river is not well understood.

A variety of birds and mammals utilize tributary channel habitat for water, food, and travel corridors. Birds such as wood ducks, hooded mergansers, pied-billed grebes, and kingfishers are commonly found throughout these aquatic habitats. Beavers are a key species because they directly alter stream hydrology in the river channel habitat. Their dam building activities create and maintain wetlands that provide extensive benefits to fish and virtually all wetland-associated species and organisms (Grannes 2008). Other aquatic-oriented mammals such as river otter, muskrat, and mink are abundant.

The low elevation gradient and slow-moving river provide a rich environment for a thick growth of submersed, aquatic, native plant species such as pondweed, native western milfoil, and American waterweed; floating plants such as mosquito fern and duckweed; and emergent plants such as water starwort, spatterdock, smartweeds, and water pennywort. These species are important to this habitat and provide shelter and food for a variety of aquatic and terrestrial animals. Woody debris near the surface of the channel supports plants such as small-flowered touch-me-nots and monkey flower. The

vegetation and woody debris provide substrates for algae growth, an important food source to invertebrates and immature amphibians, as well as dense cover and foraging opportunities for amphibians, invertebrates, and fishes.

4.3.6 Tributary Channel Habitat

Overview

There are approximately 16 miles of tributary channel that provide habitat for a variety of aquatic and terrestrial plants and animals located within the Unit acquisition boundary. These waterways historically have been impacted by various habitat alterations since the time of Euro-American settlement in the area. Lands adjacent to the Unit were cleared of forests and managed for various purposes such as agriculture (farming activities, livestock grazing), forest products (lumber), and urbanization (roads, houses). All of these activities have resulted in increased impacts to tributary habitats, including water temperatures, erosion, chemicals, trash, reduced groundwater recharge, and water diversions for agricultural and industrial purposes, all of which affect the quality and quantity of water in the watershed and at the Unit.

Tributaries within the Unit acquisition boundary include Waddell, Dempsey, Stony, Darlin, Blooms Ditch, and several smaller, unnamed creeks, all of which vary considerably in size, length, depth, and character. Waddell Creek water runs clear, cool, has shallow areas with riffles, deep holes, a cobble bottom, woody debris, and in some summers it dries up or goes underground. Dempsey Creek has a soft peat bottom, steep sides, appears abnormally deep and channelized in former agricultural lands. Blooms Ditch is also deep and channelized but has a sandy substrate.

Regional Distribution, Conditions, and Trends of Tributary Channel Habitat

Prior to entering the Unit boundary, these creeks and streams meander through a variety of forest, agricultural, and residential areas presenting a variety of issues and conservation challenges for maintaining a healthy watershed.

An altered hydrologic regime outside the Unit boundary may have affected the health and individual tributary conditions. Perched culverts may prevent salmonid movement into appropriate spawning grounds. Within the Unit boundary, nonnative plant species such as reed canarygrass and yellow flag iris can dominate the channel edges, sides, and beds, impeding stream velocity, temperatures, and plant and animal diversity. Adjacent agricultural lands and development may provide sources for contaminants, including herbicides, fertilizer, fecal coliform from livestock and septic systems, and increases in sediments.

Nonnative plant and animal species (e.g., bullfrogs, nonnative warm-water fish, New Zealand mud snail, hydrilla, Eurasian watermilfoil, parrotfeather, fanwort) may also be problematic to the health of the tributaries. However, data are not yet available to determine which nonnative animals are living in the tributaries within the Unit.

Bridges over tributaries can be supported by wooden structures that are periodically treated with insect and animal retardant. Creosote contamination may impact aquatic invertebrates, Oregon spotted frog, and salmonids. The Delphi Road Bridge over Dempsey Creek was recently treated with creosote (~2012).

Key Species Supported

Some tributaries such as Waddell Creek have cobble-channel habitat with cool, rapid-flowing water which provides different habitat than the river or muddy bottom tributaries. Invertebrates, freshwater mussels, juvenile salmon (coho), crayfish, and perhaps freshwater sponges can be found in the cobble tributaries—all of which may be different species than those found in the Black River.

Dempsey Creek likely provides habitat for a variety of plants and animals similar to those found in the Black River because the creek has similar characteristics. The creek appears to have been dredged to increase agricultural field drainage; the substrate is muck and most of it is not shaded by trees or shrubs. Oregon spotted frogs have been known to use this creek to move through various habitats.

A variety of birds and mammals utilize tributary channel habitats for water, food, and as a travel corridor. Many of the same plant species found in the river are also found in the creeks (see Section 4.3.5 Channel Habitat).

4.3.7 Bog

Overview

The Unit protects approximately 56 acres of bog habitat that extends from the northern edge of the Unit boundary at Black Lake to the confluence of Dempsey Creek (see Map 5). Other occurrences of bog habitat may be found within the Unit boundary (Easterly and Salstrom 2008).

A bog is a slightly domed, low-nutrient, low-pH system which grows on sphagnum peat and is dependent on low-nutrient rainfall for moisture. The organic, wetland soils retain rainwater and provide a natural water filtration system. Various bog types have been found within the Unit, which include forested bog, shrub bog that contains a dry shrub bog, an intermediate between wet and dry bog, and areas of wet bog (Kunze, L. 2001, pers. comm.).

Regional Distribution, Conditions, and Trends of Bog Habitat

Bogs occur within Puget Sound lowlands, around lakes, slow-moving rivers, and valleys. Only a fraction of western Washington bogs remain undisturbed (Bigley and Hull 2000). Bogs are Category I wetlands because they are sensitive to disturbance and impossible to re-create through compensatory mitigation (Hurby 2004).

“Nutrient-poor wetlands, such as bogs, have higher species richness, many more rare species, and a greater range of plant communities than nutrient-rich wetlands” (reviewed in Adamus and Brandt 1990). They are, therefore, more important than would be accounted for using a simple assessment of wetland functions (Moore et al. 1989). In addition to being sensitive to disturbance, bogs are not easy to re-create. Restoration may be impossible because of changes to the biotic and abiotic properties that preclude the reestablishment of bogs (Schouwenaars 1995, Schrautzer et al. 1996). Furthermore, bogs form extremely slowly, with organic soils forming at a rate of about 1 inch per 40 years in western Washington (Rigg 1958 from Hruby 2004, Bigley and Hull 2000).

Bogs can be damaged by subtle nutrient and mineral inputs which change the chemical equilibrium of the bog system. For example, exposing bare soil near a bog can be particularly damaging as

resulting soil-laden runoff alters the chemical character of the bog and can kill living sphagnum. Burning slash, trash, or a wildfire near a bog can also be detrimental due to the release of high-nutrient ash (Bigley and Hull 2000). Typical logging and clearing practices in or around the Unit bogs most likely have had negative effects.

Subtle hydrologic changes cause problems for bog habitats. Diverting water into or around a bog will sever the habitats' isolation, dependence on rainwater for nutrients, and may expose it to damaging chemicals. Removing water from bogs by dropping surface water levels with ditches or drains will lower the water table and will speed the decomposition of the peat, sometimes leaving trees standing on their roots. Loss and lowering of ground water levels may reduce spring flows around bogs. The WDNR Natural Heritage Wetland Program and Thurston County Critical Areas Ordinance regulation states that changes to water, drainage, or nutrient flow cannot occur within a minimum of 250 feet of a bog. Onsite sewage disposal systems or drain fields may not be within 300 feet of a bog (Thurston County 2012).

In addition, nonnative plants will change plant community function and dynamics. Specific invasive species that may cause problems include reed canarygrass, knotweed species, purple loosestrife, yellow flag iris, holly, and potentially New Zealand mudsnail.

Key Species Supported

Those plants dependent upon bog habitats and found in the Unit bogs include western Labrador tea, sphagnum species, sundew, cottongrass, bog cranberry, bog laurel, bog orchid, thinleaf (also called gray alder), bog birch, shore pine, and Sitka spruce trees.

A number of plant and animal species associated with bog habitats may be found with future research and study of this difficult-to-access area. The potential for three State-candidate and SOCs in this habitat include Beller's ground beetle, Hatch's click beetle, and Queen Charlotte's copper butterfly. The State-candidate long-horned leaf beetle (bog idol) and the silver-bordered bog fritillary butterfly are also associated with Washington lowland bogs, but may or may not be found in this particular location (WDFW 1995). Additionally, Bradshaw's lomatium, western or red-root yampah, water howellia, western toad, western pond turtle, and uncommon salamanders could be found in the bog complex with future monitoring. WDNR biologists recorded a patch of bristly (longhair) sedges that are listed in Washington's Natural Heritage Program as a sensitive species (WNHP 2008). In the bog areas, signs of black bear and beaver were evident as were wildlife trails.

4.3.8 Shrub Swamp

Overview

The Unit protects 512 acres of shrub swamp habitat. This habitat occurs extensively in the lowland floodplains along the river channel, secondary channels, and in broad low-lying zones where soils are poorly drained, fine-textured organic muck, and the substrate would be semi- or permanently saturated. This habitat type is most extensive in the northern portions of the Unit and in narrow strips along the river southward to 123rd Avenue. This habitat grows interspersed with emergent marshes and riparian forest. It is wetter than forested swamps and slightly drier than marshes. It has been described as an impenetrable thicket of unstable ground and shrubs (Easterly and Salstrom 2008).

Regional Distribution, Conditions, and Trends of Shrub Swamp

This habitat ranges from Prince William Sound, Alaska, to the southern coast of Oregon (Crawford and Rocchio 2011). Historically this habitat was more prevalent, for example, small patches still exist in the Ohop and Green River valley (Barham, J. 2013, pers. comm.). Because this habitat is now an uncommon lowland wetland system, limited understanding of its requirements for healthy function and process exists. Future study could ensure a healthy ecosystem (Easterly and Salstrom 2008).

Evidence of past conditions shows a portion of this habitat type may have been a forested wetland populated with large Sitka spruce and other conifers. Large stumps indicate early logging has likely removed a forested overstory component of the wetland. Former logging may have contributed to converting a conifer-forested wetland to shrub swamp that is now dominated with Oregon ash, Pacific crabapple, willow, Douglas spirea, and slough sedge.
The Black Lake drainage ditch prevents strong flood events from occurring and has most likely caused changes in the shrub swamp plant community composition and disturbance regime, although the changes are not yet fully understood. The loss of river water amounts and flow reduction from water diversion, water withdrawal, and hydrologic changes could cause losses of seasonally occurring high water conditions and has most likely affected the shrub swamp plant community.

Over time, if water sources continue to be reduced, this habitat may transition into a drier forest, and invasive reed canarygrass will most likely increase in open patches or in areas of herbaceous groundcover. Portions of this habitat that extend farther from the river may have been converted to agriculture because of lower water levels. Additionally, because of hydrological changes over time, the shrub swamp may be shifting and moving into bog areas (Kunze, L.M. 2011, pers. comm.). An understanding of the hydrology will be needed throughout the life of this CCP to benefit all species living in the shrub swamp habitat. An examination of plant community interaction between bog and shrub swamp habitats is needed.

Nonnative, invasive plant species, especially reed canarygrass, present a serious threat to the shrub swamp. Reed canarygrass has become densely established in open areas of the shrub swamp, especially along the river channel edge, and has changed the composition of the vegetative community. Its establishment has eliminated exposed mud patches along the river, impeded sunlight penetration, and impeded animal access through the understory. Small, native understory wetland plants growing along the river and in shrub swamp edges are unable to compete against this thick, tall grass. Purple loosestrife and yellow flag iris have become well established in many locations in the shrub swamp.

Submersed aquatic plants such as hydrilla, elodea, and parrotfeather could also be threats when infested surface waters from the river or tributary channels spread under the shrubs. Because the soils in these shrub swamps remain wet and protected from sun throughout the year, many submersed plants could survive. Additional perennial or woody invasive plant threats to the shrub swamp include knotweed species and other new species from elsewhere in the watershed that may be inadvertently introduced.

Nonnative fish presence alters natural habitats and conditions for native animals sharing the same locations. Most nonnative, warm-water fish such as bass, crappie, and northern pikeminnow are predatory on native fish, amphibians, and invertebrates. Their presence changes and likely reduces native fish, amphibian, and invertebrate populations. In addition, nonnative fish reduce prey resource availability for native fish and amphibians. These fish may be especially deleterious to endemic

Olympic mudminnow and the State-listed as endangered and federally listed as threatened Oregon spotted frog and the prey resources they need to survive.

Key Species Supported

The shrub swamp consists of deciduous shrubs comprising a mosaic of willows, Oregon ash, red osier dogwood, Pacific crabapple, ninebark, twinberry, and Douglas spirea that range from 5 to 30 feet tall and support complex growth of lichen and mosses. The herbaceous plant understory typically includes skunk cabbage, veronica, marsh speedwell, burweed, smartweed, sedges, touch-me-not, gallium, Cooley's hedge nettle, horsetail species, and Pacific water parsley.

North of the pipeline, plant species composition also includes gray alder and patches of bog-related species. South of the pipeline, Easterly and Salstrom (2008) noted thinleaf alder to be a major component on this habitat along the river.

This habitat provides important cover and food resources for migrating passerines and landbirds such as Pacific-slope and willow flycatcher, yellow warbler, orange-crowned warbler, American goldfinch, and black-capped chickadee. During spring migration, high numbers of flycatchers have been observed using this habitat.

Extended periods of high water that inundate the shrub swamp habitats provide excellent habitat and foraging conditions for aquatic animals including small fish (e.g., juvenile salmon and mudminnows), salamanders, and frogs, including the Oregon spotted frog and Pacific chorus frog (also called tree frog).

Potential ROCs that may utilize this habitat include Chinook and coho salmon, steelhead trout, and cutthroat trout. Bristly sedge, a Washington State rare plant species, has been recorded where the shrub swamp and river channel edge intersect. Another Washington State rare species, the Pacific clubtail dragonfly, has been recorded in the same habitat as bristly sedge. The endemic Olympic mudminnow and the threatened Oregon spotted frog are likely to use this habitat as refugia during high-water conditions in winter and early spring and to avoid higher flow rates in the river channel.

4.3.9 Riparian Forest

Overview

The Unit supports approximately 265 acres of riparian forest habitat. Riparian forest habitats occur at slightly higher elevation than adjacent shrub swamp habitats and support plants that need slightly drier soil conditions. The Unit’s riparian forests consist of native deciduous trees of mixed age and species, dominated by big leaf maple, western cottonwood, red alder, and Pacific willow. Lichen and moss growth can be found on the trees. Larger trees provide LWD to the river channel and floodplain (Rocchio 2011a).

Some areas show an early to mid-successional stage of maturity with tree canopy, thick midstory cover, and good ground cover. Very early successional stages are sparsely vegetated and dominated by shrubs, small saplings, and herbaceous vegetation, and in this case often-dense reed canarygrass growth as well.

A key function of riparian habitat is to provide a safe corridor for animals to move between areas, including isolated natural areas. The importance of riparian areas as travel corridors and routes for dispersion is amplified in developed or fragmented landscapes (Knutson and Naef 1997). Even in early seral stages, this habitat can provide excellent nesting, cover, and foraging conditions for passerines and other landbirds, amphibians, and mammals, in part because of its proximity to the river and its tributaries. Over time, as young riparian habitats mature, the diversity and complexity of the habitat can support greater wildlife numbers and increased diversity (Knutson and Naef 1997).

Regional Distribution, Conditions, and Trends of Riparian Forest

At least 50 percent, and as much as 90 percent, of the riparian habitat in Washington has been lost or extensively modified since the 1800s (Knutson and Naef 1997). What remains of the diminished riparian areas are often small, disjunct patches in generally poor condition due to human impacts (Johnson and O'Neil 2001). Due to the density and diversity of species using riparian habitat, intact riparian areas are important to the conservation of Washington's vertebrate species.

Threats to this habitat include a slow recovery of large-sized trees that were logged out earlier, loss of developing snags, water diversion or water removal from tributaries and the river, fragmentation, and a history of excessive nutrients from agriculture or development. Once again, invasive species are a very large threat. Reed canarygrass is the main impediment to natural regeneration and can dominate logged areas, while other invasive plants can also impact the habitats. An understanding of climate change and possible management options regarding potential impacts to this habitat type need to be addressed.

Key Species Supported

Broadleaf tree species found in the riparian community are big leaf maple, black cottonwood, red alder, Sitka and Pacific willow, red osier dogwood, ninebark, Pacific crabapple, black hawthorn, and Oregon ash. Conifers tend to increase with succession in the absence of major disturbance and can include Sitka spruce, grand fir, and western red cedar. Native shrubs such as twinberry, red osier dogwood, snowberry, salmonberry, thimbleberry, salal, red and evergreen huckleberry, rose species, stinging nettle, osoberry, and devil's club comprise the midstory, and a rich understory of skunk cabbage, inside-out flower, twinflower, wild ginger, trillium, vanilla leaf, false lily of the valley, and lilies provide flowers for pollinators and vegetation for wildlife foraging. Diverse lichen and moss communities grow on trees and shrubs in this habitat.

Approximately 85 percent of Washington's terrestrial vertebrate species use riparian habitat for essential life activities (Knutson and Naef 1997). Of the 118 species of migrant landbirds occurring in Washington, 67 species (57 percent) use riparian habitat (Andelman and Stock 1994, Knutson and Naef 1997). The density of wildlife in riparian areas is comparatively high (Knutson and Naef 1997). Bird species that use riparian habitats include both resident and migrant species such as rufous hummingbird, red-breasted sapsucker, northern flicker, pileated woodpecker, Swainson's thrushes, and warblers. In older riparian forests, accipiters (such as Cooper's and sharp-shinned hawks) and owls can reside.

Riparian habitats are also very important for amphibians such as Pacific chorus frog, rough-skinned newt, and others species. Mammals including several species of *Myotis* bats, rodents, and carnivores such as long-tailed weasel and mink use the habitat throughout most of their lives, while larger

mammals such as black bear, bobcat, and cougar use riparian habitats as travel corridors within their home territories.

Riparian habitat is additionally important to supporting healthy native fish populations by improving channel characteristics including LWD, temperature, water quality, water chemistry, cover, and nutrients. Riparian habitat importance to the watershed includes providing leaves, twigs, and branches that provide basic food and nutrients to support instream habitats and animals. Riparian vegetation, litter layers, and soils filter incoming sediments and pollutants assisting in the maintenance of high water quality (Knutson and Naef 1997).

Potential ROCs include migrating passerines and nesting birds on watch lists or SOC lists such as Vaux's swift, purple martin, pileated woodpecker, and merlin, as well as Keen's myotis and Townsend's big-eared bat.

4.3.10 Emergent Marsh

Overview

Emergent marsh is generally found in western Washington valley bottoms, lowlands, along slow-moving rivers, in oxbows, saturated soil depressions, and where there is abundant rainfall (Rocchio 2011b). The Unit supports more than 34 acres of emergent marsh habitat. On the Unit, the emergent marsh usually forms a mosaic with other wetlands such as shrub swamp, riparian forest, and the edge of the river channel. A lowland depression located around 123rd and 110th Avenues also supports emergent marsh.

Herbaceous wetland plants in shallow, seasonally to semi-permanently or permanently flooded areas dominate freshwater emergent marshes. The habitat is characterized by undrained hydric soils (muck or mineral) where nutrient-laden water is at or above the surface for most of the growing season. Surface water depths range from <2 to 25 inches deep with deeper-water conditions closer to the river. Surface water depth increases with fall, winter, and early spring rains.

In good quality habitat, there would be a moderate amount of soil exposure (no vegetation), some decaying LWD brought in by high-water events, and 30–70 percent cover of emergent hydrophytic vegetation and native seed-bearing plants.

The river and tributaries are consistent and permanent freshwater sources for these wetlands, which are essential to the function of this vegetative system and provide direct access to and from deeper water sites for amphibians and fish.

Regional Distribution, Conditions, and Trends of Emergent Marsh

It is estimated that 33–50 percent of Washington's wetlands have been lost since colonization, with some metropolitan areas in Puget Sound losing over 90 percent of their wetlands (WDOE 1992). Emergent marsh is found throughout western Washington and is still found near the Unit. Beaver, a species which can create and maintain these types of wetlands, was almost eliminated earlier in the century and these wetlands have decreased along with the diminished influence of beavers on the landscape. Even with regulatory protection, the amount of herbaceous and emergent marshes continues to be altered, farmed, and converted to other uses in Washington (Johnson and O'Neil 2001).

Reed canarygrass has aggressively invaded this habitat. Small, native sedges and low-growing herbaceous perennial plants are not able to compete against such an aggressive invader. This loss of habitat diversity negatively effects native wildlife species' ability to use these compromised areas. Additional threats include the potential loss of connectivity to the river or tributaries due to roads and barrier construction; off-Refuge water diversion, water withdrawals and hydrologic regime alteration; passage barriers; water quality issues (temperature and sedimentation); conversion of former emergent marsh to seasonally flooded, nonnative grasslands; and natural succession to shrub swamp.

Bullfrogs are large, successful, nonnative predators of native frogs, salamanders, small fish, ducklings, and invertebrates (Hallock and McAllister 2009). Oregon spotted frogs did not evolve with bullfrogs and have no defense mechanisms (Leonard et al. 1993). Nonnative fish also negatively affect the native fish and amphibian populations and compete with wildlife for wetland invertebrates (Maxwell et al. 2010, Howell 2010). A worldwide chytrid fungus that is thought to contribute to the overall decline in amphibians, especially frogs (Weldon et al. 2004, Pearl et al. 2009), has been found in Unit emergent marsh waters where Oregon spotted frogs live part of their lives. The fungus, found on all tested Oregon spotted frogs, could be negatively affecting all species of amphibians in the Unit (Pearl et al. 2009).

Key Species Supported

Slough sedge and cattail can dominate in permanent, deeper-water areas. In shallow areas a diverse array of small sedges, bulrushes, rushes, spike rushes, bur-reed, beggar ticks, monkey flower, small-flowered forget-me-nots, skunk cabbage, creeping buttercup, possibly bristly sedge, and other low-growing, moisture-loving plants are found.

This habitat is exceptionally important for good-quality juvenile Oregon spotted frog-rearing conditions. It provides relatively warm surface water, shallow to moderately deep (2 to 24+ inches) in late spring and summer. Low to moderate vegetation density and algal growth on vegetative stems and leaves provide foraging opportunities. Herbaceous or shrubby vegetative cover provides direct swimming access to deeper water. This plant community provides adult Oregon spotted frog habitat in late spring and summer that includes still, standing, or slow moving surface water; connection to deeper and cooler water conditions; moderately complex vegetative cover; and invertebrates and small fish prey. This habitat is vital to the State-endangered and federally threatened Oregon spotted frog.

The presence of the federally listed water howellia plant is possible, but is unknown. Bristly sedge, a State-sensitive and rare plant, was recorded in a thin, long patch of emergent marsh between the river channel edge and shrub swamp. Another rare species, the Pacific clubtail dragonfly, has been recorded in this habitat. Additional key species include the Olympic mudminnow, Chinook and coho salmon, steelhead trout, and possibly western toad and western pond turtle.

Secretive marshbirds such as American bittern, sora, Virginia rail, green heron, great blue heron, pied-billed grebe, and American coot depend upon this habitat for their life histories. During higher water conditions, migrating and wintering waterfowl also use this habitat type.
Elk and black-tailed deer browse on emergent plants, while otter, mink, beaver, and muskrat forage and den in this habitat. Northern harriers hunt over the habitat and use it to nest. Large numbers of amphibians, such as northwest and long-toed salamanders, rough-skinned newts, red-legged frogs, and Pacific chorus frogs, lay their eggs and the juveniles mature into adults in the marsh.

4.3.11 Seasonally Flooded, Nonnative Grasslands Overview

The Unit supports over 82 acres of seasonally flooded, nonnative grasslands. These lowlands are relatively flat, generally are seasonally flooded in winter and early spring, and can be covered with water nearly 36 inches deep. Portions of this habitat closest to the river tend to be inundated with water during most months except September and early October. The saturated, poorly drained Semiahoo muck soils generally remain wet even during extended late-summer dry conditions. Most sites are located along river and tributary edges, in swales, oxbows, and land depressions that connect to other wetlands and deeper waters.

Historically, these areas may have previously been emergent marsh, wet prairie, open areas within shrub swamp or riparian forest, or part of a forested wetland. However, after Euro-American settlement, these areas have been converted to grasses that are adapted to the saturated soils and surface water coverage found in lowland river valleys. The most likely plant found in these nonnative grasslands is reed canarygrass.

Regional Distribution, Conditions, and Trends of Seasonally Flooded, Nonnative Grasslands

Planting of reed canarygrass in the Pacific Northwest began in the late 1800s and has been widely used in northern states and Canada. No other forage plant is as well-adapted to wet, marshy areas as reed canarygrass. This aggressive, cool-season, mat-forming, nonnative grass moves out of pasturelands and into stream bottoms, wetlands, and canal banks and persists where it is not desirable. It now dominates where wetland herbaceous plants or open moist soil would have been found on the Unit and in other areas throughout the watershed. It grows so vigorously that it seriously inhibits or completely eliminates all other plant growth (Reinhardt and Galatowitsch 2004) and it is a major threat to wetland ecosystems (Kilbride and Paveglio 1999). It is estimated that over 98 percent of what was emergent marsh, wet prairie, or wetland forest has been converted to seasonally flooded, nonnative grassland (reed canarygrass).

Unlike native wetland vegetation, dense stands of reed canarygrass have little value for wildlife (Tu 2004). In summer and early fall, reed canarygrass stems grow over 8 feet tall and are dense enough to impede both large and small animal movement.

Key Species Supported

This monoculture of nonnative grass does not provide the diversity of a native marsh-plant complex, which is necessary for a healthy plant community and associated wildlife. However, some wildlife use this habitat, including waterfowl (dabbling ducks, Canada and cackling geese) during late fall, winter, and spring when it is flooded. Some secretive marshbirds, such as American bittern, sora, and Wilson’s snipe, may use shallow water edges. Elk and black-tailed deer graze on new grass shoots in late spring and summer. Leaf-mats are sometimes used as basking, resting, or feeding platforms by small aquatic mammals such as muskrats and waterfowl.

These grasslands obstruct movement of mature amphibians and fish. Negotiating through the dense grass (even when flooded) may cause both amphibians and fish to expend high energy levels that ultimately may reduce their ability to survive and reproduce. Stems and leaves provide an abundance of surfaces for algal growth in late spring and early summer and may provide food for juvenile amphibian growth and some insects.

4.3.12 Dry, Nonnative Grasslands

Overview

There are 163 acres of dry, nonnative grasslands on the Unit. Dry, nonnative grasslands on the Unit border include mixed forests; seasonally flooded, nonnative grasslands; riparian habitats; and marshes. These areas are now composed of a mixture of nonnative pasture grasses, herbaceous plants, and shrubs. This habitat occurs in a mosaic throughout the Unit acquisition boundary and in a large field approximately 100 acres near the 123rd Ave and Endicott Road area. Vegetation in this habitat is a mixture of nonnative pasture grasses (such as velvet grass, orchard grass, perennial rye, timothy), native perennial grasses (such as Roemer's and red fescue), and some native and nonnative forbs (such as alfalfa). The mixture of vegetation heights ranges between 6 and 30 inches high. The edges of the grasslands may contain a shrubby component that transitions into mixed forests or riparian habitats.

Regional Distribution, Conditions, and Trends of Dry, Nonnative Grasslands

Generally, nonnative grasslands in western Washington are former prairie, oak woodlands, and forest habitats that were converted for agricultural purposes, such as horse or cattle pastures. Livestock grazing is necessary to keep the grasslands open and not overcome with other species.

Extensive work by TNC, Center for Natural Lands Management, South Puget Sound Prairie Landscape Working Group, and the Service (Western Washington Fish and Wildlife Office) has defined where native prairie habitats are located in the Puget Trough based on soil types. Prairie habitat is considered among the most imperiled habitats in western Washington, and many species associated with it are State candidates or SOCs. The Unit's dry, nonnative grasslands are not considered true prairie because they are not native to western Washington. However, because of the large losses of western Washington native prairie habitat, retaining Unit nonnative grassland habitat may be helpful in supporting some species that rely on open uplands.

Threats include invasion from nonnative pest plants that thrive in open areas without competition, such as wild chervil, Scotch broom, common burdock, common teasel, Canada and bull thistle, Himalayan blackberry, and poison hemlock. Forest encroachment or conversion into shrub lands will take place in the absence of management by prescribed fire, mowing, grazing, or haying. Conversion into forestlands will reduce the habitat mosaic in the Unit and reduce open habitat availability for reliant wildlife species.

Key Species Supported

Although no listed species are known to rely on this habitat type, a number of grassland species that evolved to use open areas of relatively short grass and forbs may use dry, nonnative grasslands.

This habitat type provides ground-nesting and foraging areas for birds such as savannah sparrow, western meadowlark, purple martin, mourning dove, and killdeer, as well as denning sites for small mammals such as mouse, mole, and vole. It provides hunting sites for raptors such as American kestrel, red-tailed hawk, great horned and barn owls, and northern shrike. In winter, dry, nonnative grassland provides thermal cover for short-eared owl, small mammals, and other wildlife. These areas also provide winter forage and loafing sites for ungulates such as black-tailed deer and elk. In

addition, they provide migration or dispersal corridors for small and large mammals as well as amphibians. This habitat may contain an occasional deciduous tree such as big leaf maple or Garry oak. These trees can grow into large cavity-producing specimens that enhance the habitat for American kestrel, owl, bat, Vaux's swift, and insects. A tapered edge of flowering shrubs provides nectar and attracts pollinating insects and provides a transition area for animals utilizing both grassland and woodlands.

4.3.13 Mixed Forest

Overview

Mixed conifer and deciduous forest habitat is generally the most extensive forest system in the lowlands west of the Cascades and forms the matrix within which other plant communities occur as patches. Many of the local area forests managed for conifer production lack species diversity and forest function that benefits wildlife (Carey 2006). The Unit supports 394 acres of upland mixed forest habitat of varying ages. These forests have well-drained soils that are moist much of the year and dry for approximately 3–4 months.

Most forests on the Unit are young mixed forest stands reestablishing after logging prior to Unit acquisition. In naturally regenerating young forests, commonly represented species include grand fir, western red cedar, big leaf maple, and red alder. Reestablishing forests usually lack western white pine because there are few natural seed sources for this species. As stands mature, Douglas-fir, grand fir, western hemlock, western red cedar, and big leaf maple dominate the canopy as early successional and short-lived red alder dies off. Eventually big leaf maple needs more light than the conifers allow and it too become less common. Individual trees or groups of trees with >12" diameter and 20' long become snags that provide nesting cavities, and fallen trees become nurse logs. Over time, this habitat can mature into old-growth forest.

Most of the Unit forests are products of restoration efforts. Carey (2003) notes

> "…many managed forests are impoverished in species. Intentional management can reduce the need for wide riparian buffers, produce landscapes dominated by late-seral stages that are hospitable to wildlife associated with old-growth forests, provide a sustained yield of forest products, and contribute to economic, social, and environmental sustainability."

Regional Distribution, Conditions, and Trends of Mixed Forest

The State of Washington manages 1.4 million acres of forested lands in western Washington (DNR 1997). Long-term sustainable forest practices are a management priority in the State. Both public and private forestlands throughout the region are actively managed for a variety of purposes, including timber sales, recreation, and habitat conservation. Locally, Douglas-fir is the timber preferred by land owners and is currently the dominant species adjacent to the Unit.

Threats to this habitat include forest management narrowly focused on timber production, limited species diversity, poor function for wildlife species, habitat fragmentation due to development pressure, and some timber harvesting practices (Carey 2003, 2006, Heiken 2007). Other threats to the mixed forest ecosystem include invasive species infestations such as reed canarygrass in wetter areas; holly, spurge laurel, English laurel, English ivy, yellow archangel, and periwinkle in shaded areas and Scotch broom and blackberry in drier, more open locations.

Key Species Supported

Mid-story plants in older forests include vine maple, red-osier dogwood, evergreen and red huckleberry, salmonberry, thimbleberry, salal, osoberry, and perhaps native rhododendron. Additionally, rose species, stinging nettle, and devil's club can be found. The understory is populated with sword fern, salal, dull Oregon grape, trailing blackberry, twinflower, inside-out flower, wild ginger, trillium, false lily of the valley, Pacific bleeding heart, and lilies. In the more mesic sites, lady fern and sword fern can be more dominant.

Wildlife associated with older, structurally complex and more diverse forests are rufous hummingbird, red-breasted sapsucker, northern flicker, pileated woodpecker, Steller's jay, Vaux's swift, purple martin, tree swallow, chestnut-backed chickadee, golden-crowned kinglet, winter wren, Swainson's and varied thrushes, Pacific slope flycatcher, Wilson's, Townsend's, and MacGillivray's warblers, Keen's myotis, Townsend's big-eared bat, elk, and black-tailed deer. Black bear and cougar use forests when enough habitat acreage exists and habitat corridors link to other large scale appropriate habitats.

4.4 Major Species Groups

4.4.1 Fish

Grays Harbor National Wildlife Refuge

Estuaries are a critical link between freshwater and marine habitats, providing a transition zone between fresh- and saltwater for anadromous species. They also are vital nursery areas for juvenile and sub-adult fish prior to migrating to the ocean. The diverse habitats represented in Grays Harbor, along with abundant food resources, support a wide variety of species and life stages. Some species make use of the estuary for all stages of their life cycle, while others use it primarily for one or two stages.

Much of the greater Grays Harbor estuary has been degraded by a combination of logging, channeling, gravel mining, water diversion, road building, diking, dredging, aquaculture, small-scale coal mining, mill effluent, sewage release, and pesticide use for aquaculture and cranberry farming (Smith et al. 1976, Hiss et al. 1982, Wood and Stark 2002, Smith and Wenger 2001 (cited by Sandell et al. 2011)). However, despite the long-term degradation, it provides habitat for 54 fish species (Sandell et al. 2011).

No fish surveys have been conducted within the Grays Harbor Refuge boundary. However, some large-scale fish studies conducted in the greater Grays Harbor estuary have included a sampling site on the south side of Moon Island, which is located just on the other side of the peninsula to Grays Harbor Refuge (Simenstad and Eggers 1981, Simenstad 1981, Sandell et al. 2011). This site is relatively close to Refuge lands, but may include deeper water than is found in the intertidal mudflat habitats; however, it still may be representative of the open water portions of the Refuge.

Based on these studies, 28 species of fish use the shallow open water and intertidal area around Moon Island between March and October (Simenstad and Eggers 1981, Simenstad 1981). Juvenile chum salmon, coho salmon, Chinook salmon, and steelhead use the open water and intertidal flats. Juvenile chum enter the estuary in January, leave in May, and are most abundant in March and April.

Juvenile coho salmon arrive in April, leave in June, and are most abundant in May. Juvenile Chinook salmon arrive in April, leave in October or later, and are most abundant in June. Juvenile steelhead are generally present in the estuary between May and July. Juvenile Chinook salmon and chum salmon and juvenile English sole use shallow intertidal areas almost exclusively. Three individual bull trout were found in the southeastern portion of the estuary in 2011.

Different species of juvenile salmonids have differing food preferences (Simenstad et al. 1981). Two primary food categories are epibenthic organisms (harpacticoid copepods, and cumaceans) and neritic zooplankton (larval fish, crangonid shrimp larvae, calanoid copepods, and cyclopoid copepods). Primary prey for Chinook salmon are epibenthic cumaceans, drift insects, and fish larvae. Coho salmon mostly feed on neritic organisms, primarily crab species. Steelhead mostly feed on neritic crab larvae and juvenile smelt.

Grays Harbor estuary is an important rearing area for juvenile English sole (Simenstad and Eggers 1981). English sole spawn offshore from Grays Harbor and juveniles migrate into the estuary to rear. The density and abundance of epibenthic invertebrates, and specifically crustaceans, in shallow open water and intertidal areas is critical to rearing of English sole. Simenstad and Eggers (1981) found that first year juvenile fish are abundant near the Refuge throughout most of the study period and that they primarily feed on crustaceans. Two additional species of flounder may also occur at the Refuge.

Seven species of forage fish (or baitfish) are found near the Refuge (Simenstad and Eggers 1981). Of these, juvenile Pacific herring and all life stages of northern anchovies are abundant. Adult and juvenile surf smelt and all life stages of longfin smelt are common. Pacific herring juveniles are found near Moon Island from May through October and are most abundant July through September. Northern anchovies have three population peaks: May, July, and September. Juvenile longfin smelt numbers peak in March, June, July, August, and September. Juvenile and egg forms of Pacific sand lance were present mostly in April, and infrequently in May, July, August, and September. In addition, Sandell et al. (2011) found American shad and Pacific sardine present, but in small numbers. All forage fish were associated with sand flats and eelgrass, showing a strong preference for eelgrass far beyond the relative contribution of eelgrass to the overall estuary habitat complexity. All forage fish feed almost exclusively on zooplankton and are prey for larger predatory fish (Sandell et al. 2011).

Adult, juvenile, and larval stages of 12 additional species of fish use shallow open water and intertidal habitats. Adult and juvenile peamouth, three-spined stickleback, bay pipefish, shiner perch, saddleback gunnel, and staghorn sculpin were found, as well as all life stages of snake prickleback. Juvenile Pacific tomcod, eelpouts, walleye surfperch, and greenling are present (Simenstad 1981). The abundance of food resources is critical to these smaller fish, which in turn provide a food base for larger fish and many fish-eating waterbirds.

Few large pikeminnow or staghorn sculpin were captured, suggesting that size classes of these predators big enough to consume salmon smolts are not overly abundant (Sandell et al. 2011).

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Black River Unit encompasses a complex mosaic of wetlands and connecting uplands, extensive plant communities, and varied species of wildlife. The Creveling et al. study in 1980 is likely the most comprehensive natural history investigation of the upper Black River to date. It covers more area than the Unit acquisition boundary, so it encompasses most habitats found in the Unit and is an

excellent baseline source of information. The Unit species lists include those animals and plants that have been observed or are strongly thought to exist within Unit.

Twenty-nine species of fish are known to occur in the Black River, 20 of which are native. Native anadromous fish found in the river and likely within the Unit boundary are Pacific lamprey, coho and Chinook salmon, cutthroat trout, and steelhead. Native resident fish are cold-water species and include western brook lamprey, mountain whitefish, peamouth, speckled dace, redside shiner, large scale sucker, three-spined stickleback, Olympic mudminnow, and five species of sculpins. Nonnative fish are widespread in the river and, unlike the native fish, many are warm-water species: American shad, brown bullhead, pumpkinseed, bluegill, rock bass, large and smallmouth bass, black crappie, yellow perch, and northern pikeminnow (Kunze, L. 2011, pers. comm., Creveling et al. 1980, Caldwell et al. 2004).

Spring Chinook salmon, fall Chinook salmon, fall chum salmon, coho salmon, winter steelhead, and cutthroat trout, all of the Chehalis River Evolutionarily Significant Unit, occur in the Black River but mostly downstream of the Unit (Caldwell et al. 2004). No salmon of this Evolutionarily Significant Unit are listed with State or Federal agencies. Salmon and steelhead spawning habitat in the Black River drainage is primarily in tributaries because the majority of the mainstem has a mud or fine sediment bottom due to the extremely low gradients (Smith and Wegner 2001). Spring Chinook salmon spawn in the lower 9 miles of the river mainstem and likely do not spawn in the Unit. Fall Chinook salmon spawn up to river mile 9 and also between river miles 16 and 17.3, which is also downstream of the Unit. However, they also spawn in the first mile of Waddell Creek within the Unit (Smith and Wegner 2001).

Chum salmon were once abundant but their numbers have greatly diminished since the 1970s, and now they spawn only within the first 10 river miles (Phinney and Bucknell 1975 [cited in Smith and Wegner 2001]). Coho salmon spawning is widely distributed in Black River tributaries, with the most productive spawning habitat located in Waddell, Mima, and Allen Creeks (Caldwell et al. 2004). There is excellent rearing habitat for juvenile coho salmon in the upper reaches of the river, but high temperatures and low DO may limit use. Nonetheless, there is some rearing of juvenile coho salmon in the low gradient reaches within the Unit. Winter steelhead spawn in the lower 7 miles of the river below the Unit and in Blooms Ditch, Dempsey, Salmon, Beaver, Waddell, and Mima Creeks (Caldwell et al. 2004, Smith and Wenger 2001), some of which drain into the river within the boundary. Juvenile steelhead rear for 2 years and likely use the Unit, but may be limited by summer low-flow conditions (Caldwell et al. 2004). Cutthroat trout use the Black River from October through April with anadromous fish spawning January through mid-March and resident cutthroat trout spawning February through mid-March. Although the status is unknown, the stock is believed to be relatively abundant and widely distributed in the system (Caldwell et al. 2004).

Historically Chinook, coho, chum, and steelhead salmonids all migrated up the Chehalis River, through the Black River and into its tributaries, and into Black Lake, where they spawned in Black Lake's tributaries. More recently, man-made alterations to lake water levels and the installation of a pipeline have impeded fish passage, contributing to the elimination of salmonid movement between Black River and Black Lake (Hawkins 2000, Smith and Wegner 2001, Caldwell et al. 2004). Salmon populations are likely much smaller than they were historically. The reduction of salmon abundance in the Black Lake and Black River watershed is of special concern because salmon are a keystone species, meaning that a wide array of organisms benefit from or depend on the trophic inputs salmon provide to the food web (Cederholm et al. 2000 in TNC 2005).

Low flows, high water temperatures, low DO levels, increased sediment loads, and concentrated toxins reduce survival of all salmonid life cycle stages. Pre-spawning mortality can be caused by low flows or reduced water quality. In 1989 there was a fish-kill in the river, south of Unit lands, which resulted in the death of adult Chinook salmon due to low DO, high nutrient levels, and warm water temperatures (Berg et al. 1995, Pickett 1994). Survival of eggs is dependent upon clean, stable gravel substrates. Low flows and high water temperatures can force early out-migration of juvenile fish, reducing their survival (see Chapter 3).

The small Olympic mudminnow (*Novumbra hubbsi*) is State-listed as a sensitive species and is a priority species under WDFW Priority Habitat and Species Program (PHS), but has no Federal status. Only three other species of *Novumbra* are found in North America and one in Eastern Europe, but the endemic Olympic mudminnow is found only in Washington State. The current distribution of the Olympic mudminnow includes the southern and western lowlands of the Olympic Peninsula, the Chehalis and lower Deschutes River drainages, and south Puget Sound, west of the Nisqually River (Mongillo and Hallock 1999). It occurs in quiet waters with several centimeters of soft mud substrate, little to no water flow, and abundant aquatic vegetation. If any of these characteristics are missing, no mudminnows are found (Mongillo and Hallock 1999). Meldrim noted that marshy streams with brownish water and overhanging banks are also important to the mudminnow (Meldrim 2012).

Adults are about 2 inches long and feed on live, moving prey, mostly ostracods, isopods, oligochaetes, mysids, mollusks, and dipterans. Spawning occurs over an extended period from late November to the following June (Mongillo and Hallock 1999). Females deposit eggs on vegetation and they hatch in approximately 10 days. Olympic mudminnows appear to be quite sensitive to competition or predation from exotic and native fish species (Mongillo and Hallock 1999). Because of this, the Olympic mudminnow's restricted range, and the continuing loss of wetlands, WDFW biologists believe the Olympic mudminnow is vulnerable and likely to become threatened or endangered in a significant portion of their range without cooperative management (Simon and Peoples 2006). Threats include habitat destruction, competition, and predation, particularly by exotic spiny-rayed fish (NatureServe 2012a).

Nonnative and invasive fish populations in the Black River include American shad, brown bullhead, pumpkinseed, bluegill, rock bass, largemouth and smallmouth bass, rainbow trout, black crappie, and yellow perch (Creveling et al. 1980). See Appendix L for the fish species list and Chapter 4, Section 4.7, for more information on these fish and their impacts on the habitat and native species.

Between August 6 and 7, 1989, a fish-kill occurred in the Black River and another on August 10 and 11 in the Chehalis River (Yake et al. 1989). Evidence suggests that a toxic substance entered the Black River at about river mile 9.2 on August 6 and moved downstream entering the Chehalis River. Estimates of the number of fish killed between river mile 9.2 and the mouth of the Black River include 100,000 coho salmon fingerlings, 17,000 cutthroat trout, and 118,000 forage fish (sculpins, dace, shiners, suckers, and lamprey). Over 300 adult Chinook salmon were killed in the Chehalis River. This fish-kill occurred below the Unit.

4.4.2 Waterfowl

Grays Harbor National Wildlife Refuge

The greater Grays Harbor estuary provides important migratory and overwintering habitat for waterfowl. It is listed as a key wetland requiring protection in both the Concept Plan for Waterfowl Wintering Habitat Preservation and Important Fish and Wildlife Habitats of Washington (USFWS 1979). As many as 45,000 birds have been recorded in the entire estuary during aerial surveys, with the highest counts during October and November. Grays Harbor is a large, protected estuary with a variety of habitats that provide foraging and cover sites, including eelgrass beds, shallow water areas, and marshes which produce sedge and grass seeds. Dabbling ducks are more prevalent than diving ducks in this shallow estuary. Surveys of the entire estuary showed American wigeon make up nearly 60 percent of the waterfowl, mallards 16 percent, green-winged teal 10 percent, and northern pintail 3 percent (USFWS 1990)

The most common species using the Refuge in the fall through spring are American wigeon, northern pintail, northern shoveler, green-winged teal, gadwall, surf scoter, common goldeneye, bufflehead, red-breasted merganser, and cackling and white-fronted geese. Mallards are common year round, as are Canada geese. Black brant were once rarely seen at the Refuge but are now occasionally observed on the open water or flooded intertidal mudflat in spring. It is unknown whether brant use reflects the increased presence of Japanese eelgrass (Baldwin and Lovvorn 1994), an invasive nonnative plant that is growing on the intertidal mudflats.

In the past, some waterfowl listed as occurring at the Refuge were actually using the Hoquiam sewage ponds to the east. Those species include canvasback, greater scaup, lesser scaup, and hooded merganser.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Mallards, American wigeon, green-winged teal, northern shoveler, northern pintail, hooded merganser, wood duck, bufflehead, ring-necked duck, and American coot use habitats within the Unit. Dabbling ducks are usually found in the open areas of emergent marsh, whereas diving ducks are usually found associated with the river's deeper-channel waters. Typical seasonal rains create mild to moderate surface flooding conditions, which in turn support habitat for both dabbling and diving ducks and geese. Canada and cackling geese also use emergent marsh; seasonally flooded, nonnative grasslands; and dry, nonnative grasslands in late fall, winter, and early spring.

Waterfowl surveys were conducted by Unit staff twice a week in 2002, from mid-February to the end of March, in the open wetlands just north of 123rd Avenue. At that time approximately 115 ducks and geese a day were observed, and species included mallard, northern shovelers, green-winged teal, and American wigeon.

4.4.3 Water Birds

Grays Harbor National Wildlife Refuge

Great blue herons are common year round at the Refuge feeding in the intertidal areas. Double-crested cormorants are also common and forage in open water and flooded intertidal mudflats.

Horned grebes are common fall through spring in open water areas. Western grebes were once common in winter and spring but are now rarely observed. Common loons are seen and sometimes heard in the open water habitat.

Caspian terns historically bred on islands in Grays Harbor estuary, but the last known nesting was in 1989 (Seto et al. 2003). Caspian terns commonly forage in shallow waters at the Refuge in spring through fall. Glaucous-winged, western, hybrid cross, California, mew, and ring-billed gulls are common fall through spring.

Some water birds listed as occurring at the Refuge were actually observed using the nearby water treatment facility. These include brown pelicans and pied-billed grebes.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Black River wetlands are excellent locations for migratory and resident waterbirds, especially secretive marshbirds such as green heron, American bittern, Virginia rail, and sora. These birds nest and forage in the dense cover that can be found in the emergent marsh, shrub swamp, and along the edge of the river channel. Great blue herons use the same habitats but also forage in more open areas such as the seasonally flooded, nonnative grassland. Pied-billed grebes use the deeper waters of the river channel to forage and nest in the cover where the shrub swamp and emergent marsh converge.

4.4.4 Shorebirds

Grays Harbor National Wildlife Refuge

Greater Grays Harbor estuary is one of the largest staging areas for spring migratory shorebirds on the Pacific coast of North America and hosts one of the largest concentrations of shorebirds on the Pacific coast, south of Alaska. In 1996 it was designated as a Western Hemisphere Shorebird Reserve Network Site of Hemispheric Significance (Manomet Center for Conservation Sciences 2013) and an Important Bird Area within the Washington Coast Estuaries IBA (Bayard 2013). In the spring of 1981 over 1,000,000 shorebirds were observed using the entire harbor to forage and rest as they made their way from South and Central America to breeding grounds in and around Alaska's arctic and subarctic areas (Herman and Bulger 1981).

Grays Harbor Refuge occupies only 2 percent of the intertidal mudflat habitat of Grays Harbor estuary and yet hosts approximately 50 percent of the spring-migrating shorebirds (Herman and Bulger 1981). Of the 33 species of shorebirds that migrate annually along the west coast between the arctic and South or Central America, 24 have been observed at the Refuge. Currently the most abundant shorebirds using the Refuge are western sandpiper, dunlin, and semipalmated plover. Shorebirds that commonly use the Refuge in smaller numbers include black-bellied plover, greater yellowlegs, least sandpiper, short- and long-billed dowitchers, and red knot.

Grays Harbor Refuge brings together three characteristics critical to shorebirds. The first is a high concentration of invertebrates, which fuel the birds' migration. The second is the higher-elevation intertidal mudflats that result in Refuge mudflats being the first in Grays Harbor to be exposed and the last to be inundated as the tide ebbs and flows, allowing birds to feed an additional 1 to 2 hours each tidal cycle. Third, the Refuge is protected from wave action, providing a sheltered environment for shorebirds and waterfowl (USFWS 1990). During low tides, shorebirds fan out over the intertidal mudflats following the receding water. As the returning tide advances, birds move shoreward and

may roost on the exposed intertidal mudflats, salt marsh, or on LWD until the tide begins to recede again (Herman and Bulger 1981). Birds often leave the Refuge to roost on Mini Moon Island just west of the Refuge.

The spring Refuge shorebird population is dominated early in the migration period by western sandpiper and dunlin, but semipalmated and black-bellied plovers, dowitchers, yellowlegs, and least sandpipers are also observed. Slightly later in the migration period, species diversity increases with red knots and occasionally whimbrels, marbled godwits, and ruddy turnstones observed foraging or resting at the Refuge.

The shorebirds migrate southward after breeding season ends or as dwindling food resources and cold weather forces them to move. The birds stop more frequently to forage on the southbound journey than they do in the spring. Some birds continue their flight into Central and South America, while some stop in Washington. These birds make a round-trip of 7,460 to 15,500 miles (Herman and Bulger 1981 [cited in USFWS 1990]).

Grays Harbor Refuge is important to shorebirds throughout the winter. Service records show that up to 20,000 shorebirds, mostly dunlin, use the Refuge through the fall and winter months (Herman and Bulger 1981 [cited in USFWS 1990]). Annual Audubon Christmas Bird Counts for the entire Grays Harbor estuary and coastline routinely record large numbers of dunlin (USFWS 1990).

Red knots are an SOC on both the east and west coasts of the United States. Individuals of the west coast subspecies (*Calidris canutus roselaari*) have declined in Grays Harbor estuary. It appears they are no longer using the Refuge in large numbers as they were in the past. Recent efforts to understand the natural history of *C. c. roselaari* have been helpful to understanding where these birds may be found within the greater Grays Harbor estuary (Buchanan 2006, 2008; Buchanan et al. 2011). It is possible that food resources and prey availability have declined at the Refuge, perhaps as a result of increased sedimentation levels (Buchanan, J. 2012, pers. comm.).

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Shorebirds such as greater yellowlegs, dunlin, Wilson's snipe, spotted sandpiper, and killdeer forage in the open, shallow wetlands. Yellowlegs winter there, dunlin may winter or stop during migration, Wilson's snipe most likely nest there, and killdeer move up to the drier, nonnative grasslands to nest.

4.4.5 Raptors

Grays Harbor National Wildlife Refuge

Ten species of raptors are known to use the Refuge and five are common. Peregrine falcons and merlins are frequent sights during spring and fall migration and through the winter, feeding on the dense populations of shorebirds. Northern harriers and red-tailed hawks are common year round and feed mostly on small mammals in the salt marsh. Bald eagles commonly use the Refuge during the winter and spring, feeding mostly on fish and waterfowl, although they sometimes attempt to capture the highly maneuverable shorebirds. Ospreys, present spring through fall, feed exclusively on fish.

An often-seen raptor is the sharp-shinned hawk; less commonly seen is the Cooper's hawk. Both hawks feed on small landbirds in forested habitat. Rough-legged hawks show up infrequently in

winter and prey on birds, small mammals, and carrion. American kestrels are observed even less frequently and feed mostly on insects, passerines, and small vertebrates.

Grays Harbor estuary is an important over-wintering area for peregrine falcons. During the winter of 1981–1982, six peregrines were radio-tracked in Grays Harbor and the most widely used areas were the Refuge, Point New to the northwest, and around the northeastern portion of North Bay to the mouth of the Humptulips River. Up to three peregrines have been seen at the Refuge at one time, their occurrence directly related to the large numbers of shorebirds in the area. Over 65 percent of wintering peregrine prey is shorebirds, mostly dunlin, (Dobler and Spencer 1989, Hayes and Buchanan 2002).

Merlins make use of Grays Harbor Refuge, notably during the winter (Buchanan et al. 1988) and spring shorebird migration. As many as 16 merlins were recorded in the greater Grays Harbor estuary during the 1977 Audubon Christmas Bird Count. Merlin use of the Refuge is tied to high densities of migrating and overwinter shorebirds.

Most of the raptors discussed above nest near the Refuge. Bald eagles nest along the entire coast of Washington, and adults and juveniles are seen year round at the Refuge. They teach their young foraging techniques on estuary waters. Numbers increase in fall and winter, and their occurrence is most closely tied to salmon spawning runs, waterfowl, and shorebird migrations. Ospreys have nested just outside the Refuge boundary in large banks of lights located along an abandoned open field. After a 2007 storm felled these lights, the Port of Grays Harbor erected an osprey platform near the Hoquiam water treatment pool. To date, ospreys have not used this as a nesting platform, although it is used by other raptors as a perch site. Peregrine falcons are known to nest within the estuary and on cliffs along the outer coast of Washington and make use of Grays Harbor year round. Merlins are thought to nest somewhere nearby. Red-tailed hawks commonly nest in the surrounding landscape.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Some raptors reside on the Unit year round, some use it as a stopover site during migration, and some winter in the area. Greater species diversity and larger numbers are observed in the fall and winter months. Owls that are common and nest in the area include barn and great horned owl. Owls that may use or nest in the area, but are not verified, are western screech, northern pygmy, and northern saw-whet. The short-eared owl may use the open old fields as hunting grounds during the nonbreeding season. Hawks expected to use the Unit include northern harrier, red-tailed hawk, Cooper’s and sharp-shinned hawk. American kestrels forage over the open grassland areas and are expected to be nesting nearby. Turkey vultures and bald eagles soar over open meadows and floodplains. Ospreys may also forage in the Unit.

4.4.6 Landbirds and Passerines

Grays Harbor National Wildlife Refuge

Over 54 species of landbirds have been observed at Grays Harbor Refuge, most making use of the forest and the tall shrubs and grasses along the margins of the Refuge (Sundstrom 2008). Most commonly occurring species appear to be breeding or year-round residents. A few species are either migratory, using the Refuge during the spring and/or fall, or overwintering.

A 2-year study along the State Highway 109 right-of-way (ROW) (in forest and salt marsh habitats) along the north side of the Refuge recorded a small group of species present during each season that included song sparrow, bald eagle, gull species, common raven, red-tailed hawk, and marsh wren (Sundstrom 2008). Song sparrow, American robin, black-capped chickadee, marsh wren, and American crow were the most frequently detected species and comprised 51 percent of all bird detections during the study. Thirty-three species were commonly detected in both study years, with fall being the season when most were detected (Sundstrom 2008).

In the southern end of the Refuge, 12 species of landbirds are common year round: downy woodpecker, northern flicker, American crow, black-capped chickadee, Bewick's wren, marsh wren, American robin, European starling, spotted towhee, song sparrow, house finch, and American goldfinch. Twenty-two species of landbirds are common during at least one season of the year, mostly spring through fall or summer. Seasonally common birds include rufous hummingbird, Pacific-slope flycatcher, willow flycatcher, violet-green swallow, tree swallow, cliff swallow, barn swallow, orange-crowned warbler, yellow warbler, yellow-rumped warbler, common yellowthroat, Wilson's warbler, savannah sparrow, and brown-headed cowbird.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Over 74 species of migrant or resident landbirds and passerines have been recorded within the Black River Unit boundary, including 8 species of raptors, including owls, hawks, falcons, and eagles. Long-distance migrants travel between breeding grounds in temperate North America and wintering grounds in Central and South America. Resident species both breed and winter in the local area.

Within the Unit, mixed forests, riparian forests, and shrub swamps provide differing growth forms, layers of vegetation structure, plant diversity, and food resources which support many species of landbirds. A mosaic of habitats and the transition zones between them provide bird species greater use of the areas. Many passerines rely on the cover, food availability, foraging space, undisturbed areas for nesting, branches to support nests, and access to water that the thickets and wetlands provide.

Year-round resident woodpeckers using mixed and riparian forests include northern flicker; downy, hairy, and pileated woodpeckers; and red-breasted sapsucker. Rufous hummingbird is the only known hummingbird species on the Unit, but Anna's hummingbirds are expanding their range throughout western Washington and may now occur on the Unit. Belted kingfishers forage for fish in the river, band-tailed pigeons and cedar waxwings forage on fruit-bearing plants in the forests, and mourning doves use the open areas of dry, nonnative grasslands. Nesting violet-green swallow, tree swallow, barn swallow, cliff swallow, and northern rough-winged swallow consume insects over the floodplain. Some habitats should be appropriate for Vaux's swift.

Many passerines rely on the Unit during migration to and from distant breeding grounds. Large numbers of warblers, vireos, flycatchers, thrushes, and swallows stop to refuel in the mixed forest, riparian forest, and shrub swamp habitats. Habitat in the riparian and shrub swamp is used by yellow warbler, yellow-rumped warbler, common yellowthroat, red-eyed vireo, Cassin's vireo, warbling vireo, black-headed grosbeak, evening grosbeak, western tanager, bushtit, black-capped chickadee, chestnut-backed chickadee, Bewick's wren, Pacific wren, and sparrow species.

The drier mixed forests support American robin, spotted towhee, Swainson's thrush, varied thrush, hermit thrush, American goldfinch, Steller's jay, American crow, raven, red-breasted nuthatch, Pacific wren, Bewick's wren, Wilson's warbler, Townsend's warbler, black-throated gray warbler, brown creeper, chestnut-backed chickadee, ruffed grouse, blue grouse, and band-tailed pigeon. The emergent marsh supports the marsh wren, common yellowthroat, and red-winged blackbird. Dry, nonnative grasslands could provide habitat for western meadowlark, American kestrel, California quail, sparrow species, killdeer, American robin, purple martin, Vaux's swift, and swallow species.

4.4.7 Mammals

Grays Harbor National Wildlife Refuge

No mammal surveys have been conducted at the Refuge, which has limited upland habitat and is isolated from adjacent lands. Black-tailed deer and breeding short-tailed weasel are observed annually. River otter are occasionally seen on the intertidal mudflats as well as the occasional harbor seal pup. It is likely that vole, shrew, raccoon, mink, and coyote use the Refuge, but surveys are lacking. Nonnative species including opossum, eastern gray squirrel, and eastern cottontail likely occur on the Refuge. A report of elk was once provided by a visitor but not verified, and a single, unverified observation of a dead black bear cub was made.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The most comprehensive inventory of mammal species for the Black River drainage was done by Creveling et al. in 1980 for the Washington Department of Game. They identified a total of 54 species of mammals from habitats found the Black River watershed: 4 species in aquatic habitats, 13 species in wetland habitats, 15 species in the riparian zone, 15 species in shrub habitats, and 36 in the forests. Today nutria, eastern gray squirrel, opossum, and eastern cottontail should be added to the list as nonnative mammals. Creveling et al. also found Norway rat and house mouse, but those are expected in more developed areas instead of natural areas.

Native species found exclusively within the aquatic and wetland habitats include water and vagrant shrew, shrew mole, Townsend's and water vole, beaver, muskrat, mink, long-tailed weasel, and river otter. Those species found exclusively within upland habitats include masked and Trowbridge's shrews, mountain beaver, Townsend's chipmunk, Douglas' squirrel, northern flying squirrel, deer mouse, bushy-tailed woodrat, Gapper's red-backed vole, creeping vole, porcupine, coyote, red fox, ermine, striped skunk, Roosevelt elk, and black-tailed deer. Species which use both the upland and riparian habitats include Pacific water shrew, Townsend's mole, long-tailed vole, Pacific jumping mouse, snowshoe hare, black bear, western spotted skunk, mountain lion, and bobcat. At least eight species of bats have been identified using the area: Yuma, Keen's, long-eared, California myotis, Townsend's big-eared, silver-haired, big brown, and hoary bats (Creveling et al. 1980). Many of these species use abandoned structures for roosting and maternity sites.

Beavers are an important source of disturbance in the Black River lowland floodplain ecosystem. Most beavers were removed from rivers and streams in the Pacific Northwest in the late 1800s as a result of the fur trade. Beaver populations were also reduced by eradication efforts to prevent flooding in lands planned for agricultural use and development and to reduce insect populations. Until recently, fisheries biologists encouraged natural-land managers to break up beaver dams because according to early studies, they thought the dams hindered passage for anadromous

salmonids and decreased fish habitat (Reid 1952 [cited in Pollock et al. 2008], Sanchez 2008). In areas where human development grew, beaver populations never rebounded to former levels. Areas impounded by beaver dams have been associated with biomass or diversity increases in a wide range of taxa, including birds, mammals, plants, and insects (Pollock et al. 2008). Beaver-impounded wetlands provide important off-channel rearing habitat for juvenile salmon during seasonal high water periods, and submerged vegetation and woody debris associated with beaver ponds provide excellent cover for rearing salmon. Beaver activity holds water through the dry season, providing needed habitat and water resources to a large number of species, animal populations, and plant communities. Beaver ponds also create a nutrient sink, which increases productivity of aquatic invertebrates, both in the ponds and in tributaries downstream of the ponds. Beaver dams provide storage areas of fine sediment and stabilize flows during high water events as water is stored in ponds and released slowly over the beaver dams (Cederholm et al. 2000, Smith and Wegner 2001).

In the entire Black River system, the only undeveloped or unaltered floodplain remaining is the wetlands along the upper reaches of the river. The low-gradient floodplain provides ideal conditions for beaver colonization and an abundance of off-channel habitats that are preferred by juvenile salmon species. In the river, the beaver dams across the river channel do not create characteristic open ponds. Instead, water spreads widely over the flat floodplain landscape. They help create the shrub swamp and emergent marshes which provide important ecological benefits to a variety of wildlife species. By constructing dams and impounding streams, beavers considerably alter stream hydrology in a way that provides extensive benefits to fish as well as other organisms, resulting in a high species diversity supported by these systems (Rossell et al. 2005). It is most likely that cutthroat trout and coho salmon make extensive use of these areas for overwintering and feeding.

4.4.8 Reptiles and Amphibians

Grays Harbor National Wildlife Refuge

Surveys for reptiles and amphibians are incomplete. Pacific chorus frog is expected to occur in the forest habitats, and there may be other species of amphibians and snakes in residence.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

A total of 13 species of amphibians have been found within the Black River basin (Creveling et al. 1980). Most were found in the wetland zones, but many were also found in forested locations, including riparian habitats. Not all species found by Creveling et al. may occur within the Unit, but the expected species include northwestern, long-toed, and ensatina salamanders and rough-skinned newt. Native frogs or toads using the Unit include the Pacific chorus frog, red-legged frog, and Oregon spotted frog, and possibly western toad. Nonnative bullfrogs occur in localized areas. Detailed information on the Oregon spotted frog can be found in Section 4.5. Rare Species.

Ten species of reptiles were found within the entire watershed that might occur within the approved Unit boundary; eight of these were found in forested habitats, six in riparian, and three in both the aquatic and wetland areas. Two species of turtles occur in the wetland and aquatic habitats: painted turtle (native to eastern Washington) and the nonnative red-eared slider. At one time, Pacific (western) pond turtles, a State endangered species, were found but they are now thought to be extirpated. Two species of lizards are possible in the upland habitats: northern alligator and western fence lizard. Six species of snakes may occur within the Unit, including two species occurring

exclusively in the uplands: gopher and northwestern garter snake. Species that could occur in both uplands and wetlands include rubber boa and common and western terrestrial garter snakes.

4.4.9 Invertebrates

Grays Harbor National Wildlife Refuge

Invertebrates within the water column and in the substrates of Grays Harbor estuary are a vital part of the food web supporting the wealth of higher species that make use of the landscape. Invertebrates are a critical part of the food web at the Refuge, notably providing food for migrating and overwintering shorebirds, ducks, water birds, juvenile salmonids, and non-salmonid fish. Their densities, biomass, and species diversity support large concentrations of animals (such as migrating shorebirds), which in turn attract larger, vertebrate predators such as peregrine falcon, merlin, and bald eagle.

Benthic invertebrates (those below the sediment surface) are critical to shorebird use of the Refuge. Species composition and densities of benthic invertebrates vary depending on tidal level and substrate (Wolfe, Moore, and Cameron 1974, Wolfe and Moore 1973, Wolfe 1973, Warnock et al. 2004). Both abundance and biomass of invertebrates are considerations in food availability for predator species. Substrates at the mid-tide level have greatest biomass of insects, polychaetes, and amphipods but only half as many individual insects as either polychaetes or amphipods (Warnock et al. 2004). One individual polychaete animal accounted for two-thirds of the total mass of polychaetes in that 2004 study. Substrates at the low-tide level have very high biomass and numbers of individual polychaete worms, and moderately high biomass and numbers of individual bi-valves (Warnock et al. 2004).

Epibenthic invertebrates (those on the sediment surface) are important food resources for fish and some bird species, such as those that peck at the exposed surface. Forty-eight taxa of epibenthic invertebrates are found at the Refuge and are predominantly harpacticoid and calanoid copepods (Simenstad and Eggers 1981, Simenstad 1981). As many as 84,500 organisms per cubic meter were measured, which is near the highest density found at other locations along the Pacific coast. Species abundances shift with the tides. Historically the basin was a nursery area for Dungeness crab (Wolfe 1973).

Invertebrates in the water column, neritic zooplankton, are critical food for fish and some bird species. Over 100 taxa of zooplankton are found at the Refuge, of which at least 95 are invertebrates (Simenstad and Eggers 1981, Simenstad 1981). Seasonal species abundances shift dramatically, with the greatest abundance (about 1,900 organisms per cubic meter) the end of April and the beginning of May and the lowest abundance in July (about 51 organisms per cubic meter). A second peak in abundance occurs in September. By far, copepods and barnacles make up the greatest biomass.

Little is known about invertebrate food preferences of different avian predators using the Refuge. Two species of crustaceans and one species of amphipod make up about 94 percent of the stomach contents of overwintering dunlin at the Refuge (Brennan et al. 1990), which could indicate preferential feeding or could reflect species abundance at the time of feeding.

Anthropogenic impacts to sediment levels and tidal levels within the Refuge are of concern in that they most likely affect the density and species composition of invertebrates (Wolfe, Moore, and

Cameron 1974), which are critical to fish and migratory birds. Additionally, invasive plant species spreading over the intertidal mudflats may affect invertebrate species.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Studies of freshwater benthic invertebrates are incomplete, but water quality studies in the lower portions of the river (samples collected at 110th Avenue) noted that the invertebrate population generally is not diverse, is dominated by pollution-tolerant species, and has low numbers of pollution-sensitive species. Midge larvae, which are pollution-tolerant, are the most abundant, while mayflies, stoneflies and caddisflies, which are pollution-intolerant, were uncommon. The populations recorded from six sites along the river included mayflies, stoneflies, caddisflies, dragonflies, scuds (amphipods), water beetles, true flies (including midges), true bugs, moths, and alderflies. The Berg et al. study (1995) also found freshwater clams, snails, aquatic sow bugs, crayfish, and leeches.

More recent observations include broken freshwater mussel shells found on top of bent-over reed canarygrass in a flooded area next to the river. They were identified as Oregon floaters by Service biologist Donna Allard. Additional shells were found in Waddell Creek and were also identified as Oregon floaters. Crayfish have been observed in Waddell Creek, but the species has not yet been identified. However, a native signal crayfish was identified in emergent marsh near 123rd Avenue by Unit staff. Freshwater sponges (species unknown) are also thought to be living in the river within the Unit boundaries, and Mumford (2013, pers. comm.) has noted freshwater sponges are abundant between river miles 4 through 15. Nonnative bryozoan colonies have been found in the river just south of Littlerock and may also be within the Unit boundary.

Rare invertebrates that may occur at the Unit include Beller's ground beetle, Hatch's click beetle, and the Pacific clubtail (Kunze, L. 2011, pers. comm.).

4.5 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 species with Federal or State status, and other special status species, in the planning process.

4.5.1 Grays Harbor National Wildlife Refuge

Fish

Three species of fish listed as threatened under the ESA potentially occur at Grays Harbor Refuge: green sturgeon, eulachon, and bull trout; however, no surveys have been conducted to date within the Refuge boundary. The juvenile stage of green sturgeon might make use of the open water habitat. Eulachon eggs and larvae might be found briefly in either the open water or intertidal mudflat habitats. Adult and juvenile bull trout might make use of the open water habitat.

The **Southern Distinct Population Segment of North American Green Sturgeon** is a NOAA federally listed threatened species. Habitat use outside of natal areas includes coastal estuaries and

coastal marine waters from southern California to Alaska. Grays Harbor coast and estuary are specifically designated as critical habitat. Most of the fish expected to occur in Grays Harbor would likely be immature fish that use the Harbor during summer to feed and to optimize growth (Lindley et al. 2008, Moser and Lindley 2007 [cited in Federal Register volume 74, page 52300]). Little is known about green sturgeon spawning, but it is not thought to spawn in the Chehalis River. The greatest threats include overfishing, modification of spawning habitats, entrapment in water project diversions, and pollution (Adams et al. 2002, WSDOT 2010).

Eulachons, also known as candlefish or Pacific smelt, are a NOAA federally listed threatened species and a State-candidate species. Eulachon were commonly found in Grays Harbor estuary into the 1990s. Adults pass through Grays Harbor between late December and early March on their way to spawning grounds in the many rivers and tributaries draining into the Harbor. On the Refuge, eulachon would most likely be found only as eggs or larvae because they are soon washed out to the Pacific Ocean. The numbers of eulachon in Grays Harbor declined after the early 1990s to the point where they were only occasionally observed in 2001. Threats to eulachons are many, including possible predation of eggs and larvae. It is theorized that climate change may pose a significant threat through increased ocean warming and changes to their copepod prey base during the transition from larvae to juveniles (NFSC 2008).

Bull trout are a Service federally listed threatened species and State-candidate species. Most bull trout populations spend their entire lives in cold, clean, fresh water, but those in the Coastal-Puget Sound population migrate between fresh water and the marine environment (USFWS 2004). Chehalis River/Grays Harbor is a designated Critical Habitat Subunit of the Olympic Peninsula Critical Habitat Unit of the Coastal Recovery Unit for Bull Trout. This unit is considered essential for maintaining distribution of the anadromous life history form of bull trout which is rare across the species' geographic range (USFWS 2010b). Grays Harbor estuary provides a key connection between the Pacific Ocean and freshwater habitats within the Chehalis River basin and Humptulips River drainage. Bull trout are not thought to spawn in the Chehalis River, rather are suspected to spawn in tributaries with headwaters north of the river (USFWS 2010b). Bull trout were found in the mouth of the Chehalis River in Grays Harbor estuary between 2001 and 2004, and historic data showed them netted near Moon Island once in 1973, three times in 1974, and three times in 1977 (Jeanes and Morello 2006).

The Refuge may provide important habitats such as native eelgrass beds, salt marshes, and intertidal mudflats at high tide. Contrary to the generally expected requirement of cold water temperatures and the need for complex habitat, bull trout were found to repeatedly use relatively shallow, near-shore waters in bays and estuaries in the lower Skagit River delta between March and August. In one study the majority of radio-tagged fish occupied depths < 4 meters and were found to use eelgrass, green algae, saltmarsh, and intertidal mudflats areas more than expected (Hayes et al. 2011). Shallow water habitats not only provide bull trout with opportunities for foraging, but may reduce predation by large predators such as seals.

Threats to bull trout include habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management, and the introduction of nonnative species such as brown, lake, and brook trout. Effects from climate change threaten bull trout throughout their range in the coterminous United States. With a warming climate, cool-enough spawning and rearing areas are expected to shrink during warm seasons, in some cases dramatically, causing them to become even more isolated from one another. Climate change will likely interact with other stressors, such as habitat loss and fragmentation, invasions of nonnative fish, diseases, and other threats, to render

some current spawning, rearing, and migratory habitats marginal or wholly unsuitable (USFWS 2010b, USFWS 2010c).

Birds

Bald eagles are no longer federally listed as threatened in Washington, but continue to be protected by the Federal Bald and Golden Eagle Act and are considered a State-sensitive species. Both adult and immature eagles forage on flocks of waterfowl and shorebirds on the Refuge. Eagles most likely forage for fish in open water habitat, during high tide conditions on the intertidal mudflat, and in the surrounding greater estuary. They do not nest on the Refuge.

Brown pelicans are no longer federally listed as threatened in Washington; however, they are considered State-endangered. On the Pacific coast, brown pelicans nest in California and fly north along coastlines in Oregon and Washington to forage on fish-rich waters, most commonly between June and October. They can be observed in greater Grays Harbor estuary, including Refuge open waters. They have also been observed using the water treatment lagoon near Paulson Road.

Common loons are a State-sensitive species. They forage on fish in open water habitat, during high tides on intertidal mudflats, and in the surrounding greater estuary, including the shipping channel near the Refuge. Nesting habitat is not available on the Refuge.

Peregrine falcons are no longer federally listed in Washington, but are considered a State-sensitive species. This species preys on birds and can be observed chasing flocks of waterfowl and shorebirds during winter and spring seasons. They do not nest on the Refuge.

Western Grebes are an SOC. These birds may use the open water habitats of the Refuge to prey upon fish and to loaf. They do not nest on the Refuge.

Invertebrates

Newcomb's Littorine Snail is a State-candidate species. This snail lives on the stems of *Salicornia*, and possibly other estuarine marsh plants. It also lives on the substrate beneath vegetation, where it remains moist and protected from the sun and wind. It feeds on micro- and macroscopic algae and the vascular plants on and under which it lives (MacDonald 1969, Hinde 1954 [cited in Larsen et. al 1995]).

4.5.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Fish

Pacific lampreys are an SOC (NatureServe 2012b). They occur from Alaska south through California, are widespread, but have declining numbers. They are anadromous parasitic fish that spawn in June and July in Washington. Juveniles live in freshwater for 4–6 years, then metamorphose into adults and migrate to the Pacific Ocean. Pacific lampreys use shallow backwater areas or eddies along edges of streams with mud, silt, and sand bottoms. They spawn in riffles with rock, sand, or gravel substrates in clear streams. Juveniles are filter feeders. Adults are parasitic on fish, particularly salmon, staying attached for 20–40 months. Primary threats are channelized streams, pollution, barriers to migration, and reduced food resources (salmon). Pacific lampreys have been found in tributaries draining into Black River (WDFW 2013).

Olympic mudminnows are a State-sensitive and endemic species. They require slow-moving rivers, ponds, or wetlands with muddy substrates and dense submerged vegetation such as in Black River. Mudminnows prey on an assortment of small invertebrates and depend on healthy wetland habitat for their survival. This species does not fare well when sharing habitat with nonnative species of fish. It is uncertain if this is a result of competition or predation, but some combination is likely. Because of this, and the Olympic mudminnows' restricted range and the continuing loss of wetlands, they are thought to be vulnerable and likely to become threatened or endangered in a significant portion of their range without cooperative management (Mongillo and Hallock 1999).

Plants

Water howellia is a federally threatened species and a State-threatened species. It is regionally endemic, currently known from California, Montana, Idaho, and Washington and was historically known from Oregon (USFWS 1996a). In Washington, it occurs within the Columbia Basin and Puget Trough physiographic provinces. It occurs in wetlands, mostly in small, vernal ponds, although some of the ponds may retain water throughout the year. Soils are rich in organic matter and frequently contain partially decomposed leaves, stems, and wood. Water howellia is known to exist in the Black River watershed, although its presence is unknown within the Black River Unit.

The most significant threats and management concerns are changes in wetland hydrology, an increase in weedy species (e.g., reed canarygrass), the threat of invasion by noxious weeds (e.g., purple loosestrife), livestock overgrazing, and timber harvest activities on adjacent uplands (USFWS 1996a).

Bristly sedge is listed as State-sensitive and WDNR recorded its presence in what is now the Black River Unit (Kunze L. 2011, pers. comm.). Its status on the Unit is currently unknown.

Birds

There are no federally listed (threatened or endangered) birds using the Black River Unit.

Pileated woodpeckers are a State-candidate species. These woodpeckers prefer mature deciduous, coniferous, or mixed forests where larger trees provide appropriate habitat for nest cavities which are excavated new each year. They forage on insects and eats fruit and nuts (Seattle Audubon Society 2002).

Purple martins are a State-candidate species. Purple martins are loosely colonial and prefer natural cavities near water to nest. They often use holes excavated by woodpeckers in mature mixed deciduous and conifer forests where larger trees provide appropriate habitat for cavities. Purple martins build a cup nest within the cavity. They forage for aerial insects over open lands near water such as emergent marsh, open wetlands, or open fields (Seattle Audubon Society 2002).

Vaux's swifts are a State-candidate species. Vaux's swifts are loosely colonial and forage in open sky over woodlands, lakes, and rivers, where flying insects are abundant. Nesting habitats include either coniferous or deciduous forests that provide large, hollow trees or snags with vertical entrances for nesting and roosting. The nest is a shallow half-cup attached to the inside of a tree with sticky saliva (Seattle Audubon Society 2002).

Mammals

Townsend's big-eared bats are an SOC and a State-candidate species that are known to use habitats in the Black River watershed and may occur within the Black River Unit boundary. Townsend's big-eared bats can be found in British Columbia, throughout the western United States, and in Mexico. They commonly occur in mesic coniferous and deciduous forested regions. Townsend's big-eared bats feed on flying insects, primarily moths, near trees and shrubs in the mid- to upper canopy. They typically use caves, mines, and buildings for both maternity colonies and hibernating. Nursery colonies tend to be small, up to 200 individuals. They hibernate singly or in small groups. These bats mate in late fall through winter, and a single young is born in mid-July. Primary threats are loss of habitat and disturbance of maternity roosts and hibernacula (NatureServe 2013, WDFW 2013).

Amphibians

Oregon spotted frogs are a federally threatened and State-endangered species. They have occurred from southwestern British Columbia to northeastern California but have been extirpated from California. Much-reduced populations are in British Columbia. Remaining extant populations are in isolated areas of eastern and western Washington and western Oregon. As of 2001, Oregon spotted frogs are known from eight sites in Washington State (USFWS 2011). Oregon spotted frogs are highly aquatic, staying in or in close proximity to open water. They prefer streams, lakes, ponds, and marshes that provide open, permanent, quiet waters with relatively warm temperatures and short vegetative cover throughout the year. Adults are opportunistic feeders on a wide range of insects, mollusks, crustaceans, and arachnids. Larvae and tadpoles depend upon vegetative detritus and algae.

Optimal Oregon spotted frog breeding, egg-laying, and rearing conditions occur between January and June and contain open, short vegetation locations in sun-warmed, shallow water which are hydrologically connected to permanent waters. Herbaceous plants used by Oregon spotted frogs are low-growing and sparse; some preferred areas show exposed mineral soils, and an occasional shrub provides a source of cover from predators. Shallow water allows surface water temperatures to rise and speeds egg development. Stable, shallow water levels are critical to keep egg masses hydrated during development into the larvae stage. As spring progresses to summer, surface water must remain connected to nearby deeper, permanent waters to allow tadpole migration. If surface water evaporates and water levels drop before tadpole migration occurs, the young frogs become isolated, desiccate, and cannot survive (USFWS 2011).

Major threats to Oregon spotted frogs include breeding and egg-laying habitat loss and limitations to natural life cycles. Densely growing reed canarygrass may cause frogs to expend large amounts of energy to move through it daily and seasonally. It potentially prevents frogs from reaching optimal breeding and egg-laying sites. Nonnative bullfrogs and nonnative fish in Unit wetlands and channels may prey upon both Oregon spotted frog adults and tadpoles (USFWS 2011, Cucherousset and Olden 2011, Howell 2010). Oregon spotted frogs tested in the Black River drainage showed exposure to chytrid fungus (*Batrachochytrium dendrobatidis*), which is responsible for the decline of many amphibian species worldwide. Dermal infections by chytrid fungus are thought to cause amphibian mortality by interfering with skin functions (Pearl et al. 2009, Speare and Berger 2004, in USFWS 2011).

The Service, WDFW, WDNR, and private landowner biologists in Thurston County coordinate with surveying, monitoring, and research on this species throughout the drainage, including the Unit.

Annual egg surveys help gauge frog populations and habitat quality. WDFW and Service data suggest the Black River drainage population is declining.

Invertebrates

Five invertebrate species of specific interest may occur on the Black River Unit. Future inventory of Unit habitats for these species should be conducted.

Beller's ground beetles are a State-candidate species. They occur in sphagnum bogs in open areas with native cranberry, sundew, and low-growing graminoids (Xerces Society 2011). Adults breed in the spring. They eat seeds, vegetation, and small insects. Little is known about the larvae. Threats include habitat loss, changes in hydrology, trampling, and pollution. This species is distributed from the Queen Charlotte Islands through coastal British Columbia, Washington, and Oregon, but only about 25 populations are currently known (Maynard 2009). Two populations are found in Thurston County, including one within the Black River drainage.

Hatch's click beetles are a State-candidate species. They occur in sphagnum bogs, possibly in drier areas associated with Labrador tea (Xerces Society 2011). Adults are capable of flight and have been found April through June. Little is known about the larvae but they may take several years to develop. Adults feed on honey dew, pollen, nectar, and floral structures. This species is endemic to the Puget Trough region and is known from King County. The primary threats to this species are loss of habitat and loss of connectivity between populations (Kunze, L. 2011, pers. comm.).

Queen Charlotte's copper butterflies are a State-candidate species (NatureServe 2011). They were previously known as the Makah copper butterfly and occur in coastal bogs associated with native cranberry. Their range is from the Yukon Territory south through British Columbia and Washington.

Bog idol leaf beetles (formerly Long-horned leaf beetle) are a State-candidate species that is specifically associated with lowland sphagnum bog habitats and is at risk of extinction due to their limited distribution and isolated populations. The beetles' larvae feed on submerged portions of aquatic plants, whereas adults feed on exposed portions of aquatic plants (White 1983 [cited in Larsen et. al 1995]). Threats are from urban runoff waters that may contain pesticides and other pollutants, and from exotic, nonnative fish that could potentially prey on beetle larvae (Larsen et al. 1995).

Pacific clubtail dragonflies are a State-candidate species. They occur from Washington south through California and east into Idaho. They are found in a variety of aquatic habitats including lakes and slow-moving rivers. Adults fly early June through mid-August. Adults feed on flying insects, whereas larvae feed on invertebrates and possibly small vertebrates. There are currently two known populations in Washington, one on the east side of Black Lake and the other in Skamania County. Larvae require fine-textured substrates for burrowing, and disturbance of appropriate substrates is a key threat. Additional threats include wind- or water-born insecticides, herbicides, and other contaminants (Kunze, L. 2011, pers. comm.).

4.6 Invasive and Nuisance Species

Invasive species are one of the most serious challenges that affect natural resources worldwide. Recent estimates of environmental and economic costs of invasive species in the United States alone

approach $120 billion per year (Pimentel, Zuniga, and Morrison 2005). Invasive plants are plants that have been introduced to the region or U.S. from a different region or country. They may have been introduced intentionally (as an ornamental plant, for example) or accidentally (as a contaminant in crop seeds, for example). Many terms, such as nuisance, noxious, alien, invasive, pest, nonindigenous, are used in referring to nonnative plants and animals. While many nonnative plants are extremely beneficial to society, like rice or potatoes, invasive, noxious, and pest plants spread rapidly and cause or are likely to cause harm to economic, environmental, or human health.

President Clinton signed the Invasive Species Executive Order (EO 13112) in 1999 "to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause." The EO further defines an invasive species as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health" (USFS 2015).

The Refuge encompasses a number of diverse habitat types, all of which are threatened by exotic or invasive plant species. An *exotic* species may be defined as any species occurring in a particular ecosystem or habitat that is not native to that ecosystem or habitat. An *invasive* species may be defined as an exotic species whose introduction is likely to cause economic or environmental harm or harm to human health (USFWS Executive Order 13112). The Washington State Noxious Weed Board maintains an official State list of noxious weeds and each county keeps a more locally prioritized list. Those lists provide guidance to Refuge staff, especially about plant species that are required to be controlled. Some species are more problematic than others on Refuge habitats and some nonnative species are not targeted for control.

The Refuge strives to maintain healthy plant communities to ensure that high quality habitat is available for native flora and fauna, and management of invasive plants is a major strategy. The management strategy utilized is Integrated Pest Management (IPM) (see Appendix G), an ecological approach that uses a number of mechanical, physical, biological, and chemical control methods, including herbicide application, mechanical mowing, haying, selective hand cutting and thatch removal, herbivore grazing, prescribed fire, water control methods, or barrier cloth placement that are minimally detrimental to rare or declining species populations. Preferred methods are those that have the least environmental impact while effectively controlling invasive species. Early detection of new invasions and rapid response is considered critical for cost-effective control and prevention of invasive species from rapidly spreading.

Nonnative animal species are present on the Refuge and threaten native animals, especially rare, sensitive, or listed species, as well as potentially impacting habitats. In 2001, over 42 species of introduced or nonnative species of wildlife (birds, mammals, amphibians, reptiles) were identified in Washington and Oregon, and more species have become established since then (Witmer and Lewis 2001). Many nonnative species have adverse ecological consequences through direct or indirect mechanisms (e.g., resource competition, displacement, predation, hybridization, disease transmission). Management and control efforts are often difficult and costly, and each situation must be assessed on a species- and site-specific basis (Witmer and Lewis 2001).

The establishment of any invasive species has the potential to cause significant ecological and economic damage to the host ecosystem. Invasive species are typically established without the predator they would experience in their native habitats, often allowing their populations to grow rapidly once introduced (Beck 1994).

Some nonnative species have been targeted for greater levels of control effort than others based on budget levels, staffing, perceived threat, and ability to enact effective reduction or control. The following descriptions are for some of the species known to affect the Refuge and the Unit and fish and wildlife populations.

4.6.1 Grays Harbor National Wildlife Refuge

Plants

Spartina (cordgrass species) occurs in the greater Grays Harbor estuary and in Grays Harbor Refuge. Rapid infestation rates likely occur on the West Coast because invertebrate herbivores (leaf-feeders and stem-borers) that naturally control *Spartina* within its native range on the Atlantic coast are not found on the West Coast. *Spartina* clones ultimately grow together to form dense, monotypic stands (meadows) in the mudflats that entrap sediments (~15 cm/yr) at and above mean higher high water. The intertidal mudflats displaced by *Spartina* are important habitat for migratory birds, juvenile fishes, native eelgrass, Dungeness crab, and clams. It also grows in the saltmarshes, rapidly outcompeting native saltmarsh plants and creating monocultures that become undesirable to fish and wildlife (WSAG 2011).

A cooperative agreement between the Service, WDFW, and Washington Department of Agriculture has been very successful in controlling *Spartina* in greater Grays Harbor estuary. This multi-agency partnership has provided funding and assistance in controlling this invasive plant. Surveys are conducted annually for this plant to determine presence, location, and to prioritize treatment (WSAG 2011).

Common reed or *Phragmites* is known from many areas of Grays Harbor estuary, but the infestation in the northern portion of the estuary, including the Refuge, has been the most damaging to native habitats.

This introduced grass grows extremely densely, 10–20 feet high, and outcompetes lower growing native herbaceous plants and shrubs. In the Pacific Northwest, it appears to spread mostly from rhizomatous growth instead of seed dispersal. It is tolerant of fluctuating salinity, is found throughout the temperate regions of the world, and is often found in disturbed areas where inundation is erratic. It flourishes in dredged material disposal sites, roadside ditches, and diked flats. *Phragmites* is known to spread as fast as 6–10 feet per year; thus control of this pest at an early stage is important to prevent widespread infestations.

Phragmites was first noted in 1941 as a small patch on the western tip of Moon Island (Alcorn 1941). A 1991 photo shows it was well established before the Refuge was created in 1990. More recent records show *Phragmites* had spread to sites along State Highway 109, and it had invaded high to mid-salt marsh habitat and upland transition zones adjacent to the airport and boardwalk. There was also a large, disjunct patch near the eastern end of the mudflats along the deep slough. A spray treatment in 1995, followed by manually cutting and treating each spring, took place until 2006, but the plant continued to spread rapidly through the marsh and into the mudflats. A concerted, long-term, cooperative effort with State partners since 2005 has been successful in reducing the *Phragmites* footprint on the marsh and allowing native plants to reestablish. Vigilant monitoring and re-treatment is necessary to ensure it does not again become dense enough to create habitat loss for fish and wildlife.

Japanese (or dwarf or Asian) eelgrass is found in estuaries along the Pacific coast in California, Oregon, Washington, and British Columbia. It is present in the greater Grays Harbor and in the Refuge, spreading across the intertidal mudflats. It appears to be able to grow and survive in mud, with extended periods of air exposure. Generally, Japanese eelgrass occurs higher in the intertidal zone than native eelgrass, *Zostera marina* (Ruesink et al. 2010), and occupies different niches in the intertidal zone (Shafer 2007, cited in Mach et al. 2010). Although the different intertidal ranges of Japanese eelgrass and native eelgrass limit direct competition, when these species do compete for space, in most instances both species are adversely affected.

Whether Japanese eelgrass is a threat to the Grays Harbor ecosystem is debatable. In a review of ecological effects of Japanese eelgrass, Mach et al. (2014) found that studies designed to quantitatively assess the nonnative eelgrass's impacts are limited. However, the available studies suggest that Japanese eelgrass increases overall diversity in both vegetated and unvegetated habitats, while decreasing large infaunal species, such as Manila clam and ghost shrimp when compared to unvegetated habitats. While there were no significant differences to waterfowl and Chinook salmon when Japanese eelgrass replaced unvegetated habitats, waterfowl and fish species seemed to prefer native eelgrass over Japanese eelgrass.

Studies by Lamberson et al. (2011) and Frazier et al. (2014), based on the Yaquina estuary in Oregon, provide a preliminary evaluation of the impacts of Japanese eelgrass on bird use of intertidal habitats. Overall, these studies found that native eelgrass and possibly *Upogebia*/mudflat habitats supported significantly greater bird densities compared to low marsh, *Neotrypaea*/sandflat, and Japanese eelgrass. The Japanese eelgrass beds were used primarily by ducks (mostly mallards), coot, and geese foraging either at mid-tide levels (0.6–1.5 m) when the native eelgrass beds were flooded, or at high tide (1.8 m) when Japanese eelgrass was flooded but shallow. In late winter, the aboveground biomass of Japanese eelgrass died and plants were largely reduced to stubble, and shorebirds foraged both within this habitat and in the adjacent *Neotrypaea*/sandflat habitat without apparent regard to the presence of the stubble. There were no significant differences for any metric of bird use between Japanese eelgrass and *Neotrypea*/sand habitat, which nonnative eelgrass has been supplanting. Thus, there was no evidence that birds will be negatively impacted by the presence of Japanese eelgrass in Yaquina estuary (Frazier et al. 2014). Baldwin and Lovvorn (1994) have shown that Japanese eelgrass is readily fed on and is an important food source for Brant and a variety of dabbling ducks.

Japanese eelgrass is known to cover over bivalves (such as oysters, clams, and mussels) and it may disrupt the bivalve natural system functions. It has been problematic for shellfish growers (WSNWCB 2011). This eelgrass may also trap sediment and become a factor in intertidal mudflats' elevation rise. California and Oregon have been working to remove and prevent the spread of this plant for years. However, up until 2010, Washington had protected all eelgrass species, including both the native and nonnative species. Recent changes in the law allow commercial shellfish growers to legally control it on their lands (WSNWCB 2011). More work is needed to understand the ramifications of this nonnative species.

Knotweed is a collective name for the many introduced species of Japanese knotweed, Himalayan knotweed, giant knotweed, and the hybrid Bohemian knotweed that have invaded the Pacific Northwest. This perennial plant dies back each winter, but spring growth reaches 20–35 feet, overtaking all but tall trees. This aggressive plant grows in freshwater wetlands, riparian areas, high saltmarsh, and brackish water conditions. It rapidly spreads with each high water or flood event which carries it to new locations. This plant can root from any leaf or root node on the stem even

when it is cut up into many small pieces. It appears to have been widely spread along road ways by ROW mowing (Prather et al. 2009). It is currently found and controlled in the high saltmarsh of Grays Harbor Refuge along the Sandpiper Trail boardwalk and on the western point of the peninsula. It is dense along State Highway 109 in the Grays Harbor Public Utility District (GHPUD) ROW and from there has spread into the Refuge. No control of the highway infestation has begun.

Himalayan and evergreen blackberry species are found along forest edges, in uplands, and along the transition zones with wetlands. This plant invades disturbed areas, open areas where low-growing native vegetation exists, and near where seed sources are located. Often this plant is not controlled unless intense restoration is planned. In many areas, this plant is first cut low to the ground, and regrowth is sprayed with herbicide and native plants are installed.

Scotch broom is generally located in upland sites, along ditches, roads, and trails, and has infested areas in the high salt marsh. In most cases, Scotch broom is either cut by hand, mowed, or removed with a weed wrench. Some indicators show that cutting it low to the ground when it is blooming can kill it. Scotch broom seeds can remain viable for more than 50 years in the soil.

Canada thistle and **bull thistle** are located in upland sites but can be found along wetland margins. Deflowering methods are temporary control measures to prevent the spread of seeds. Bull thistle can be manually controlled by cutting the vegetated top from the root at the soil line. Canada thistle grows through rhizomes and is not controlled with cutting. These invasive plants are controlled with herbicides in areas of soil disturbance, initial clearing for restoration, maintenance of past restoration sites, or maintenance of areas where buildings occur or were recently removed (TCNWCA 2013b).

Fish

Little is known about the presence of nonnative fish in Grays Harbor Refuge waters.

Birds

Brown-headed cowbirds forage in open areas and breed wherever small landbirds nest. Historically, they inhabited short-grass prairies of the mid-western U.S., but with development, agriculture, and forest fragmentation, they have expanded their range significantly. Females lay eggs in other birds' nests and leave the rearing to other species. They find nests to parasitize by looking for birds building nests, either by walking along the ground, perching quietly in shrubs or trees, or making noisy flights back and forth, possibly to flush potential hosts. Young cowbirds are at a competitive advantage as they mature faster than other young in the host nest. Over 220 species have been observed supporting brown-headed cowbird eggs in their nests, and at least 144 species have raised brown-headed cowbird young to the fledgling stage, often at the expense of their own young (Seattle Audubon Society 2002). At the Refuge cowbirds have been observed in the salt and brackish marsh and forest habitats.

European starlings have expanded their range westward ever since they were introduced to the east coast of America. At the Refuge they are found in the salt and brackish marsh and forest habitats and flocks can become large. They forage in open areas usually near development. They require nearby nesting cavities and are creative in using crevices in building structures such as plane hangars. Starlings can be aggressive and will persistently harass other species to take over limited numbers of nesting cavities such as natural hollows, old woodpecker holes, and birdhouses (Seattle Audubon Society 2002).

House sparrows were introduced to this country from Europe and are found in settled areas. These sparrows are opportunistic and eat whatever is available. While they are not highly territorial with their own species, they are aggressive toward other species and may drive native birds out of their nests. They typically breed in cavities or crevices in buildings, nest boxes, or other birds' nests, but if they are in an area with no available cavities, they will nest in trees or shrubs, often in small colonies (Seattle Audubon Society 2002).

Mammals

Little information is known regarding invasive or exotic mammals on Grays Harbor Refuge.

Reptiles and Amphibians

Little information is known regarding invasive or nonnative reptiles or amphibians on Grays Harbor Refuge.

Invertebrates

European green crabs were found by WDFW between 1999 and 2003 within the Refuge and on the south side of the airport peninsula (WDOE 2008). The green crab spread to the U.S. west coast around 1989 or 1990, most likely as larvae in ballast water from ships. It is speculated that during the El Niño winter of 1997–1998, ocean currents transported green crab larvae north to Washington State, where the first crabs were found in the summer of 1998. Field observations and laboratory experiments have shown that the European green crab both consumes and competes with a vast array of organisms, including clams, oysters, mussels, snails, and other crabs. The biodiversity of local ecosystems could be affected, with impacts on sensitive species of concern (Holmes 2001).

Most likely, more nonnative species exist in the marine waters and benthic communities, but data for the Refuge is lacking.

Potential New Threats from Nonnative and Invasive Species

Many nonnative and invasive species are present in Washington State and poised to become established on the Refuge. Early detection of new invasions and a rapid response is considered critical for cost-effective control and prevention of invasive species from spreading.

Virginia opossums were found only in Central America and the southeastern United States prior to European settlement. During the 1900s, their range expanded northward and westward and first arrived in Washington in the early 1900s as pets and novelties. Some of these animals, or their offspring, later escaped from captivity or were intentionally released. With few natural predators, the absence of hunting, and an abundance of food and shelter, opossums have adapted well to living close to people in urban and suburban environments. Except for higher elevations, opossums now occupy most human-occupied habitats in western Washington. These animals are most likely present in or near Grays Harbor Refuge.

Eastern cottontails were introduced to several areas in Washington as a game animal beginning in the 1930s. They often are associated with Himalayan blackberry thickets which provide them with a secure hideout to foray out at dawn and dusk or other shrubby cover areas. No rabbit is native to the west side of the Cascades. These animals are most likely present in or near Grays Harbor Refuge.

4.6.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Plants

Reed canarygrass is the most threatening and major invasive plant problem on the Unit. It is a cool-season, sod-forming, wetland grass native to the northern temperate regions of Europe, Asia, and some parts of North America. Its use in the Pacific Northwest began in the late 1800s. Farming followed logging operations and reed canarygrass was often used to stabilize rough logging areas as it was extremely productive, easy to establish, and persisted very well. No other forage plant is as well adapted to wet, marshy areas as reed canarygrass. It can withstand flooding and can tolerate continuous inundation for as long as 60–70 days without permanent injury (possibly longer depending on temperature, current, and silt content of the water). It thrives along stream banks, wet meadows and pastures, wetlands, roadside ditches, river levees and dikes, drainages, and floodplains. Although wet areas in full sun are preferred, reed canarygrass is also very drought tolerant and able to withstand high degrees of variability in soil type, PH levels, fertility, temperature, and exposure (Tu 2004, Kilbride and Paveglio 1999).

Unfortunately, reed canarygrass has proven to be very aggressive in the Pacific Northwest. It moves out of pastureland and into stream bottoms, wetlands, and canal banks and persists where it is not desirable. Reed canarygrass can outcompete most native species, threatening natural wetlands by forming large, single-species stands. It has limited value to wildlife. Limited foraging occurs from deer and elk while it is young and tender, however, they do not continue to graze on it when it grows tall and coarse. It grows so densely that it inhibits movement of small mammals, waterfowl, amphibians, and reptiles. It causes increased siltation in slow-moving creeks and rivers. It produces large amounts of pollen and other grasses; pollen from reed canarygrass is easily airborne and is moderately allergenic to humans. Once established, reed canarygrass is very difficult to control because it spreads rapidly by rhizomes, seeds, and is so adaptive (Tu 1974, WDOE 2015a, TCNWCA 2013a).

This difficult pest has long dominated the Puget lowlands and is a serious threat to the Black River channel and tributary habitats and to the animals that depend upon this habitat. It is solidly established along the river edge growing out from the river banks and overtaking all open, sun-warmed, muddy bank sites that are so important for animals to bask in and rest. The river edge has become a dense, tall, grass monoculture instead of a diverse plant community of flowering plants. It has rooted on the abundant woody debris in the river. In the northern portion of the Unit between the pipeline and 110th Avenue, it has shown an ability to root on top of submerged native plants in the river channel and spread across to root on the banks. In the northern segments of the river, it has obscured the shallow river channel, choking water flow, impeding sunlight penetration, and preventing canoe access. It has significantly changed the wetland vegetative community of the Black River area.

Poison hemlock's entire plant structure is toxic to humans and animals. It grows in both uplands and moist sites. Ongoing efforts to control this species have been successful and only a few small, resilient patches persist. For those sites where manual control is difficult, an appropriate herbicide has been used.

Purple loosestrife is identified throughout the U.S. as an invasive wetland marsh plant and has been found in many locations along the Refuge. The Thurston County Noxious Weed Agency has worked

diligently to control it for years, and recently the Billy Frank Jr. Nisqually Refuge Weed Warriors have taken up the challenge and continue the work to control it by hand digging. Although the control work has gone on for years, the seed bank allows plants to come up every year. Herbicide spot treatment is used judiciously on difficult-to-reach purple loosestrife plants. Bio-control beetles have been successful in helping to control large loosestrife populations in Oregon, but most likely would not be effective on the few plants that pop up each year on the Unit.

Yellow flag iris is a nonnative, ornamental flowering bulb that has escaped cultivation into wetland marshes, river channel edges, and wetland shrub-scrub. It forms dense clumps and thick mats of bulbs in freshwater wetlands and can tolerate brackish conditions. Its large seed pods float and spread viable seeds downstream to produce additional plants. Fragmented roots and bulbs rip off during high water events or can be torn out by animals and become new plants. Control of this species along the river will be difficult as the river banks are unstable muck that supports floating mats of reed canarygrass, shrub roots, and iris bulbs. Controlling the spread of this plant is dependent on annually removing seed pods before they are released into the river and treating with a wetland-approved herbicide using a cut-stump technique.

Wild chervil used to occur in a large infestation off 118th Avenue (originally about 15 acres) but is nearly gone as of 2012 and is closely monitored.

Tansy ragwort is occasionally found in dry, open areas or on margins of forest. A history of control has reduced the amount of ragwort to a very small level, and control efforts are ongoing annually.

Holly is generally found in uplands. It is a popular ornamental shrub or tree that has escaped and birds spread seeds by eating the fruit. Small plants can be pulled or dug with good results. In the past, larger specimens were cut (flowers and fruits are bagged and removed), but because of the cut stem's ability to successfully develop roots and survive, they are now girdled and herbicide is painted onto the stripped area.

Himalayan and evergreen blackberry species are described in the Grays Harbor Refuge section (4.6.1). On the Unit, blackberry is also found in upland mixed forests, riparian forest edges, dry nonnative grasslands, and open areas.

Canada thistle and **bull thistle** are described in the Grays Harbor Refuge section (4.6.1).

White watercress is a "naturalized" submerged plant that is densely growing in the river channel, especially north of 110th Avenue. Its thick growth should be examined regarding its possible impact on the waterway. Some of the factors most likely related to the growth are increased nutrient levels, decreased pressure from healthy native populations, increased sedimentation or water temperatures, and decreased predation (Seery, M.J. 2012, pers. comm.). Unimpeded growth of nonnative, submerged plants chokes water flow, impedes sunlight penetration, changes the natural conditions of the river and stream channels, limits animal (e.g., amphibian and fish) movement, and outcompetes native submersed plants (WDOE 2015b).

Fish

Nonnative fish are widespread in the Black River and, unlike the native fish, they are warm-water species. They have been introduced most likely for sport fishing and include American shad, brown

bullhead, pumpkinseed, bluegill, rock bass, largemouth and smallmouth bass, black crappie, yellow perch, northern pikeminnow, and others (Creveling et al. 1980, Kunze, L. 1996b. pers comm.).

Nonnative fish presence alters natural habitats and conditions for native animals sharing the same locations. Most nonnative, warm-water fish (or spiny-ray) are predatory on native fish, amphibians, and invertebrates. Their presence changes (and most likely reduces) native fish, amphibian, and invertebrate populations. In addition, nonnative fish compete for and most likely reduce prey resource availability for native fish and amphibians. These fish may be especially deleterious to the populations of endemic Olympic mudminnow, the State-listed as endangered and federally listed as threatened threatened Oregon spotted frog (in every life phase), State candidate species Pacific clubtail dragonfly (egg, nymph, and naiad stages), and other sensitive species, and the prey resources they need to survive.

Birds

Brown-headed cowbirds are described in the Grays Harbor Refuge section (4.6.1).

European starlings are described in the Grays Harbor Refuge section (4.6.1).

House sparrows are described in the Grays Harbor Refuge section (4.6.1).

Mammals

Eastern gray squirrels were introduced in Washington in the early 1900s and have been repeatedly released in parks, campuses, estates, and residential areas and are adept at taking over cavities and bird houses. They are now the most common squirrels in urban and some rural areas, such as around the Unit.

The increasing number of introduced Eastern gray squirrels is often said to be responsible for the decrease in Douglas squirrels in certain areas. However, given that these squirrels have different food and shelter preferences, it is likely that increasing housing and other development and loss of coniferous forests is responsible for some of the decline in Douglas squirrel populations (Link 2004).

Nutria are semi-aquatic rodents native to southern parts of South America. In the 1930s, they were sold throughout North America to fur farmers and as a means of controlling unwanted aquatic vegetation. Various associations, magazine and newspaper articles, and demonstrations at county fairs promoted the sale of nutria in Washington. More than 600 nutria farms existed in Oregon and Washington from the 1930s to the 1950s. Flooding and storms damaged holding structures, allowing nutria to escape. Farmers also released their stock when nutria farming became uneconomical. By the 1940s, nutria were present on both sides of the Cascade Mountains in Washington (Link 2004).

Nutria generally occupy a small area throughout their lives. Daily travel distances for most nutria are less than 600 feet, although some individuals may travel much farther (Link 2004). Nutria are suspected to occur on the Unit based on observations of feeding platforms and clipped vegetation floating in the water. Nutria skulls found on the Unit in 2012 confirmed this animals' presence.

Virginia opossums are described in the Grays Harbor Refuge section (4.6.1). These opossums are found on the Unit.

Eastern cottontails are described in the Grays Harbor Refuge section (4.6.1). This rabbit species is found on the Unit.

Reptiles and Amphibians

Red-eared sliders are native to the southern midwestern U.S. In Washington, this turtle occurs in the Puget lowlands (Brown et al. 1995, Dvornich et al. 2001). Red-eared sliders compete with indigenous species for food and basking sites (Frank and McCoy 1995, Williams 1999, Salzberg 2000). Red-eared sliders seem to be adaptable to many climates. This, combined with their omnivorous diet and ability to adapt to various habitats, gives them great potential for altering native habitats should reproducing populations become established. In Washington, they are a potential threat to *Clemmys marmorata*, the Pacific pond turtle (Williams 1999), a declining species endemic to the Pacific states (Brown et al. 1995).

Bullfrogs are native to the eastern and midwestern U.S. and southeastern Canada. They have been introduced to most of western North America and to Washington by the early 1930s to provide opportunities for frog hunting, food, and stock for frog farms. The bullfrog is the largest true frog in North America, measuring 8 inches in length, and lives nearly 10 years. Bullfrogs can leap up to 3 feet, cross pastures and grasslands, and may travel overland up to 1 mile. This mobility allows them to expand their range from the location where they were introduced. The large number of eggs (10,000 to 20,000) in each egg mass laid by the females allows bullfrogs to quickly establish themselves within a new territory. In the Pacific Northwest, tadpoles usually take 2 years to mature, thus they require year-round water (Corkran and Thoms 1996).

In Washington, bullfrogs thrive in the warm waters of natural and man-made ponds, marshes, sloughs, reservoirs, and sluggish irrigation ditches and streams. Disturbance and development around wetlands often create warmer conditions. Bullfrogs tolerate polluted and muddy waters better than most native frogs and may be found within cities in wetlands, reservoirs, and stormwater ponds (Corkran and Thoms 1996, Link 2004).

Large populations of this species are believed to have contributed both directly and indirectly to the drastic decline of native amphibians and reptiles. Bullfrogs are much larger than native frogs and have few predators in Washington. Adult bullfrogs usually are "sit and wait" predators that readily attack almost any live animal smaller than themselves—insects, frogs, tadpoles, fish, small snakes, turtle hatchlings, newts, salamanders, rodents, bats, hummingbirds, ducklings, and birds up to robin size (Link 2004, McKercher and Gregoire 2012). Large multi-year larvae (in Washington) can have a significant affect upon benthic algae, and thus perturb the aquatic community structure (McKercher and Gregoire 2012).

The effects of bullfrogs on Oregon spotted frog populations have been “disastrous” for the spotted frog according to Leonard et al. (1993). “It is widely believed that bullfrog predation is largely responsible for the disappearance of the spotted frog in the Puget Sound lowlands of western Washington and Willamette Valley of western Oregon.” The authors strongly suggest “land management agencies need to look seriously at limiting further introductions and methods of reducing or eliminating bullfrogs from more environmentally sensitive habitats” (Leonard et al. 1993).

Invertebrates

There are no known nonnative invertebrates within the Black River Unit.

Potential New Threats from Nonnative and Invasive Species

Several plant species from the Washington State and Thurston County noxious weed lists are likely to become threats to the Black River Unit. A few of them are described below.

Knotweed (Japanese, Bohemian, Himalayan, giant knotweed, or hybrids) is likely to be found infesting Unit habitats in the watershed. This aggressive, perennial plant dies back each winter; spring growth reaches 10–20 feet high and it overtakes all but tall trees. It seems to grow almost anywhere there is sunlight. It grows in moist conditions along wetlands, along the edges of riparian and mixed forests, and is aggressive in dry grasslands, old pastures, and open areas. Knotweed spreads with each high water or flood event, which carries pieces of the plant to new locations where they can root. This plant successfully roots from any leaf or root node on the stem, even when it is broken or cut into many pieces. High water, flood events, mowing, and careless cutting are known to enhance its ability to spread (King County 2013). It has been found within the Unit acquisition boundary (Thurston County 2013), but is not on currently on Service-owned parcels.

Hydrilla, Brazilian elodea, variable-leaf (Eurasian) milfoil, fanwort, parrotfeather, nonnative bladderwort, and other submersed aquatics are serious threats in Unit waterways, especially because some have been found in other parts of the watershed. Although it is not known if any of these species infest Unit waters, Eurasian milfoil occurs in Black Lake, which is linked to the headwaters of the Black River. Downstream from the Black River, in the Chehalis River, a large Brazilian elodea infestation that extended 6 miles was recently controlled by Thurston County.

4.7 Biotic Responses to Climate Change

Existing and strengthening evidence shows changing climatic conditions have affected, and will continue to affect, many biotic communities (Parmesan 2006, Rosenzweig et al. 2008, Geyer et al. 2011). Projections of continued and likely accelerating changes in temperature and precipitation are well supported, especially at global scales (see Section 3.2.4). However, at our current level of understanding, it is difficult to assess near-term biotic responses to changing climatic conditions at specific locations because of the inherent spatial and temporal complexity of ecological systems, coupled with short- and long-term weather pattern variability (Akçakaya et al. 2006, Parmesan et al. 2011). Compared to present-day conditions, most climate-related effects likely will not be detectable during the 15-year timeframe of this CCP, at least to document changes outside the wide, “normal” inter-annual range of expected physical conditions in the Pacific Northwest region. However, the seriousness of potential, long-term, climate-change-induced impacts to Refuge ecological resources warrants their assessment and inclusion in relevant planning efforts (USFWS 2010d), including this CCP.

4.7.1 Grays Harbor National Wildlife Refuge

Several climate-related factors may impact the Refuge’s estuary and upland habitats. In particular, species (especially shorebirds) that rely on low-elevation, intertidal habitats are vulnerable to the substantial habitat loss projected due to sea level rise in the Pacific Northwest (Glick et al. 2007).

The nearer-term factors of most importance to the Grays Harbor estuary include rising sea level and increased prevalence of invasive plants and animals. Over time, other climate-induced changes could substantially affect Refuge environments. Effects could include altered food availability resulting from physical changes in ocean and estuary waters; increasingly intense outbreaks of insects, diseases, and pathogens; and range shifts or phenological changes that disrupt plant and invertebrate community structure.

Following are brief discussions of those climate-related impacts most relevant to the habitats and ecological communities at Grays Harbor Refuge. Details concerning historic and projected climate change effects to the physical environment are provided in Chapter 3. Additional background regarding general responses of biotic communities to climate change is available in Littell et al. (2009), Tillmann and Siemann (2011), and National Fish, Wildlife and Plants Climate Adaptation Partnership (2012).

Effects to Estuary Habitats

Sea Level Rise. Potential impacts from sea level rise to the Refuge's estuary habitats are critical to assess because a primary Refuge purpose is to provide habitat for shorebirds. At Grays Harbor, the large expanses of intertidal mudflats provide important foraging and roosting areas for migrating and over-wintering shorebirds. These intertidal habitats are extremely vulnerable to even small increases in relative sea level.

At the Refuge, the impacts of changing sea level will depend on the relative rates of sea level rise vs. sediment accretion. Unfortunately, current projections of future sea level change at Grays Harbor are largely uncertain. Changes in absolute sea level are difficult to measure because of the complexity and variability of regional ocean conditions in the northeastern Pacific Ocean, in addition to yet-unknown contributions from vertical land movements along the southwestern Washington coast.

Sediment accretion at the Refuge also is uncertain. There is recent evidence that tidal salt marsh is actually expanding (soil elevations are increasing) within the Refuge, possibly caused by altered tidal flows within Bowerman Basin and/or increased sediment loads associated with maintenance dredging of the nearby Grays Harbor shipping channel (see Chapter 3). This potential expansion of tidal marsh vegetation is a current management concern to the Refuge because it may be reducing the extent of intertidal mudflats available to shorebirds. However, this same elevation increase might mitigate potential future sea level rise.

Invasive Species. Controlling the extent of nonnative invasive plants, such as *Spartina* and *Phragmites*, is a major, ongoing Refuge management activity to maintain the quality and functioning of estuary habitats. The recent establishment of other invasive species, such as Japanese eelgrass, in Refuge subtidal and intertidal habitats is a potential management concern (Mach et al. 2010). Increased air and water temperatures, altered precipitation amounts and seasonality, and other factors associated with climate change will exacerbate the occurrence and prevalence of invasive plant and animal species (Hellman et al. 2008, Rahel and Olden 2008, Willis et al. 2010). Information on the current occurrence and/or prevalence of invasive animals (e.g., fish, crabs, mussels, snails) at the Refuge is lacking, but the threats associated with these potential invasive species are large, and changes in their future distribution and abundance as a result of climate change could have strong management implications.

Effects to Upland Habitats

Relative to estuary habitats, near-term climate-related impacts to Refuge upland (forest) habitat likely will be minimal. The Refuge's forest species have low vulnerability to projected climate change (Aubry et al. 2011) because of the generally muted changes in temperature and precipitation projected for the Grays Harbor area (Mauger and Mantua 2011).

Changes in temperature and precipitation likely will cause some level of physiological stress that will affect forest health (Vose et al. 2012). The greatest threat is the increased risk for insect and pathogen outbreaks potentially resulting from new range expansions, as well as greater susceptibility to existing insects and pathogens (Ryan and Vose 2012). However, great uncertainty exists because of the complex interactions of insects, pathogens, hosts, and climate (Kliejunas 2011).

Similar to estuary habitats, climate change may exacerbate occurrence and prevalence of nonnative invasive plants that could alter species composition and expected forest community succession (Shafer et al. 2010). Also, any substantial sea level rise likely will cause greater saltwater intrusion into the groundwater that currently supports Refuge forest habitats (Brown and Newcomb 1963, Chang and Jones 2010).

Other Potential Long-term Climate Change Effects

Over time, many additional climate-related factors could impact Refuge biota, including:

- Ocean chemistry and sea surface temperature. Increased acidification has already affected oyster larvae survival in coastal Washington (Washington State Blue Ribbon Panel on Ocean Acidification 2012). Virtually all major biological functions of marine organisms–especially photosynthesis, respiration rate, growth rates, calcification rates, reproduction, and recruitment–are sensitive to increased ocean acidification (Doney et al. 2009). Projected increases in sea surface temperatures for the northeastern Pacific Ocean could impact biotic productivity (Overland and Wang 2007, Bograd et al. 2008) and also result in increased occurrence of harmful algal blooms (see Huppert et al. 2009).

- Intensity of ocean waves and storms. Projected increases in intensity and frequency of storms and wave heights along the Pacific Northwest coast may have lesser impacts to the more-protected inland portions of Grays Harbor. However, greater connection to ocean currents resulting from maintenance of a shipping channel (i.e., jetties and channel dredging) might exacerbate potential storm effects, potentially resulting in increased erosion of intertidal mudflats (Huppert et al. 2009).

- Range shifts and altered phenology of plants and animals. Warming temperatures and changing ocean currents likely will alter the seasonal productivity and availability of food resources, potentially causing a phenological decoupling for the animal species reliant on primary production (see Tillmann and Siemann 2011).

- These potential impacts to the marine environment and food web may negatively affect Refuge resources such as shorebirds and salmonids.

4.7.2 Black River Unit

Several climate-related factors may impact the Refuge's aquatic and upland habitats. In particular, species (especially amphibians) that rely on wetland, riparian, and aquatic habitats are vulnerable to many climate-change-related effects in the Pacific Northwest (Lawler et al. 2008).

The nearer-term factors of most importance to Black River Refuge include increased prevalence of invasive plants and animals, as well as further-altered hydrology (e.g., stream flow, water temperature) within the Black River watershed. Over time, many other climate-induced changes could affect Refuge environments—these include more-intense outbreaks of insects, diseases, and pathogens; and range shifts and/or phenological changes that disrupt plant and invertebrate community structure.

Following are brief discussions of those climate-related impacts most relevant to the habitats and ecological communities at the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge. Details concerning historic and projected climate change effects to the physical environment are provided in Chapter 3. Additional background regarding general responses of biotic communities to climate change is available in Littell et al. (2009), Tillmann and Siemann (2011), and National Fish, Wildlife and Plants Climate Adaptation Partnership (2012).

Effects to Aquatic Habitats

Invasive Species. Controlling the extent of nonnative and invasive plants, such as reed canarygrass, yellow flag iris, and purple loosestrife is a major, ongoing Refuge management activity to maintain the quality and functioning of aquatic habitats. Other invasive/introduced species, including aquatic plants (e.g., hydrilla, Brazilian elodea, Eurasian milfoil), algae, warm-water fish (e.g., northern pikeminnow, bullhead, bass, crappie), bullfrogs, and invertebrates (e.g., New Zealand mudsnails, red swamp crayfish), are or may be present within Unit habitats. Increased air and water temperatures, altered precipitation amounts and seasonality, and other factors associated with climate change likely will exacerbate the occurrence and prevalence of invasive plant and animal species (Hellman et al. 2008, Rahel and Olden 2008, HDR Alaska 2009, Willis et al. 2010). This may be particularly important regarding future management activities for Oregon spotted frogs. Invasive plants (especially reed canarygrass) and bullfrogs already are substantial threats to these frogs, and any additional impact from climate-enhanced invasive species populations would require greater management effort to maintain and enhance the Refuge's Oregon spotted frog population.

Hydrological Changes to the Black River Watershed

The hydrology of the upper Black River watershed has already been impacted by anthropogenic alterations (see Chapter 3). These changes have affected water quality and quantity, and ultimately the Unit's biological resources.

Climate change effects within the rain-dominated Black River watershed likely will be muted during the next few decades. However, projections for reduced summer (low) flows and increased air temperatures would undoubtedly impact water temperature and quality. Even these muted impacts likely would exacerbate algal blooms (Kundzewicz et al. 2007) and the prevalence of invasive plant and animal species (see above). Increased stream temperatures also could negatively affect salmonid use of the Black River as well as its tributaries (Mantua et al. 2010, Isaak et al. 2012). These same

climate impacts have been associated with increased infectious disease occurrence and resulting population declines in amphibians (Blaustein et al. 2012).

As described above for invasive species, any further degradation of hydrologic conditions would pose additional threats to priority Unit resources such as Oregon spotted frogs and Olympic mudminnows.

Effects to Upland Habitats

Relative to riverine habitats, near-term climate-related impacts to Unit upland habitats likely will be minimal. The Unit's forest species have low vulnerability to projected climate change (Aubry et al. 2011) because of the generally muted changes in temperature and precipitation projected for the Black River watershed (Mauger and Mantua 2011). The Unit's dry, nonnative grassland habitats are already greatly altered, and the plant species composition there likely is resilient to near-term projected changes in precipitation and air temperature (IPCC 2007:11).

Changes in temperature and precipitation likely will cause some level of physiological stress that will affect forest health (Vose et al. 2012). The greatest threat is the increased risk for insect and pathogen outbreaks, potentially resulting from both new range expansions as well as greater susceptibility to existing insects and pathogens (Ryan and Vose 2012). However, great uncertainty exists because of the complex interactions of insects, pathogens, hosts, and climate (Kliejunas 2011).

Similar to aquatic habitats, climate change may exacerbate occurrence and prevalence of nonnative invasive plants that could alter species composition and expected forest community succession (Shafer et al. 2010). Also, drier and warmer summer weather could increase occurrence of wildland fires (Climate Impacts Group 2004), which could affect forest composition and regeneration as well as grassland forage availability.

Other Potential Long-term Climate Change Effects

Over time, many additional climate-related factors could impact Unit biota. For the Black River watershed, the most important might be range shifts and altered phenology of plants and animals. Warming temperatures and altered precipitation patterns may alter many processes, including leaf unfolding, flowering, insect emergence, and the arrival of migratory birds (see Tillmann and Siemann 2011).

4.8 Wildlife and Habitat Research, Inventory, and Monitoring

4.8.1 Wildlife and Habitat Research and Monitoring Efforts

Grays Harbor National Wildlife Refuge

Many collaborative research and monitoring projects have been conducted at Grays Harbor Refuge since it was established. The Refuge routinely partners with other Service programs, other Federal and State agencies, NGOs, and universities.

Table 4-2a. Grays Harbor Research, Inventory, and Monitoring Projects (past and current)

Wildlife Surveys	Year/Season(s)	Active	Emphasis
Shorebirds Ground Survey	1988–present Spring Migration	Yes	Area: Refuge and sometimes Bottle Beach State Park Timing: Spring migration Data/Results Availability: Monitoring, Refuge records Emphasis: See Goal 4 Survey maintained and conducted by staff and volunteers. Surveys to estimate numbers and species of shorebirds using Refuge habitats during northbound migration.
Christmas Bird Count	Annually December	Yes	Area: Official Audubon Grays Harbor Count Circle (includes the Refuge) Timing: December Data/Results Availability: Monitoring, Audubon records Emphasis: See Goals 3 and 4 Nationwide monitoring program run by Audubon, volunteer surveyors, and Refuge staff.
Red Knot Research	2006–present Spring Migration	Yes	Area: Grays Harbor estuary, Refuge, and Willapa Bay Timing: Annual spring migration Data/Results Availability: Research, Publications on internet Emphasis: See Goals 3 and 4, Biologist Joe Buchanan working on red knots since 2006 has investigated knot migration, habitat use, foraging, and roosting sites. Abundance estimation by observing flagged red knots originating from Mexico is also ongoing. Observations of knots on the Refuge are passed on to researcher.

Wildlife Surveys	Year/Season(s)	Active	Emphasis
Point Blue Conservation Science's winter shorebird survey of Grays Harbor Greater Estuary and Refuge	2012–2014	Yes	Area: Greater Grays Harbor estuary and Refuge. Who: Cooperate with Point Blue Conservation Science Timing: Annually November 15–December 15 Data/Results Availability: on Point Blue/PRBO online electronic data website and Refuge produced project reports for 2012 and 2013. Emphasis: Cooperate with the Pacific coast monitoring effort to provide wintering shorebird habitat and bird use data.
Shorebirds Aerial Survey	1999–2004 Peak Spring Migration	No	Area: Greater Grays Harbor estuary and Refuge Timing: Staff estimates of peak spring migration Data/Results Availability: Monitoring, Refuge records Emphasis: See Goals 3 and 4 Flights provided a "snapshot" of the numbers of shorebirds using greater Grays Harbor estuary and shoreline during peak spring migration. Data were more valuable that localized Refuge surveys. Discontinued because of lack of funding.
Avian Ground Survey	2001–2002	No	Area: Refuge Timing: Once a month for the year Data/Results Availability: Monitoring, Refuge records Emphasis: See Goal 4 An intense 1-year effort by Refuge staff and volunteers to survey all birds using upland and marsh habitats to better understand habitat use.
Brown Pelican Aerial survey	2010	No	Area: Greater Grays Harbor estuary and Refuge Timing: One time only Data/Results Availability: Survey, Willapa records Emphasis: See Goals 3 and 4 Willapa NWR biologist survey of Willapa and greater Grays Harbor. Discontinued with loss of funding and delisting.

Wildlife Surveys	Year/Season(s)	Active	Emphasis
Waterfowl Aerial survey	1993–2003 Monthly in fall and winter	No	Area: Greater Grays Harbor estuary and Refuge Timing: Once a month November, December, January, February Data/Results Availability: Monitoring, Refuge records Emphasis: See Goal 4 Monthly aerial surveys gained information on waterfowl and waterbird use of the entire Grays Harbor estuary, as well as the Refuge. Flight occurrence ranged from two to four surveys depending upon funding availability. The January flight was also the Service's Mid-winter Waterfowl Survey. Discontinued all but the January flight because of funding loss and changing emphasis.
Waterfowl Ground survey	1993–2010 Monthly to bimonthly November to February	No	Area: Refuge Timing: Once a month November, December, January, February Data/Results Availability: Monitoring, Refuge records Emphasis: See Goals 4 Monthly ground surveys of the Refuge were conducted to gain understanding of waterfowl habitat use of the Refuge during the winter season. Discontinued due to lack of staff and changing emphasis.
Habitat and Invasive Species Monitoring			
Phragmites Monitoring and Treatment	2005–present Annually	Yes	Area: Refuge Timing: Summer monitoring, fall treatment Data/Results Availability: Monitoring/Treatment, Refuge records Emphasis: See Goals 1, 2, 3, and 4 WDFW and WSAG partnerships are important to this control effort.
Spartina Monitoring and Treatment	2005–present Survey ~ 1+ times during the growing season	Yes	Area: Greater Grays Harbor estuary and Refuge Timing: Three monitoring rounds of the estuary with treatment. Starts early spring and runs until fall. Data/Results Availability: WSAG annual reports, online

Wildlife Surveys	Year/Season(s)	Active	Emphasis
			Emphasis: See Goals 1, 2, 3, and 4 Coordination with the Service's WFWO, the Refuge, WDFW, and WSAG has resulted in excellent control and up-to-date monitoring for invasive *Spartina* species.
Knotweed Monitoring and Treatment	Annually since 2003	South side-Yes. North side-No	Area: Refuge Timing: summer monitoring, fall treatment Data/Results Availability: Monitoring/Treatment, Refuge records Emphasis: See Goals 1, 2, 3, and 4 The **South** side of the Refuge has been controlled as needed, treatment sites mapped and progress documented. The **North** side of the Refuge infestation comes off the GHPUD ROW. Need to coordinate with GHPUD to cooperatively control knotweed.
Research or Formal Studies			
Estuary and Climate Change	2013–2014	Yes	Area: Refuge Timing: 2013–2014 Data/Results Availability: Research, USGS in progress Emphasis: See Goals 2, 3, and 4 Establish baseline bathymetry, vegetation, tidal inundation conditions of the Refuge salt marshes. This data will be used to model sea level rise conditions and investigate how it impacts wildlife and the vegetation community.
Powerline Avian Study	2005–2008	No	Area: Refuge Timing: Year-round study, actual field work was 2 yrs. Data/Results Availability: Study, Refuge records Emphasis: See Goal 4 Study to determine if waterfowl, shorebird, passerines, or raptors were negatively impacted by newly installed, tall powerlines along the north side of Refuge and along State Highway 109. A limited-time study.
Shorebirds	Spring Migration	No	Area: Pacific Coast Flyway from Central American to Alaska, including the greater

Wildlife Surveys	Year/Season(s)	Active	Emphasis
			Grays Harbor estuary and Refuge Timing: Spring Migration Data/Results Availability: Research, Publications on internet Emphasis: See Goals 3 and 4 Past research on long distance migration of western sandpipers, dowitchers, and dunlin by N.Warnock, J.Takekawa, and M.Bishop.
Shorebirds	Varies	No	Area: Greater Grays Harbor estuary and Refuge Timing: Variable depending on project Data/Results Availability: Research, Publications on internet Emphasis: See Goals 3 and 4 Past shorebird research on diet, foraging, and habitat use of the estuary by J. Buchanan, and S. Herman, J Bulger.
Multiple Research Projects over time	Varies	No	Area: Greater Grays Harbor estuary and Refuge Timing: Variable depending on project Data/Results Availability: Research, Publications on internet Emphasis: See Goals 3 and 4 Many important research projects have been conducted over time in both the greater Grays Harbor estuary and the Refuge. Specifically, S. B. Nightengale, C. Simenstad, D. Eggers, R. Thom, K. Radedeke, and many others. A wide range of projects on conditions that affect the greater estuary and what is now the Refuge. Reports and publications often include detailed information on natural history of fish, birds, invertebrates, and habitats.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Baseline inventory and ongoing monitoring is needed at many levels at the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge. Scientific research is needed to understand the changes and implications of mudflat sedimentation rates and the effects on shorebirds and food webs and to better understand predicted changes in sea level rise. (See Goals 1, 2, and 4 for detailed information).

Table 4-2b. Black River Unit Research, Inventory, and Monitoring Projects (past and current)

Wildlife Surveys	Year/Season(s)	Active	Emphasis
Oregon spotted frog egg survey	2001–present	Yes	Area: Black River Unit Timing: Spring breeding season, annually Data/Results Availability: Monitoring, Unit records Emphasis: See Goals 1, 3, 4 Annual egg mass counts are conducted on Unit lands by Unit staff, volunteers, and partnering agencies to estimate Oregon spotted frog population size, habitat preference, and habitat quality.
Oregon spotted frog egg removal for new population establishment	2008–2012	No	Area: Black River Unit Timing: Early spring, annually Data/Results Availability: Species augmentation, Unit and WDFW records Emphasis: See Goal 4 Specific numbers of Oregon spotted frog eggs were removed for offsite rearing in support of WDFW project to introduce Oregon spotted frogs into a different watershed.
Waterfowl Survey	2002	No	Area: Black River Unit 123rd Area Timing: February and March Data/Results Availability: Baseline Survey, Unit records Emphasis: See Goal 1, 3, and 4 Unit staff conducted winter surveys early in land acquisition stage of the Unit.
Secretive marshbird survey	2003	No	Area: Black River Unit, River corridor from 123rd north 2.5 miles Timing: April, May, June Data/Results Availability: Baseline survey, Unit records Emphasis: See Goals 1, 3, 4 Survey conducted to better understand secretive marshbirds and habitat use along the river.
Bat roost survey	2003–2004	No	Area: Black River Unit 123rd Avenue Area

Wildlife Surveys	Year/Season(s)	Active	Emphasis
			Timing: Summer Data/Results Availability: Baseline observation, Unit records Emphasis: See Goal 4 Two summers of bat flight/echolocation call surveys conducted in an old barn.
Newly acquired parcel surveys	2001–2002	No	Area: Black River Unit Timing: As parcels were acquired Data/Results Availability: Baseline observations, Unit records Emphasis: See Goal 4 Unit staff recorded wildlife observations on newly acquired parcels for 1 year to better understand management needs.
Seasonal wetland habitat management using herbivores	2008–2010	No	Area: Black River Unit Timing: Year-round Data/Results Availability: Unit records Emphasis: See Goals 1, 3, 4 Cattle were used as management tools to control rank, invasive reed canarygrass growth and enhance Oregon spotted frog egg-laying conditions. Private, NGO, and agency partners cooperated on this project.
Plant species list development	1995	No	Area: Black River Unit Timing: Opportunistic Data/Results Availability: Baseline survey, Unit records Emphasis: See Goals 1, 2, 3, and 4 Unit volunteers created species list (with wetland affiliation) and herbarium records early in Unit development. The data has been used to understand habitats in the Unit. Additional species added as observed.
Research or Formal Studies	**Year/Season(s)**	**Active**	**Emphasis**
Oregon spotted frog	1990–present	No	Area: Black River Unit Timing: Variable dependent on research Data/Results Availability: Available on internet, Unit records Emphasis: See Goals 1, 3, and 4 A number of research studies have been conducted by partners, including WDFW biologists related to the Oregon spotted frog's natural history, habitat usage,

Wildlife Surveys	Year/Season(s)	Active	Emphasis
			movement, and potential disease exposure in the floodplain of the Black River and its tributaries.
Flow Direction Hydrology Study	2003	No	Area: Black River Unit, the river, north of the pipeline location Timing: Winter and spring Data/Results Availability: Report available on internet, Unit records Emphasis: See Goals 1, 3, and 4 Hydrologists conducted a limited study to examine Black River water origin, flow, direction, speed, physical barriers and changes, water loss to the river, and changes to natural conditions surrounding the headwaters.
Malformed frog contaminant study	2002–2003	No	Area: Black River Unit Timing: Summer Data/Results Availability: Baseline observation, Unit and Service's WFWO records Emphasis: See Goal 4 In response to a nationwide amphibian health concern, 2 years of surveys were conducted on red-legged frogs to determine the prevalence of physical deformation as a method to determine gross levels of potential wetland contaminants that looked abnormal. Surveys conducted in partnership with the Service's WFWO.
History of habitat changes in Black River floodplain	2008	No	Area: Black River Unit - floodplain Timing: Spring and summer Data/Results Availability: Formal publication for WDNR, Unit copy Emphasis: Research to understand habitat changes occurring in the Black River floodplain since early European arrival and establishment. Includes portions of the Unit
Wild chervil control project	2003	No	Area: Black River Unit Timing: Summer and fall Data/Results Availability: Unit records Emphasis: See Goals 2, 3, and 4 The Unit worked with the Washington State Noxious Weed Board to determine

Wildlife Surveys	Year/Season(s)	Active	Emphasis
			effective methods to control nonnative and aggressive wild chervil.
Monitoring			
Habitat assessment		Yes	Area: Black River Unit Timing: As new land acquired Data/Results Availability: Unit records Emphasis: See Goals 1 and 2 To understand the habitats and management needs of newly acquired properties.
Bog observation	2011	No	Area: Black River Unit Timing: Summer Data/Results Availability: Baseline observations, Unit records Emphasis: See Goals 1, 2, 3, and 4 Former WDNR wetland biologist and Unit biologist did a one-time visit of some bog sites in the northern-most portion of the Unit to begin the process of understanding the habitat and its wildlife components, as well as potential and current threats and management needs.
Targeted Invasive Species	Ongoing	Yes	Area: Black River Unit Timing: As needed Data/Results Availability: Unit records Emphasis: See Goals 1, 2, 3, and 4 Unit priority noxious weeds are monitored and treated to reduce land coverage and habitat impacts. The Unit works with Thurston County and Washington State Noxious Weed boards.
Seasonal wetland habitat management using limited numbers of cattle	2008–2010	Yes	Area: Black River Unit Timing: Year-round Data/Results Availability: Unit records Emphasis: See Goals 1, 3, and 4 Cattle are used as management tools to reduce the height of invasive reed canarygrass growth after a study showed habitat enhancement success and benefit for waterfowl, open wetland-related wildlife such as Oregon spotted frog, other amphibians, and Wilson's snipe.

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Chapter 5
Human Environment

USFWS

Chapter 5. Human Environment

5.1 Cultural and Historical Resources

5.1.1 Grays Harbor National Wildlife Refuge

The U.S. Fish and Wildlife Service is mandated by law to appropriately manage the cultural resources under its control (Appendix F). This cultural history provides an overview of the known archaeological and ethnographic use of resources in the congressionally authorized boundaries of Grays Harbor National Wildlife Refuge.

5.1.1.1 Prehistoric and Ethnographic Resources

Paleontological and Prehistoric Sites

There is no known information about paleontological resources occurring on the Refuge. While there are no prehistoric archaeological sites recorded on the Refuge, there has also been no systematic archaeological survey or testing conducted. A large portion of the approved boundary is open water and tidelands, which is not a conducive environment for archaeological survey. Any potential pre-contact sites around the shoreline could be buried beneath accumulated sediment or introduced fill.

The archaeological record for Washington's southern ocean coastline is not well documented as a result of limited surveys and often unfavorable environments for artifact preservation. There is one documented prehistoric site across the North Bay area. While there is no connection between this site and the Refuge, this and other known sites can inform our understanding of the types of environmental settings and potential composition of sites that might exist in relation to the Refuge.

Native American Cultural History and Landscape

The coastal people were mobile hunters, gatherers, and fishermen who moved around following a seasonal cycle dictated by the availability of resources in the region's diverse ecosystems, with camps located on the coast nearer to traditional hunting, fishing, and gathering areas likely being occupied primarily in the spring and summer, and villages located in more protected locations being occupied in the winter months [(Wessen 1990:418) in Parks 2011].

The Grays Harbor area was and remains an important location to Native Americans for cultural activities, such as fishing; hunting; plant and shellfish gathering; travel; trade; and social, ceremonial, and religious uses. The Quinault and Chehalis tribes use fisheries stocks from the harbor. Ancestors of many contemporary tribes used the Grays Harbor area at treaty times and in many cases, their descendants continue to use the area. In addition, other Indian peoples who may or may not have used the Grays Harbor area directly used the resources of Grays Harbor through trade, hunting, and fishing (James and Martino 1986).

Ethnographically, the Refuge is within the area traditionally occupied by the Lower Chehalis—members of the Southwestern Coastal Salish culture group (Hajda 1990:503). The Hoquiam and Humptulips, sometimes described as subgroups, bands, or tribelets of Lower Chehalis, utilized the north shore of Grays Harbor. The Lower Chehalis people were water-oriented, focusing on fish as a

staple resource. According to one report, the north shore of Bowerman Basin is a documented sweetgrass gathering area ([Dellert et al. 2010] in Parks 2011).

The Quinault tribe includes the Grays Harbor area within their usual and accustomed fishing grounds [(Swindell 1942) in James and Martino 1986]. Many other tribes have historically been associated with Grays Harbor because of the great amount of natural resources, especially fish, and ease of access; some of the tribes include the Hoh, Makah, Queets, Quileute, Shoalwater Bay, Skokomish, and the Squaxin Island (James and Martino 1986). This list of tribes is neither complete nor exclusive.

One specific description of historic use by local tribes in what is now the Refuge is:

> Remains of an Indian fish trap were identified south of the eastern tip of Moon Island, along the North Channel (Herman 1985). The south shore of Moon Island was identified as a site where weaving materials were picked prior to construction of the airport, when access became difficult (Susewind 1983) [in James and Martino 1986].

Euro-American Exploration and Settlement

Government Land Office (GLO) maps provide some of the earliest documentation of what the landscape of the area looked like prior to large-scale settlement by Euro-Americans. The changing shoreline on the north side of Grays Harbor in Hoquiam appears to have started as a result of the filling of tideflats to expand sawmills operations at the Grays Harbor Lumber Company in the early years of the 20th century while it was owned by NJ Blagen. This area is located well outside of the Refuge to the east, but it does have some bearing on the development of the landform which bounds the Refuge on its south side. According to the site form for the Blagen Mill, the historic deposits occur under 1 to 12 feet of historic and recent fill, while the prehistoric deposits, which include split cedar stakes associated with fish weirs, occur below 17 to 21 feet of fill. A 2006 report regarding a power substation outside the east boundary of the Refuge suggests that the fill in that area dates to the 1950s, but the claim is not substantiated by a reference.

The southern boundary of the Refuge includes a small amount of land on Bowerman Peninsula (formerly known as Moon Island). The 1866 GLO plat suggests that the strip of land known as Moon Island did not exist prehistorically. No maps for the period between 1866 and 1935 have been located. However, the 1935 Metsker map illustrates that while there appears to have been emergent mudflat topography, there was no permanent landform in the area of Moon Island at that time, which is confirmed by a February 1935 Army aerial photograph. Newspaper articles and notices of the late 1930s and early 1940s fill in some of the gaps in the evolution of the island, more accurately a peninsula, as it is connected to the mainland (the filled tideflats) to the east. Because the Refuge encompasses a portion of this strip of land, its evolution is relevant to the history of the Refuge and is explored in more detail below.

Moon Island Airport and the Works Progress Administration (WPA)

Articles and photographs provide conflicting information about the development of the Moon Island (later Bowerman) Airport, but the general timeline points to initial construction between 1937 and 1940, with expansion by the Army during World War II (WWII). In the December 18, 1935, *Centralia Daily Chronicle*, a small notice on page two announced the approval of a plan for an

airport on Moon Island. The obituary of former Mayor Ralph Philbrick in 1945 attributes the airport to the mayor's vision:

> It was Mayor Philbrick who first saw the possibility of an airport in the Moon Island District. It was largely through his efforts that the plans were accepted by the works progress administration & became a reality (Aberdeen Daily World 27 January 1945).

Two articles in 1937 suggest that the construction process did not go smoothly, and they also provide insight into the role the WPA played in the project.

The *Mt. Adams Sun* included the following in its summary of regional news on its Northwest News Weekly page for November 15, 1940, which, in concert with the fact that WPA workers had already been at work as early as 1937, suggests that planning and construction were contemporaneous:

> Federal and county officials have completed plans for what will ultimately be an 800-acre airport on Moon Island, west of here. Cost will be $412,788 (Mt. Adams Sun 1940).

The Port of Grays Harbor produced a timeline on the occasion of its centennial in 2011 which included an entry for 1940: "The Port agreed to furnish the Robert Gray Dredge to help the United States Government's Works Progress Administration in the construction of Moon Island Airport" (Port of Grays Harbor n.d.).

In 1942, during WWII, the airport became an Army airfield (HistoryLink.org 2010) and returned to civilian operation in 1946 (Port of Grays Harbor n.d.). It was renamed Bowerman Field in 1953 in honor of WWII fighter pilot Robert Bowerman, who founded Western Washington Airways. The airport was operated for several years by Grays Harbor County, with financial contributions from the Port of Grays Harbor, which took over sole ownership and control in 1962.

Known Historic Sites

There are no historic sites recorded on the Refuge. An 1866 GLO map illustrates that much of the current ground surface associated with the Refuge has been deposited and developed within the last 150 years. The Moon Island Airport Terminal is the closest known resource to the Refuge.

5.1.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The cultural history of the Black River Unit is identified primarily from a report concerning differences in vegetation over time in the Black River lowlands (Easterly and Salstrom 2008) and a cultural resource report and overviews prepared by Service archaeologists (Parks 2011).

5.1.2.1 Prehistoric and Ethnographic Resources

Paleontological and Prehistoric Sites

There is no known information about paleontological resources occurring on the Unit; there are no prehistoric archaeological sites recorded. However, there has been virtually no systematic archaeological survey or testing conducted. Moreover, a large portion of the approved boundary is not currently under Federal ownership. All ground-disturbing activities proposed for the Unit and for parcels that are acquired in the future will be subject to compliance with Section 106 of the National

Historic Preservation Act, which may include pedestrian surveys and other identification efforts as appropriate (Parks 2011).

Native American Cultural History and Landscape

The Black River Unit lies within the territory of the Southwestern Coast Salish peoples (Hajda 1990). In particular, the Upper Chehalis Tribe fished the waters of the Black River and harvested camas (an edible plant) from the surrounding prairies (south of the Unit) and used fire to maintain open fields for game species (elk and deer) and plants. As noted by Cooper, one of the "naturalists to the expedition" surveying the route of the Pacific Northern Railroad in the mid-1850s:

> *A few remarks are necessary upon the origin of the dry prairies so singularly scattered through the forest region. Their most striking feature is the abruptness of the forests which surround them, giving them the appearance of stands which have been cleared and cultivated for hundreds of years. From various facts observed I conclude that they are the remains of much more extensive prairies, which, within a comparatively recent period, occupied all the lower and dryer parts of the valleys, and which the forests have been gradually spreading over in their downward progress from the mountains. The Indians, in order to preserve their open grounds for game, and for the production of their important root, the camas, soon found the advantage of burning, and when they began this it was only those trees already large enough that could withstand the fires.* (Cooper 1859, as quoted in Storm 2004, in Parks 2011)

Ethnographic evidence indicates that the Southwestern Coast Salish peoples were divided into small bands that claimed resource areas such as watersheds (Larson and Jermann 1978:10). The Upper Chehalis-speaking Squiaitl or Kwaiailk ranged from the Black River northward to Eld Inlet (Hajda 1990). The individual groups were loosely affiliated, sharing similar dialects and resource-based lifestyles, but not political connections. Most villages were located at the mouths or confluences of creeks and rivers for easy access to fisheries. Houses were constructed with posts and cedar planks in a long, rectangular form that accommodated several families. Rivers were important transportation routes for the inland Upper Chehalis, but trails were also important in areas where streams were impassible or infrequent (Hajda 1990 in Parks 2011).

Subsistence patterns were defined by seasonal availability of salmon runs, roots, and berries, supplemented by gathering shellfish and hunting. In the spring and summer, villages would divide into smaller clusters to gather berries and hunt. Stone tools, net weights, shell middens, and fire-cracked rocks used for cooking foods are the most obvious evidence of occupation sites (Speulda 1997 in Parks 2011).

Euro-American Exploration and Settlement

Descriptions of conditions along the river near the beginning of European settlement are provided by official records made by early explorers in the area. Comments on the vegetation from two expeditions in the area thought to be within the current boundaries of the Black River. The first of these was in 1824, when the Hudson Bay Company sponsored the James McMillan Expedition, a 41-man expedition to the Frasier River from the Columbia River in search of sites for trading forts. The McMillan Expedition noted:

> [T]he river became … so narrow and nearly choked up with willow and trees that we found it necessary to make a portage…. the shores are complete thickets of willows and different kinds of

> deciduous trees, mostly ash. The portage is a fine road through a handsome plain. Saw several marks of beaver by their cuttings they seem to be fonder of the ash than other trees" ([Work 1824] in Easterly and Salstrom 2008).

The second expedition through the area was in 1841, when Charles Wilkes commanded the earliest U.S. Exploring Expedition to reach the Oregon Country. Wilkes sent a party of nine men in July of that year from the Hudson Bay Company's Fort Nisqually to Grays Harbor by way of the Black River. From an area just below Black Lake, the Wilkes' Expedition noted:

> This appeared at first almost impassable, for it was for four miles almost choked up with Sparganium, Nup[h]ar, &c., so that it was difficult to pass even with the small canoe. Its breadth was from twenty to sixty feet, and it was from three to twelve feet deep. The turns were sometimes so short, that the large canoe would be in contact with the thickets on the banks at both ends, and it required much force to drag her along, by pulling by the branches, and caused great labor in cutting their way. . . They were obliged to continue their course down the river, until nine o'clock at night, before they could find any place to encamp, on account of the bog and jungle ([Wilkes 1844, pp 132-133]in Easterly and Salstrom 2008).

Euro-American settlement in the Nisqually Delta occurred in the early 1800s. The Hudson's Bay Company established Fort Nisqually in 1832. The small settlement of farmers developed a thriving livestock industry to support other Hudson's Bay Company outposts. Overland migration beginning in the 1840s brought Americans into the Northwest, many of whom chose the Puget Sound Region in which to settle (Speulda 1997). Settlement of the Littlerock and Black River area began in the 1850s by the Dodge, Shotwell, and Rutledge families. In 1852, Thurston County was established and Olympia selected as the provisional capitol of the Washington Territory (Parks 2011).

At each section corner GLO surveyors recorded notes about the vegetation encountered along the line in the previous mile segment. Records included the species encountered (generally trees and shrubs); presence, extent, and/or sign of fire along the GLO transect; and general composition of the understory (sparse/dense). Also noted were the transition points between prairies, hills, marshes (or bottomlands), timber and burnt timber, usually with the bearing direction of the ecotone/margin noted. The locations, width, and direction of rivers and streams were also recorded. Township maps were then drawn using GLO field notebook data. These maps showed the section line locations of rivers, streams, prairies, hills, and marshes, and the estimated direction or shape of the feature (Easterly and Salstrom 2008).

More quantitative historic information was provided by surveys done for the GLO and Donation Land Claims, which were done during the 1850s in the study area. For the GLO surveys, transects were made first to establish Township boundaries; later surveys established the corners of each Section within the Township. The GLO survey maps are among the earliest documentation/description of the landscape prior to farming and development (Parks 2011) (Table 5-3).

Table 5-1. Summary of Landscape Descriptions on GLO survey maps in the vicinity of Black River.

Township	Range	Date Completed	Notes on landscape in study area
16 North	3 West	1855	Soil in the river bottom first rate; rolling gravelly prairie soil second rate; Land rolling soil second rate. Timber for cedar and maple; undergrowth hazel, fern, vine, maple, salal
17 North	2 West	1854	Unsurveyed land unfit for settlement or cultivation
17 North	3 West	1856	Alder, willow, and spruce swamp, entirely covered with water. Unfit for cultivation. Impassible and unsurveyed (Black River floodplain)

Known Historic Sites

As parcels are acquired within the approved boundary of the Unit, they often come with standing structures associated with the area's agricultural history. Several farm complexes or residential structures have been documented and evaluated by the Service's Cultural Resources Team as they were acquired. One site was determined to be eligible for the National Register of Historic Places (NRHP), and a Memorandum of Agreement (MOA) to mitigate effects of demolition was adopted and its stipulations were completed in 2005. Three farms were determined to be ineligible. Where needed, the subject buildings have been recorded and removed or are slated for removal through demolition and salvage.

Historic Resources Recorded on the Black River Unit

The history of land use and development associated with the farms provides an important source of background information for Unit management when making decisions regarding habitat restoration and enhancement. The following text from Parks (2011) summarizes information about the various parcels within the Unit boundaries.

Weiks-Evergreen Dairy

The first settler to acquire land in the area encompassed by the Evergreen Dairy was Nathaniel Z. Thallheimer in 1866, when he filed for a Donation Land Claim for 162.26 acres in the NW ¼ of the section (GLO Records #216). Another claimant, possibly William Morey, filed for a homestead claim in 1869 for the NE ¼ of the section. The homesteads were not successful and there is no evidence remaining of the pioneer period.

In 1879, Thomas Rutledge opened a post office, designated Littlerock, to serve the local community. Logging increased during the 1880s, and there were 40 logging camps operating in Thurston County (Costantini and Stevenson 1985:7). The town of Littlerock was platted in the 1890s. The railroad, constructed in about 1890, crosses through the eastern portion of section 2, connecting through the community of Littlerock. Land speculation followed the railroad, and by 1900 two land development companies, Everett's Addition and Waddell Valley Garden Tracts, were advertising in the Black River Valley for small 5- to 10-acre tracts. The Waddell Valley Garden Tracts B-9, B-10, and B-11 encompass most of the area that later became the Evergreen Dairy.

The early 1900s was a period of growth for Thurston County, with Olympia growing in population and expanding its government offices. The dairy industry also began to thrive because the growing

population created a local market for fresh milk. By the 1920s and 30s, electricity extended to many farms and all-electric milking machinery and modern equipment for bottling milk added to the convenience and safety of fresh milk. Home delivery increased with modern delivery trucks. After WWII, the dairy industry consolidated as larger, regionally-based dairies began marketing their products at supermarkets. This trend continued, reducing the number of small, family-owned dairies.

Carl Weiks was born in 1876 in Norway and stowed away on a vessel bound for the United States, drawn to Washington by the logging boom of the 1890s. By 1910, Weiks had settled his growing family near Littlerock and was working as a logger and later became a livestock and dairy farmer.

The Polk's Directory for Thurston County lists Carl Weiks in the 1919–1920 directory, but it was not until 1923–1924 that he was listed as the Carl Weiks Dairy. By the early 1930s, there were 16 dairies listed in the vicinity. Weiks' was one of the first, and thanks to his ability to draw on family members, the enterprise was able to diversify and became successful during and after the Depression. The Evergreen Dairy bottled milk and had the home delivery route for most of Tumwater from the mid-1920s to about 1940. After WWII, they branched out into poultry and livestock breeding. The family operation continued, evolving to adapt to the changing industry, until the mid-1980s, when the time of the independent, family-owned dairy was coming to a close. In 1985, Darigold, a large national dairy chain, began leasing the operation, but then began to close it down (Speulda 2004a).

A 1985 countywide cultural resources survey which inventoried representative "prevalent styles of architecture, important social organizations, commercial governmental and agricultural development and important individuals who have influenced the culture, history and government of Thurston County" (Costantini and Stevenson 1985), included the Weiks-Evergreen Dairy among the 143 out of 318 properties that met the criteria of significance.

In 1997, the dairy, situated at an elevation of about 130 feet on a 100-year floodplain, was inundated by floodwaters, soon followed by a downturn in the market in 1999. These factors forced the Weiks family into foreclosure and they lost the farm in 1999. Scatter Creek Holdings purchased several farms at auction, then sold them to The Nature Conservancy, which in turn offered selected parcels to the Service, including the Weiks-Evergreen Dairy, the La France Farm, and the North Farm. The Service acquired the parcels in 2002 with 20 buildings still standing.

La France Farm

The first settler to acquire the land in the La France Farm area was Marcy C. William, who in 1869 completed the requirements for a homestead for the 160-acre parcel. Her claim encompassed most of the area currently developed as the community of Littlerock. No additional information about Marcy William has been uncovered. The parcel was subsequently subdivided with the railroad, constructed in 1890 crossing through the claim northwest to southeast, and La France Road dividing east and west halves of the claim. By 1900, two land development companies, Everett's Addition and Garden Tracts, were operating in the Black River Valley, subdividing the valley into small 5- and 10-acre tracts. The La France Farm area was included in the Everett's Addition subdivision as Lot 24 (Metsker 1900).

In about 1914 Carl Weiks began purchasing lots within the Everett's Addition and Garden Tracts subdivision, amassing several hundred acres for a dairy operation from the development companies that had proven unsuccessful. After WWII, the family used the La France Farm for raising pigs. The

family owned the La France Farm as part of their extensive operations until 1998, when a downturn in the market led to foreclosure on the property. Scatter Creek Holdings purchased several farms in the Black River Valley during an auction following the foreclosure. Several parcels, including La France Farm, were subsequently purchased by The Nature Conservancy, which then offered the parcels to the Service. The farm did not contain a house or other elements of a farm to distinguish it, and the two sheds on the land at time of the Service's purchase were determined to be ineligible to the NRHP (Speulda 2001a).

North Farm

When the GLO survey of this location was completed in 1856, it was listed simply as a swamp with no improvements. The first transfer of the property from Federal ownership occurred in 1894, when it was included in a railroad grant of more than 9,000 acres. In about 1911, a development grant was issued for Waddell Creek Valley Garden Tracts by N.J. and Lucy Redpath and C.E. and Barbetta J. Maynard. The garden tracts were 5- to 10-acre plots for a subdivision type of development. They had been logged over and were described locally as "stump farms" (Weiks, M. 2001b. pers comm.). The subdivision never materialized, instead the lots were combined into larger blocks for agricultural development.

The North Farm is among the Waddell Creek Valley tracts that were purchased by Carl Weiks in about 1914. Members of the family remember living adjacent to the North Farm, but not on it. The family continued to own the North Farm as part of their extensive operations until 1997, when a change in family interests led to foreclosure on the property and an auction sale to Scatter Creek Holdings (along with La France Farm and the Weiks' Evergreen Dairy Farm).

When the farm was evaluated in 2001, there were 10 buildings. All were constructed between the 1930s and 1980s, and were determined to be ineligible for listing on the NRHP (Speulda 2001b). All but two have been removed.

Kiser Tract

The Kiser Tract is a 68.8-acre parcel of agricultural land in the Black River floodplain that was acquired for inclusion in the Black River Unit in 2000. A complex of buildings on 3 acres at the western edge of the property was evaluated for its significance in 2004 in anticipation of demolition for safety and management reasons. The Kiser buildings were not included among the significant historic properties identified in the 1985 Thurston County cultural resources survey (Costantini and Stevenson 1985). In 1856, when the GLO survey was completed, the area where the farm was later situated was identified as swamp land with no improvements. The SE ¼ of section 35 was homesteaded by John F. Shotwell. No buildings or features on the property correlate with the original homestead period of the 1870s. None of the existing buildings on the parcel were determined to be eligible to the NRHP when purchased by the Service (Speulda 2004b).

Although only the historic sites above have been recorded on lands owned by the Refuge, there are very likely additional tracts that will be acquired in the future which include infrastructure greater than 50 years old.

5.2 Infrastructure and Facilities

The infrastructure and facilities discussed in this section include buildings, roads, trails, regulatory and interpretive signs, and other physical structures. Refer to Chapter 2, Alternative 1, and Map 1 for the locations of existing facilities.

5.2.1 Boundary Fences, Markers, Buildings and Facilities

5.2.1.1 Grays Harbor National Wildlife Refuge

The Refuge encompasses 1,851 acres within the approved Refuge boundary (Map 3). Most of the boundary is marked with signs. The perimeter of the Refuge borders State Highway 109 to the north and Paulson Road to the east. The western boundary extends into the open water and is marked with marine pilings and boundary signs. The boundary on the south is adjacent to property owned by the Port of Grays Harbor. In some locations the boundary may not be posted or posted slightly inside the actual property line due to difficult water or land conditions. Periodically, boundary signage is checked to identify and replace damaged and missing signs.

The Refuge owns a large building along Airport Way. This building was a distributor business prior to purchase by the Refuge, and for a number of years the Grays Harbor Food Bank was issued a special use permit to utilize the warehouse for a distribution site. It includes 10,000 square feet of warehouse and an area with six small rooms and two restrooms. The Refuge maintains the rooms and bathrooms for use during the Grays Harbor Shorebird Festival and the warehouse serves as Refuge storage. Through a cooperative agreement, WDFW and Washington State Department of Agriculture also store equipment in the warehouse. The building has a large outdoor covered area, loading docks, and a parking area that can accommodate about 40 cars during the Shorebird Festival. The building and parking area are enclosed with a chain-link fence. The building is in fair condition. The structure is planned to be rehabilitated and converted to a maintenance shop to support Refuge functions or operations (Chapter 2, Objective 5.2).

5.2.1.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Unit has been closed to all public use and activities during the development and ongoing acquisition phase. Unit boundary signs or fences are generally installed around the perimeter of all newly acquired lands. As parcels are acquired, the buildings on them are often not needed. The Unit has several derelict buildings in need of removal. These include barns, outbuildings, and houses that are in disrepair and need to be demolished. The remaining buildings are subject to trespass and vandalism. Removal of these buildings is a priority and will continue as funding becomes available. This need is also included in the Common to All Section of Chapter 2.2.

5.2.2 Roads, Parking Areas, and Trails

5.2.2.1 Grays Harbor National Wildlife Refuge

The Refuge does not own or maintain any roads. Adjacent roads are owned by Grays Harbor County, the City of Hoquiam, and the Port of Grays Harbor. The Refuge clears vegetation along the roadways when necessary for clearance of large vehicles. Parking is on Refuge-owned property along Airport Way across from Bowerman Airfield. About 40 cars can park in this area. During the Grays Harbor

Shorebird Festival visitors also park in the FAA parking lot, along Airport Way east of the FAA Building, and in the Refuge facilities yard. During the spring shorebird migration, the Refuge places additional temporary signs along Airport Way to help designate visitor parking.

The Sandpiper Trail starts at the end of the blacktop road at Bowerman Airfield. The Port of Grays Harbor allows access for 1/3 mile from the Refuge parking area to the trailhead. The Sandpiper Trail is a boardwalk that winds through willow thickets, an alder grove, and then makes a loop out into the saltmarsh where visitors have unobstructed and close-up views of the mudflats where migrating shorebirds are feeding and resting. The willow and alder thickets are also great places to see neotropical migrant songbirds that use the vegetation for cover, feeding, and nesting. Along the trail, there are several areas with benches and good views of the mudflats; one viewing area has four interpretive panels. In the area of the loop, there are viewing areas and benches and one spotting scope. During the shorebird migration, temporary interpretive signs are located along the boardwalk.

No dogs, jogging, or bicycling is allowed on the Refuge, including the Sandpiper Trail. However, these activities are allowed on the blacktop road prior to the trailhead. Visitors often walk their dogs, jog, or bike along the blacktop road. The Refuge maintains No Dogs, No Jogging, and No Biking signs at the Sandpiper Trailhead and at the kiosk, but these signs are vandalized and these activities do occur on the Sandpiper Trail as observed by Refuge staff and volunteers.

5.2.2.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Black River Unit does not maintain any roads, parking areas, or trails.

5.3 Recreation Overview

5.3.1 Entrances and Public Access Points

5.3.1.1 Grays Harbor National Wildlife Refuge

The Refuge is open daily during daylight hours. There is one official entrance to the Refuge on Airport Way. Visitors park in a marked parking area along Airport Way and walk 1/3 mile along a blacktop road owned by the Port of Grays Harbor to reach the Sandpiper Trail trailhead. The parking area has a kiosk with brochures and Refuge information. The Port of Grays Harbor maintains a secure gate across the road at the location of the kiosk. Through a cooperative agreement with the Port of Grays Harbor, Refuge visitors are allowed to walk the blacktop road to reach the trailhead. Discussions are ongoing with the Port regarding visitor access because of increased FAA security regulations.

5.3.1.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

No lands have been officially opened for public access. Some Unit-owned lands are fenced, gated, and posted.

5.3.2 Open and Closed Areas

5.3.2.1 Grays Harbor National Wildlife Refuge

Open Areas. The Refuge is open daily from sunrise to sunset. The only areas of the Refuge that are open to the public are the parking area along Airport Way and the Sandpiper Trail. Refuge wildlife and habitats may also be viewed while walking along Paulson Road, Airport Way, and the blacktop road leading to the Sandpiper trail.

Closed Areas. All areas except the Sandpiper Trail and the parking area are closed to public access. However, the Refuge building and parking area are open during the Grays Harbor Shorebird Festival.

Navigable waters surround the Refuge to the west, but due to the extreme tidal movement and lack of access points, boating is not a popular activity. Open waters of the Refuge are closed to all boating access due to potential disturbance to migratory and resident birds.

5.3.2.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Closed Areas. All areas of the Unit are closed to public access.

5.3.3 Annual Recreation Visits

5.3.3.1 Grays Harbor National Wildlife Refuge

Although the Refuge is in a rural setting, the area is well-known in the birding community and visited often by birders from throughout Western Washington. Most visitation occurs during a 3-week period in the spring when shorebirds migrate through the area. The Refuge is close to U.S. Highway 101's Pacific Coast Scenic Byway and is adjacent to State Highway 109, which is the main highway for visitors along the Washington Coast. This route was recently designated the Hidden Coast Scenic Byway.

Visitor numbers have remained constant over the years; based on estimates from staff and volunteers, 13,000 annual visitors are reported for the Refuge Annual Performance Plan. Visitation during the 3-day Grays Harbor Shorebird Festival is estimated at 1,250 at the Refuge.

5.3.3.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Service ownership of the Black River Unit does not include the waters of the Black River. The river is used as a recreational site for boating, fishing, canoeing, wildlife observation, and other activities. All areas of the Unit are closed to public access.

5.3.3.3 Accessibility of Recreation Sites and Programs

5.3.3.4 Grays Harbor National Wildlife Refuge

The Refuge's Sandpiper Trail is barrier-free and provides people of all abilities with high-quality wildlife viewing opportunities. The trail wanders through a willow thick and alder grove and provides close-up views of the mudflats where migrating shorebirds can be easily seen. The mile-

long trail is flat and wide. To access the trail, visitors park in an area that is partly paved and partly gravel and has several spaces designated for people with disabilities. From here, visitors travel through a gate and down a blacktop road.

5.3.3.5 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

All areas of the Unite are closed to public access.

5.4 Wildlife Observation and Photography

5.4.1.1 Grays Harbor National Wildlife Refuge

The Sandpiper Trail is maintained to accommodate wildlife observation and photography. In addition, there are viewing and photographing opportunities available from the parking area and along the blacktop road leading to the Sandpiper Trail.

Most Refuge visits are associated with wildlife observation and photography and occur along the Sandpiper Trail. Photography visits have increased with advances in camera phones and digital photography. Increasingly, the Refuge attracts professional or serious recreational photographers using high-powered lenses, and digital single-lens reflex camera equipment. The Sandpiper Trail provides photographers and wildlife observers with access to a mix of habitats, proximity to wildlife, and open views.

5.4.1.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

All areas of the Unit are closed to public access.

5.5 Interpretation and Outreach

5.5.1 Grays Harbor National Wildlife Refuge

5.5.1.1 The Grays Harbor Shorebird Festival

Grays Harbor Audubon Society started the Shorebird Festival in the early 1990s. The Refuge has been a partner in producing the Grays Harbor Shorebird Festival since 1997. Typically held during the last weekend in April, the Festival is a time for celebrating the annual spring migration of shorebirds in Grays Harbor County. The Festival consists of field trips, lectures, vendors, exhibitors, a Nature Fun Fair, banquet, and auction. Proceeds from the festival help fund Refuge programs, including the cost-share match for the AmeriCorps/education coordinator.

The planning of the event begins in September with many individuals and organizations involved in all aspects of event. The Shorebird Festival partners include Grays Harbor Audubon Society, the City of Hoquiam, and Grays Harbor National Wildlife Refuge. Each partner has a member on an executive committee. This committee is responsible for ensuring the mission and intent of the annual Festival are fulfilled. The Refuge manager serves on the executive committee. Grays Harbor Audubon Society is the fiscal agent for the Festival. The Refuge's visitor services manager serves on the planning committee and assists with all aspects of planning; major responsibilities include publicity (brochure and rack card development, website management, and press releases), volunteer

coordination, and Refuge liaison. The AmeriCorps/education coordinator also is on the planning committee with the specific duties of managing the Shorebird Festival Poster Contest and the Nature Fun Fair. The Fun Fair runs throughout the Festival and consists of a dozen different hands-on nature-related activities aimed at grade school age children.

During the 3 days of the Festival, the Refuge maintains a presence of volunteers at the Refuge and on the Sandpiper Trail. Volunteers provide information to visitors and lead walks during the peak shorebird viewing time. The Washington Conservation Corps team works prior to the Festival putting up signs, cleaning the building, and doing maintenance on the trail. During the Festival, Corps members staff the Port of Grays Harbor gate to allow shuttle busses to get through. They also assist with set-up and take-down at the Festival Headquarters. Throughout the 3 weeks of spring shorebird migration, volunteers are also trail-roving on the Sandpiper Trail to assist visitors with bird identification and other information.

5.5.1.2 Other Interpretation and Outreach

As time permits, Refuge volunteers and AmeriCorps members participate in community events such as River Days, the Grays Harbor County Fair, the Volunteer Recruitment Fair, and others. Typically, a staffed information table and exhibit provides information about the Refuge, shorebirds, and the Grays Harbor Shorebird Festival.

5.5.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

All areas of the Unite are closed to public access.

5.6 Environmental Education

5.6.1 Grays Harbor National Wildlife Refuge

5.6.1.1 Number of Participants

The environmental education program at the Refuge currently provides on- and offsite programs to 4,020 students and adults annually.

5.6.1.2 Education Facilities

The Refuge has no special facilities to accommodate students participating in the education program. The Port of Grays Harbor allows buses to drive past the closed gate to the end of the blacktop road so that students can more quickly access the boardwalk trail. Students walk the Sandpiper Trail to observe shorebirds, other wildlife and plants, and learn more about the areas habitats.

5.6.1.3 Teacher Training

Teacher training is considered an integral part of the Refuge’s education program. Trained teachers are able to use knowledge and resources year after year with students. Most teacher trainings have been conducted in partnership with Educational Service District 113 and the Chehalis Basin Education Consortium. Trainings have consisted of Refuge-specific and watershed-wide themes. In 2012 training was presented for the first time to early childhood educators using the “Growing Up

Wild" (Council for Environmental Education 2013) program guide. In addition, the education coordinator works one-on-one with teachers or with teams in the same school to provide training on the curriculum and the Refuge. Educators participating in the program receive "An Educator's Guide to Grays Harbor National Wildlife Refuge" (USFWS 2012). The guide was adapted from the Shorebird Sisters School Program to be specific to the Refuge and contains background on the Refuge, shorebirds, and migration, and has a number of activities and resources about shorebirds.

5.6.1.4 Environmental Education Program Details

The Refuge began providing educational programs to schools in Grays Harbor County in 2002. Each year since then, an AmeriCorps volunteer, serving for 10.5 months has worked as the Refuge's environmental education coordinator. The cost-share match for this position has been provided by Refuge partners, Grays Harbor Audubon Society and Friends of Nisqually National Wildlife Refuge Complex. Currently the program serves about 4000 3rd and 4th grade students in Grays Harbor County. The education coordinator identifies approximately 24 teachers each year and provides a series of six in-classroom lessons and activities on a variety of topics related to ecology, shorebirds, and shorebird conservation. The classes then take a field trip to the Refuge during the spring shorebird migration where students are able to observe shorebirds and habitats. The cost of bus transportation has been covered by Grays Harbor Audubon Society (proceeds from the Grays Harbor Shorebird Festival), The Nature of Learning grants secured by the Educational Service District 113, or grant funding provided by the Service with match support from partners. The ongoing funding of bus transportation is challenging and may not be sustainable.

Another aspect of the education program is the Grays Harbor Shorebird Festival Poster Contest in which 1st through 6th graders throughout Grays Harbor County are invited to participate. The education coordinator organizes this effort and provides teachers in any grade with classroom assistance in getting started with this project. On average, 600 posters are entered in the contest each year. The posters are judged by grade. A 1st through 3rd place winner and two honorable mentions are awarded for each grade. Five community members with expertise in art and shorebirds are asked to judge the contest. From the 1st place winners, a best of show is chosen; this piece of art is used the following year for all publicity related to the Grays Harbor Shorebird Festival. The poster contest winners are recognized during the Festival at an awards ceremony.

During the summer, AmeriCorps members have assisted with a variety of locally run summer camps. They provide activities and lessons related to the natural history of the area and the environment. Participation in the camps and summer activities are dependent on what local organizations have scheduled for their staffing needs and the availability of AmeriCorps member.

Partners and volunteers working with the education program, both classroom lessons and field trips, include Grays Harbor College (Model Watershed program), the City of Hoquiam (AmeriCorps volunteers), Grays Harbor Audubon Society (chapter members), Educational Service District 113 (Chehalis Basin Education Consortium), and trained Refuge volunteers.

5.6.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

There is currently no environmental education at the Unit.

5.7 Volunteers

5.7.1 Grays Harbor National Wildlife Refuge

The Refuge has a small group of about 10 trained Refuge volunteers who help with Refuge clean-up, invasive plant control, trail-roving, special events, community outreach, and the education program. The AmeriCorps volunteer has the responsibility of managing the volunteer program. They plan and organize work parties to clean up debris, clear invasive vegetation, maintain the trail, and recruit volunteers to help with the education program and outreach events. Maintaining a Refuge volunteer group has been challenging at the unstaffed Refuge. Volunteer recruitment and training occurs every couple of years because of limited time for program management by the staff. The Refuge provides a modest recognition event each year and gives volunteers awards and certificates.

5.7.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Unit does not maintain a volunteer program, however, if appropriate volunteers from Billy Frank Jr. Nisqually Refuge could be used.

5.8 Law Enforcement

Protecting resources and people on our refuges is the fundamental responsibility of Refuge law enforcement officers. The mission of the Refuge Law Enforcement Program is to support the administration of the National Wildlife Refuge System through the management and protection of natural, historic, and cultural resources; property; and people on the lands and waters of our national wildlife refuges.

5.8.1 Refuge Law Enforcement Objectives

Law enforcement is an integral part of managing the National Wildlife Refuge System. Refuge law enforcement officers are responsible for upholding Federal laws and regulations that protect natural resources, the public, and employees. These are our objectives:

- Protect Refuge visitors and employees from disturbance or harm by others
- Assist visitors in understanding Refuge laws, regulations, and the reasons for them
- Enhance the management and protection of fish and wildlife resources on Refuges
- Ensure the legally prescribed, equitable use of fish and wildlife resources on Refuges
- Obtain compliance with the laws and regulations necessary for the proper administration, management, and protection of the National Wildlife Refuge System

5.8.1.1 Grays Harbor National Wildlife Refuge

The Refuge receives law enforcement coverage to support major public events and peak visitation periods from a Service zone officer located at Billy Frank Jr. Nisqually National Wildlife Refuge in Olympia. Zone officers are assigned to multiple refuges and large geographic regions. They enforce special refuge regulations via periodic patrols of refuge lands to protect resources and maintain

public safety. The most common law enforcement issues encountered on Grays Harbor Refuge are violations of Refuge closures (trespass into closed areas), visitor presence after hours, vandalism (defaced signs and destruction of trees), littering, and trash dumping (household and commercial) along the roads or on Federal property.

5.8.1.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Law enforcement on the Black River Unit is the same as Grays Harbor Refuge.

5.9 Area Outdoor Recreational Opportunities

5.9.1 Grays Harbor National Wildlife Refuge

Grays Harbor area surrounding the Refuge has a number of local State parks overlooking the Pacific Ocean offering wildlife viewing, beachcombing, trails, and camping. Ocean City State Park, on the north side of the Harbor mouth, features interpretive activities during the summer. Westhaven, Twin Harbors State Parks in Westport, and Grayland Beach State Park approximately 7 miles south of Westport, are known for spectacular oceanfront and beachcombing opportunities**.**

Within Grays Harbor estuary, Bottle Beach State Park is located approximately 14 miles west of Aberdeen on State Highway 105. It is a 75-acre day-use park along the shore of Grays Harbor, offering birdwatching opportunities, especially shorebirds, with more than 130 species of birds observed there. The community of Ocean Shores on the northwest coast has multiple birdwatching locations especially related to the harbor.

The WDFW Johns River Wildlife Area is 1,500 acres midway between Aberdeen and Westport where waterfowl hunting is allowed, and trails provide good wildlife viewing opportunities during nonhunt seasons.

Along the Washington coastline south of Grays Harbor is the large Willapa Bay estuary with Willapa National Wildlife Refuge, which offers wildlife viewing as well as extensive hunting opportunities for big game and waterfowl.

5.9.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

A variety of outdoor pursuits are readily available in the local area. Locally Millersylvania State Park is approximately 8 miles from the Unit on the east side of I-5. The park offers camping (tent and RV), boating, swimming, mountain biking, hiking, fishing, day-use areas, metal detecting areas, amphitheater/programs, environmental learning center, and interpretation.

The State also manages the Scatter Creek Wildlife Area, which has several nearby units:

> The State-owned Black River Unit has 109 acres and is located 5.5 miles south of the Refuge-owned Black River Unit in Thurston County. The property provides upland and wetland habitats and fishing opportunities.
>
> Davis Creek Unit is approximately 500 acres and is located just outside the town of Oakville, near State Highway 12. Popular activities include hunting for waterfowl, deer, elk, and doves.

The site also hosts numerous specially permitted events for dog field trials and training. There is Chehalis River access for fishing on the eastern boundary of the property. This is an excellent birding area recognized by the Puget Lowlands Riparian Bird Conservation Area as a priority habitat.

The 492-acre Scatter Creek Unit is located 20 miles south of Olympia. Hunting, dog training, dog field trials, and exercising the family pet are dominant uses, as well as horseback riding, botanical studies, educational field trips, bird and wildlife watching, picnicking, and fishing. The landscape is a mixture of uplands, with upland game bird hunting opportunities.

Just north of the Unit boundary is Black Lake, which offers boat launch access to fish or waterski. Personal watercraft is allowed and annual high-speed boat races take place.

The Black River offers anglers opportunities to fish. Several boat launch sites are found near the communities of Littlerock and Gate. A private canoe rental location near Rochester also allows access to the River.

Fishing and waterfowl hunting by boat on the main stem of the river corridor occurs, although the Unit has never opened these recreational uses on Unit lands. The patchwork of land ownerships along the river prevents the Unit from administratively controlling these activities.

A boat launch site is located at 123rd Avenue. A small, undesignated area on the southeast side of the intersection of 123rd Avenue SW and La France Street SW provides access to the river. From this Thurston County property, boaters may proceed north or south on the main stem of the river. There is only a primitive dirt/gravel launch area at this location.

Motorized and non-motorized boating occurs on the main stem of the Black River, particularly between 110th and 123rd Avenues. The river provides a unique, non-motorized boating experience in the South Sound area because of the river's wild setting. Boaters may also go north of 110th Avenue, but this section, north to Black Lake, is challenging because of the dense vegetation, beaver dams, and the meandering nature of the river channel.

During the winter months, an elk herd browses in the open fields off Endicott Road/123rd Avenue SW and has become a somewhat popular attraction in recent years. Vehicles pull off the road in this area to view the overwintering herd and sometimes people leave their cars to stand beside fences to see them more clearly. The cars and people on the road are a safety hazard. There are currently no viewing facilities or parking in this area of the Unit.

Thurston County proposes constructing the Gate-Belmore hike-and-bike trail on the abandoned Burlington Northern Railroad. The proposed trail corridor would link the urban trail system from Tumwater at Kenneydell County Park with the south county communities of Gate and Rochester. The 12.5-mile trail would offer access to the Black River and would run adjacent to the Black River-Mima Prairie Glacial Heritage Preserve and Black River Natural Area just south of Littlerock. The trail would run near the Refuge and access to the Refuge has been proposed (see http://www.co.thurston.wa.us/parks/docs/preserve-plan-2013.pdf).

5.10 Recreation Trends

According to the National Survey on Recreation and the Environment (NSRE 2000), the six most popular individual outdoor recreational activities and percentage of the U.S. population participating were walking (87.1 percent), family gatherings (76.1 percent), viewing natural scenery (69.8 percent), visiting a nature center, nature trail, or zoo (62.8 percent), driving for pleasure through natural scenery (60.0 percent), and picnicking (59.9 percent). These types of activities are likely popular because the costs to participate are relatively low, physical exertion is minimal, and special equipment or developed skills are not required.

In the state of Washington, the Statewide Comprehensive Outdoor Recreation Plan (SCORP) developed by the Washington State Recreation and Conservation Office (RCO, formerly known as the Interagency Committee for Outdoor Recreation [IAC]) inventories outdoor recreation sites and opportunities; assesses recreational participation, preferences, and trends; and considers issues such as recreation equity, sustainability, land supply and use, the balance between habitat protection and recreation opportunities, economic and funding issues, and technology. The SCORP concludes with recommendations to help meet the outdoor recreation needs of residents and visitors and to enhance future outdoor recreation planning efforts. The most recently released Washington SCORP (RCO 2013) identified the 16 major categories of outdoor recreation. Table 5-2 lists the activities in order from most to least in terms of participation rates. Walking, hiking, climbing, and mountaineering activities, followed by recreational activities, had the highest levels of participation

Table 5-2. Ranking of Major Activity Areas of Washington State Residents (RCO 2013).

Activity Category	Percentage of Population
Walking, hiking, climbing, mountaineering	90.0
Recreational activities (team and individual sports, fitness activities, swimming, roller and inline skating, skateboarding)	82.7
Nature activities (including visiting nature centers, wildlife viewing, gathering/collecting things, and gardening)	81.4
Picnicking, barbequing, or cooking out	80.9
Water-related activities (including beach activities, boating/floating, surfing, water skiing, scuba/snorkeling, spray/splash parks)	75.2
Sightseeing	56.8
Camping	42.4
Bicycle riding	36.9
Fishing or shellfishing	34.1
Snow and ice activities (including snowshoeing, skiing, skating, and ATV riding on snow/ice)	31.3
Indoor community facilities	28.4
Hunting or shooting	21.4
Frisbee activities (including disc golf and ultimate frisbee/frisbee football)	16.8
Off-roading for recreation	15.3
Horseback riding	7.7
Air activities (including bungee jumping, sky diving, flying various aircraft, and ballooning)	3.8

Trends reported in the SCORP show that between 2006 and 2012, there was an increase in participation in many of the activities based in nature (including activities not encompassed by the more narrow definition of "nature-based activities"), such as hunting, visiting a nature interpretive center, fishing, camping, hiking, and wildlife viewing/photographing. While the most recently released Washington SCORP examined past trends, it did not offer forecasts of future regional recreation demands. A previous survey released by the Washington IAC (IAC 2002) states that outdoor recreation in most activities continues to increase at high growth rates. Many outdoor activities generally permitted on refuges are expected to show increases of 20–40 percent over the next 20 years. Table 5-3 shows the percentage change expected for Washington State by activity as reported by IAC in 2006.

Table 5-3. Projected Future Increase in Participation for Selected Outdoor Recreation Activities.

Activity Estimated Change	10 Years (2002–2012) Estimated Change	20 Years (2002–2022) Estimated Change
Hiking	10%	20%
Nature activities	23%	37%
Fishing	-5%	-10%
Hunting	-15%	-21%
Sightseeing	10%	20%
Camping	10%	20%
Canoeing/kayaking	21%	30%
Motor boating	10%	No estimate
Equestrian	5%	8%
Non-pool swimming	19%	29%

5.11 Special Designations

5.11.1 Grays Harbor National Wildlife Refuge

Grays Harbor Estuary has been given the designation of a Western Hemisphere Shorebird Reserve Network Site on the hemispheric level because of its importance to migratory shorebirds (see Chapter 1.8.1).

The Refuge was designated by the Washington Audubon Society as an Important Bird Area (IBA) of Washington State (Cullinan 2001)(see Chapter 1.8.2).

5.11.2 Black River Unit of Billy Frank Jr. National Wildlife Refuge

The Unit has no special designations.

5.12 Socioeconomic Environment

5.12.1 Grays Harbor National Wildlife Refuge

5.12.1.1 Population and Area Economy

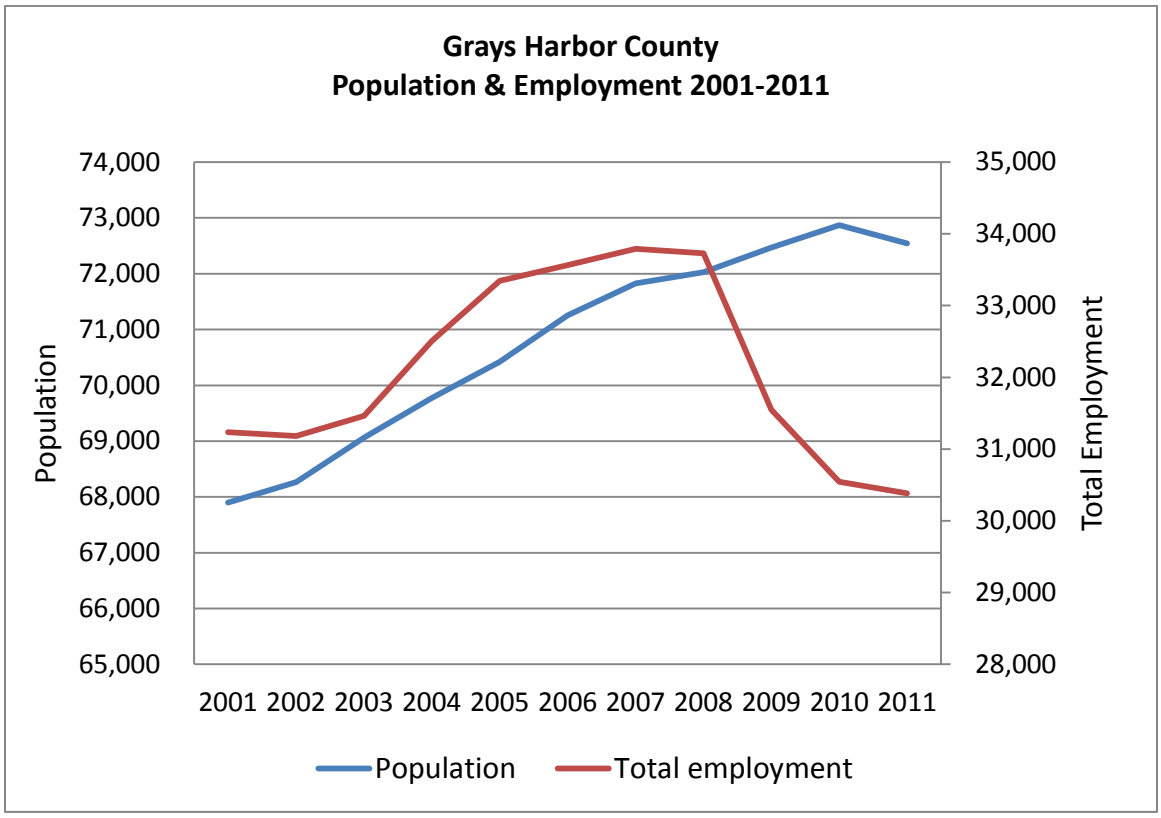
Grays Harbor Refuge is located in Hoquiam in Grays Harbor County. Aberdeen is contiguous with Hoquiam and supports a larger population than Hoquiam. Table 5-4 shows the population and area economy. The county population increased 7 percent from 2001 to 2011, compared with a 14 percent increase for Washington State and a 9 percent increase for the United States. County employment decreased by 3 percent from 2001 to 2011, compared to an employment increase in Washington State (9 percent) and the United States (6 percent). Per capita income in Grays Harbor County increased by 4 percent between 2001 and 2011, while Washington State and the United States both increased by 5 percent.

Table 5-4. Grays Harbor NWR: Summary of Area Economy, 2011 (Population & Employment in thousands; Per Capita Income in 2011 dollars)

	Population		Employment		Per Capita Income	
	2011	Percent change 2001-2011	2011	Percent change 2001-2011	2011	Percent change 2001-2011
Grays Harbor	72.5	7%	30.4	-3%	$30,355	4%
Washington	6,830.0	14%	3,828.6	9%	$43,878	5%
United States	311,591.9	9%	175,834.7	6%	$41,560	5%

Source: U.S. Department of Commerce 2012.

Figure 5-1. Grays Harbor County's population and employment over the last 10 years. In 2007, employment peaked at 33,792 and has since decreased to 30,382 in 2011, which is a 10 percent decrease. Employment changes were primarily in the construction and manufacturing sectors that experienced an increase in the first half of the decade and a subsequent decline in the latter half of the decade.



Source: Bureau of Economic Analysis 2012

The largest industry sectors for Grays Harbor County are ranked below by employment (Table 5-5). The largest employers are the State and local governments, followed by food services and drinking establishments.

Table 5-5. Industry Summary for Grays Harbor County (Dollars in thousands)

Industry	Employment	Output	Employment Income
State and local government	5,545	$291,018	$256,939
Food services and drinking establishments	1,891	$98,875	$31,013
Sawmills and wood preservation	1,156	$294,886	$66,812
Commercial logging	964	$231,322	$31,604
Private housekeeping and home care	837	$8,089	$7,058
Wholesale trade businesses	804	$117,550	$40,057
Health practitioner offices	769	$72,776	$32,763
Retail stores (food, beverage, general)	1,344	$91,932	$37,580
Civic, social, professional, and similar organizations	628	$26,699	$11,676
Construction of new nonresidential commercial and health care structures	605	$92,312	$28,561

Source: Implan 2008.

5.12.1.2 Local Community

The Refuge is in the City of Hoquiam and near Aberdeen. These cities suffered economic decline as the salmon fishing industry fell off and logging jobs decreased. The current economic downturn has made recovery difficult and the cities struggle with few jobs available and high unemployment. However the cities are well-situated for the tourism industry as the location is known as the gateway to the Olympic peninsula, Olympic National Park, communities along highway 101, and to miles of ocean beaches. Generally the demand for outdoor recreational opportunities is increasing both within the communities as well as from visitors.

5.12.1.3 Refuge Impact on the Local Economy

Visitors to the Refuge 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, 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 CCP.

5.12.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

5.12.2.1 Population and Area Economy

The Unit is located southwest of Olympia, Washington, in Thurston County. Table 5-6 shows the population and area economy. The county population increased 21 percent from 2001 to 2011, compared with a 14 percent increase for Washington State and a 9 percent increase for the United States. County employment increased by 16 percent from 2000 to 2010, compared to a smaller employment increase in Washington State (9 percent) and the United States (6 percent). Per capita income in Thurston County increased by 4 percent between 2000 and 2010, while Washington State and the United States both increased by 5 percent.

Table 5-6. Black River Unit: Summary of Area Economy, 2011 (Population & Employment in thousands; Per Capita Income in 2011 dollars)

	Population		Employment		Per Capita Income	
	2011	Percent change 2001-2011	2011	Percent change 2001-2011	2011	Percent change 2001-2011
Thurston County	256.6	21%	129.3	16%	$41,251	4%
Washington	6,830.0	14%	3,828.6	9%	$43,878	5%
United States	311,591.9	9%	175,834.7	6%	$41,560	5%

Source: U.S. Department of Commerce 2013.

The largest industry sectors for Thurston County are ranked below by employment (Table 5-7). The largest employers are the State and local governments followed by retail trade. Over the last 10 years, the largest employment increase occurred in administrative and waste management services (41 percent) while there was a decline in construction employment (8 percent).

Table 5-7. Employment Summary for Thurston County, 2011

Industry	Employment	Percentage Change 2001-2011
State and local government	34,763	2%
Retail trade	14,809	14%
Health care and social assistance	14,253	24%
Accommodation and food services	8,172	31%
Other services, except public administration	7,402	13%
Professional, scientific, and technical services	7,065	33%
Real estate and rental and leasing	5,625	39%

Industry	Employment	Percentage Change 2001-2011
Administrative and waste management services	5,617	41%
Construction	5,532	-8%
Finance and insurance	4,249	31%

Source: U.S. Department of Commerce 2013.

5.12.2.2 Local Community

The northern portion of the Unit is within 5 miles of Tumwater, 10 miles of Olympia, 15 miles of Lacey, and the southern end of the Unit is immediately north of Littlerock, a village based on a rural economy.

The cities of Tumwater, Lacey, and Olympia have grown together such that it is hard to know which municipality you are in. These three cities have a small-town feel to them and residents who value museums, theatre, and outdoor activities. The cities are well-situated for people passing through while traveling from Portland to Seattle or to the Olympic peninsula, Mt. Rainer National Park, or to the Cascade mountain range.

5.12.2.3 Refuge Impact on the Local Economy

Because the Unit has not been open to the public, there is little economic impact. The effects on the local economy associated with potential consumer expenditures (Alternative 2) on Unit-related recreation and effects associated with Unit budget expenditures are explored in detail in Chapter 6 of the CCP.

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Chapter 6 Environmental Consequences

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Chapter 6. Environmental Consequences

6.1 Introduction

This chapter provides analyses of the environmental consequences of implementing the alternatives described in Chapter 2. As appropriate, the potential effects of implementing the strategies described under each alternative were assessed for the main environmental resources described in Chapters 3–5, including physical, biological, cultural, and socioeconomic elements. The alternatives are compared side-by-side under each topic, and both the adverse and beneficial effects of implementing each alternative are described. The information used in this analysis was obtained from relevant scientific literature, existing databases and inventories, consultations with other professionals, and professional knowledge of resources based on field visits and experience.

Council on Environmental Quality (CEQ) regulations, which implement the provisions of NEPA, define the types of effects that should be evaluated in an environmental document, including direct, indirect, and cumulative (40 CFR § 1508.7) (CEQ 1997). Direct effects are generally caused by a particular action and occur at the same time and place as the action. Indirect effects are reasonably foreseeable effects caused by the proposed action, but occur later in time. Direct and indirect effects are addressed in the resource-specific sections of this chapter (Sections 6.2.1–6.2.10 for the Refuge and Sections 6.3.1–6.3.16 for the Unit). CEQ provides the following definition of cumulative effects:

> The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

Cumulative impacts can result from individually minor but cumulatively significant actions over time. This analysis is intended to consider the interaction of activities at the Refuge and the Unit with other actions occurring over a larger spatial and temporal frame of reference.

The overall cumulative effect on the environment from implementing the various alternatives is summarized in Section 6.2.11 for the Refuge and in Section 6.3.17 for the Unit. The cumulative effects analysis has essentially been completed by virtue of the comprehensive nature that the direct and indirect effects associated with implementing the various alternatives have been presented in the other sections of this chapter and in the Appropriate Refuge Uses and the Compatibility Determinations appendices. The cumulative effects sections focus on effects associated with reasonably foreseeable future events and/or actions regardless of what entity undertakes that action.

6.1.1 Effect Ratings Description

Although the analysis shows that none of the alternatives would be expected to result in significant (major) effects, some positive (beneficial) or negative effects are expected. The qualitative terms moderate (intermediate), minor, and negligible are used to describe the magnitude of the effect. To interpret these terms, moderate is of greater magnitude than minor, and minor is of greater magnitude than negligible. The word negligible is used to describe an effect that, when compared with the current situation, or the current situation forecast 15 years into the future, would not be measurable or would be difficult to measure.

The terms below are used to describe the scope, scale, and intensity of effects on natural, cultural, social (including recreational), and economic resources.

- **Neutral or Negligible.** Resources would not be affected (neutral effect), or the effects would be at or near the lowest level of detection (negligible effect). Resource conditions would not change or would be so slight that there would not be any measurable or perceptible consequence to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource. If a resource is not discussed, impacts to that resource are assumed to be neutral.

- **Minor.** Effects would be detectable within a refuge, but would be localized, small, and of little consequence to a population, wildlife or plant community, other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources. Mitigation, if needed to offset adverse effects, would be easily implemented and successful based on knowledge and experience.

- **Moderate or Intermediate.** Effects would be readily detectable and localized within a refuge, but not readily detectable or measurable beyond the refuge. Effects would have measurable consequences to a population, wildlife or plant community, or other natural resources; social values, including recreational opportunity and visitor experience; or cultural resources. Effects to economic values would not be readily detectable beyond the local community. Mitigation measures would likely be needed to offset adverse effects, and could be extensive, moderately complicated to implement, and probably successful based on knowledge and experience.

- **Significant or Major.** Region-wide effects would be obvious and would result in substantial consequences to a population, wildlife or plant community, or other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources. Extensive mitigating measures may be needed to offset adverse effects and would be large-scale in nature, possibly complicated to implement, and may not have a high probability for success. In some instances, major effects would include the irretrievable loss of the resource.

As appropriate, effects are identified as short-term or long-term, local or widespread, and, where data and analyses are available, effects are quantified.

Time and duration of effects have been defined as follows:

- **Short-term or Temporary.** An effect that generally would last less than a year or season.
- **Long-term.** A change in a resource or its condition that would last longer than a year or season.

6.1.2 Summary of Effects

Tables 6-1 and 6-2 provide overviews of the effects under each alternative by indicator. The effects related to implementing each alternative are described in terms of the change from current conditions (i.e., the environmental baseline). Alternative 1, the No-Action alternative, would continue present management actions. However, the consequences of implementing Alternative 1 may have

beneficial, neutral, or negative effects. For example, the continued use of IPM techniques under Alternative 1 to control invasive species would have a minor positive impact on native habitats and species.

Table 6-1. Summary of Effects under CCP Alternatives for Grays Harbor NWR.

	Alternative A (No Action, Current Management)	**Alternative 2 (Preferred Alternative)**
EFFECTS UPON THE PHYSICAL ENVIRONMENT		
Hydrology and Water Quality	Short-term, negligible to minor, negative Long-term, negligible to minor, positive	Short-term, negligible to minor, negative Long-term, negligible to minor, positive
Topography, Geology, and Soils	Short-term, minor, negative Long-term, moderate, positive	Short-term, minor, negative Long-term, moderate, positive
Air Quality	Short-term, minor, negative Long-term, negligible	Short-term, minor, negative Long-term, negligible
EFFECTS UPON WILDLIFE AND HABITAT		
Common to All Wildlife and Habitats	Short-term, negligible to minor, negative Long-term, minor, positive from public use and outreach programs; negligible to minor, positive from inventory, monitoring, and research	Short-term, negligible to minor, negative Long-term, minor, positive from public use and outreach programs; minor to moderate, positive from increased inventory, monitoring, and research
Estuarine Habitats and Associated Species	Short- and long-term, negligible to moderate, positive	Short-term, negligible to minor, negative Long-term, minor to moderate, positive
Forest Habitat and Associated Species	Short- and long-term, negligible	Short-term, minor, negative Long-term, minor to moderate, positive
Threatened and Endangered Species	Short-term, negligible to minor, negative Long-term, minor, positive	Short-term, negligible to minor, negative Long-term, minor to moderate, positive
EFFECTS UPON THE SOCIAL AND ECONOMIC ENVIRONMENT		
General Social Effects	Long-term, minor, positive	Long-term, moderate, positive
Wildlife Observation, Photography, Environmental Education, and Interpretation	Short- and long-term, negligible	Long-term, minor to moderate, positive
Cultural Resources	Negligible	Negligible
Economic	Negligible	Negligible to minor, positive

Table 6-2. Summary of Effects under CCP Alternatives for the Black River Unit.

	Alternative A (Current Management)	Alternative 2 (Preferred Alternative)
EFFECTS UPON THE PHYSICAL ENVIRONMENT		
Hydrology and Water Quality	Short-term, negligible to minor, negative Long-term, negligible to minor, positive	Short-term, negligible to minor, negative Long-term, minor, positive
Topography, Geology, and Soils	Short-term, minor, negative Long-term, negligible to minor, negative	Short-term, minor, negative Long-term, moderate, positive
Air Quality	Short-term, minor, negative Long-term, negligible	Short-term, minor, negative Long-term, negligible
EFFECTS UPON WILDLIFE AND HABITAT		
Common to All Wildlife and Habitats	Short-term, negligible to minor, negative Long-term, negligible to minor, positive from inventory, monitoring, and research	Short-term, negligible to minor, negative Long-term, minor, positive from public use and outreach programs; minor to moderate, positive from increased inventory, monitoring, and research
River and Tributary Channels and Associated Species	Minor, negative to negligible.	Minor to moderate, positive
Bog Habitats and Associated Species	Negligible	Short-term, negligible to minor, negative Long-term, moderate, positive
Shrub Swamp and Associated Species	Negligible	Short-term, negligible to minor, negative Long-term, minor to moderate, positive
Riparian Habitat and Associated Species	Negligible	Short-term, negligible to minor, negative Long-term, minor to moderate, positive
Emergent Marsh Habitat and Associated Species	Negligible	Short-term, negligible to minor, negative Long-term, moderate, positive
Seasonally Flooded, Nonnative Grassland and Associated Species	Short-term, minor to moderate, negative Long-term, negligible	Short-term, minor to moderate, negative Long-term, moderate, positive
Dry, Nonnative Grassland Habitat and Associated Species	Negligible to minor, positive	Short-term, minor, negative Long-term, minor, positive from wildlife and habitat management actions; long-term, negligible to minor, negative from public use

	Alternative A (Current Management)	Alternative 2 (Preferred Alternative)
Mixed Forest and Associated Species	Negligible	Short-term, minor, negative Long-term, minor, positive
Threatened and Endangered Species	Short- and long-term, minor, positive	Short- and long-term, minor to moderate, positive
EFFECTS UPON THE SOCIAL AND ECONOMIC ENVIRONMENT		
General Social Effects	Neutral	Short- and long-term, minor to moderate, positive
Wildlife Observation, Photography, and Interpretation	Neutral	Short- and long-term, minor to moderate, positive
Cultural Resources	Negligible	Negligible
Economic	Negligible	Negligible

6.2 Grays Harbor National Wildlife Refuge

6.2.1 Effects Common to All Alternatives at Grays Harbor National Wildlife Refuge

Effects Common to All Alternatives from Integrated Pest Management (IPM)

Under both alternatives, the Refuge would continue to work with Grays Harbor Noxious Weed Control Agency, Grays Harbor Public Utilities District, Grays Harbor County, the Port of Grays Harbor, WDFW, Washington State Agriculture Department, WDNR, and others to assure the highest priority invasive species threatening estuary habitats are addressed.

Mechanical, cultural, biological, and chemical control methods would be evaluated for eradication, control, or containment of invasive species in order to achieve resource management objectives (see Appendix G. IPM). Pesticide chemical selection and usage will be subject to regionally reviewed State regulations, State and federally approved herbicides and adjuvants, Service-approved Pesticide Use Proposals (PUPs), and EPA's Pesticide General Permit (PGPs). Pesticide chemical selection will also conform to the specific pesticide label requirements and be applied by licensed applicators. Service guidelines direct the Refuge to use the most efficacious pesticide available with the least potential to degrade environmental quality (soils, surface water, groundwater, and air), as well as minimizing potential effect to native nontarget species. Additionally, adjuvants (an additive that increases herbicide effectiveness such as increasing adhesion to target plants) should have the least potential effect to native nontarget species.

Potential effects to the biological and physical environment are associated with the proposed site-, time-, and target-specific use of pesticides. PUPs on the Refuge would be evaluated using scientific information and analyses documented in "Chemical Profiles" (see Appendix G). These profiles provide quantitative assessment and screening tools and threshold values to evaluate potential effects to species groups (birds, mammals, and fish) and environmental quality (water, soil, and air). Any pesticide use must be approved through a PUP. PUPs (including appropriate BMPs) would be approved where the Chemical Profiles provide scientific evidence that potential impacts to the

Refuge's biological resources and its physical environment are likely to be only minor, temporary, or localized in nature.

Based on scientific information and analyses documented in Chemical Profiles, most pesticides allowed for use on Refuge lands and waters would be of relatively low risk to nontarget organisms as a result of low toxicity or short-term persistence in the environment. Thus, potential impacts to Refuge resources and neighboring natural resources from pesticide applications would be expected to be minor, temporary, or localized in nature.

Some risks may still occur via factors not assessed under current protocols, such as intermingling of unlike chemicals in the field, species-specific sensitivity that differs from surrogate species sensitivity, exposure through inhalation, exposure through ingestion of pesticide-contaminated soil, and other factors (see Appendix G).

The effects of nonpesticide IPM strategies to address pest species on the Refuge would be similar to those effects described elsewhere in this chapter, where they are discussed specifically as habitat management techniques to achieve resource management objectives on the Refuge.

The associated fieldwork of invasive plant control can temporarily cause wildlife to move away and slight habitat disturbances. Invasive species may be spread by moving Refuge equipment from site to site. These species may also become established where soils and existing plant cover is disturbed. The Refuge equipment operators would be required to clean equipment before moving between sites to reduce the spread of seeds and plant parts. The Refuge would continue to monitor habitats for invasive weeds, aggressively control invasive plants, and restore sites to vegetation with high wildlife value. If mechanical methods are not expected to be effective or would have undesirable consequences, such as the destruction of desirable vegetation that is interspersed with weed species, then the Refuge may decide to use an herbicide. Employment of a conservative approach with herbicides would result in minor, localized, short-term negative effects and negligible long-term effects from chemical exposure. Long-term negative effects are not expected; instead, the effects should be positive on fish and wildlife as their respective habitats would be in better condition to support each species group.

Effects Common to All Alternatives Regarding Nature Center and Other Facilities Planning

In 2007, the Service developed a conceptual building design for a nature center and associated facilities, based on standard designs for Refuge facilities, to be located within a 4-acre site along the east boundary of the Refuge and the west side of Paulson Road. Under all alternatives, the Service proposes to work with other agencies, current and new partners, the local community, and others to review the 2007 nature center plan and to evaluate other options, including alternate funding, sites, and designs, that could lead to a viable solution that meets the purpose and need. If implemented, the Refuge would work with partners to develop biological, ecological, and cultural education and interpretative content as well as any associated facilities (e.g., trails, viewing platforms). However, prior to implementation, more detailed planning, design, and appropriate evaluation would need to be undertaken, including additional effects assessment in compliance with NEPA, evaluation and consultation under Section 7 of ESA, and surveys and consultation under Section 106 of NHPA. Further discussion of impacts would depend upon site selection for and design, construction, and operation of the facilities.

Effects Common to All Alternatives Regarding Estuary Restoration

An estuary restoration project that includes berm removal is planned under Alternatives 1 and 2. This project was identified as a mitigation project for Grays Harbor Refuge in the 2004 Nestucca Oil Spill Plan. With project funding, approximately 15–20 acres of compromised salt and brackish marsh habitat would be restored to a more natural function with the removal of the artificial berm. The Service would coordinate with Federal, State, and county agencies on restoration design review.

The artificial berm runs northwest to southeast through the eastern portion of the Refuge and occurs in two sections, separated by a slough that runs through the Refuge (Map 1). The south berm is approximately 900 feet long by 13 feet wide by 3 feet high. The north berm is similar in width and height, and approximately 500 feet long. Heavy equipment would be used to remove the berm down to grade. Berm materials (approximately 1,350 cubic yards) would need to be hauled offsite. Historic tidal channels would be reconnected and graded to encourage water flows within the upper saltmarsh and eliminate ponding of water.

In the short term, construction activities requiring the use of heavy equipment to remove the artificial berm could lead to temporary localized increases in water turbidity, contribution of sediment to the estuary, and impacts to estuarine soil quality such as compaction and loss of soil organic matter. These activities also bring the risk of water contamination with petroleum products. However, the implementation of BMPs associated with all construction activities would reduce the likelihood of excess turbidity, sedimentation, contamination, and ground disturbance. To decrease soil compaction, minimize the creation of unwanted depressions, and encourage quicker growth of native vegetation in the area, a combination of wide-tracked equipment with low ground pressure would be used (e.g., excavator, bulldozer). Overall, implementation of the restoration is expected to have negligible to minor short-term negative effects and minor positive long-term impacts to hydrology and water quality. Expected effects to soils would be minor and short-term but moderately beneficial in the long term.

Mosquitoes are a natural part of the Refuge's ecosystem and are a natural occurrence in salt marsh habitats. It is unknown if the berm allows for a larger than normal mosquito population due to the ponding effects created by the reduction in tidal flows within the saltmarsh. However, removal of the berm and attention to channel elevations would improve tidal movement and minimize ponding of water, thereby reducing mosquito reproduction. This restoration would likely have a negligible effect on reliant species (birds) or as a nuisance to humans.

This project would enhance habitat values and benefit migratory and resident shorebirds, waterfowl, seabirds, and wading birds by providing better quality cover at low tides, larger open water habitat during high tide, and improved foraging areas for a diversity of wildlife, plants, and fish species. Additional species that may benefit include the long-tailed weasel, river otter, garter snake, terrestrial and aquatic insects, and possibly Newcomb's littorine snail.

If present, when tides are at a very high level which allows marsh inundation, federally listed juvenile green sturgeon, bull trout, and eulachon could experience negligible to minor localized short-term negative effects associated with potential increases in sediments in the water caused by restoration actions. The berm deconstruction would take place during low tides, would be a temporary, one-time action of short duration, and would not likely create significant negative impacts to listed species. The twice-daily tides would likely dissipate excess sediments from berm removal activities. Staff would utilize proper BMPs and meet all permit requirements such as approved in-

water work widows, June 15–Feb 28 (salmon) and July 16–February 15 (bull trout), for fish protection. Long-term effects of estuarine restoration would be minor to moderately beneficial to these and other species since they would gain better access to areas of salt marsh and ultimately better foraging areas.

The overall beneficial effects for this action would be moderate, with long-term positive effects on the overall health and quality of the salt and brackish marsh habitats and wildlife. Once the artificial berm is removed, full tidal circulation would occur allowing the quality and complexity of saltmarsh habitat to improve. Without the vegetated berm, the highest high tides and storm flood events would spread out evenly across the salt marsh and help to reestablish functional processes of the saltmarsh. The deeper channels in the sloughs would no longer pond water behind the berm, thereby reducing the potential to trap fish. Wildlife would likely inhabit and utilize larger areas across the entire salt marsh. Native estuarine plants (e.g., pickleweed, tufted hairgrass, seashore salt grass, Lyngby's sedge) would repopulate the restoration area as twice-daily tidal flows naturally spread available seeds. The establishment of additional native plant species would provide high quality detritus to estuary water and provide better quality habitat for native marine invertebrates and fish during high tide. Monitoring and adaptive management would ensure the project habitat and wildlife goals are achieved over time.

Effects Common to All Alternatives Regarding Sweetgrass

Sweetgrass is a component of saltmarsh vegetation and is an important tribal resource that is used for traditional cultural practices. Under Alternatives 1 and 2, the Refuge would continue to monitor and manage the sweetgrass stands for stand health, focusing on removing invasive plants that outcompete native sweetgrass. Short-term, minor negative effects to sweetgrass may be incurred while using IPM methods to control invasive plants. Methods to control problem plants include digging them out or applying a State-, Service-, and EPA-approved aquatic herbicide (see Appendix G). Long-term beneficial effects to sweetgrass range from minor, if little work is needed, to moderate if dense invasive plant development occurs. Beneficial effects are magnified as there are relatively few other sweetgrass stands known in the Grays Harbor estuary.

Additionally, under all alternatives, the Refuge would continue to support traditional cultural use and issue SUPs to Native American tribal members for gathering sweetgrass. Permit stipulations are designed to provide long-term habitat protection and to sustain a thriving population of sweetgrass on the Refuge, leading to negligible to minor negative impacts. Compatibility determinations in Appendix B have more information on plant gathering (sweetgrass).

6.2.2 Effects to the Physical Environment at Grays Harbor National Wildlife Refuge

Effects to Hydrology and Water Quality

Under Alternatives 1 and 2, the proposed saltmarsh restoration with berm removal is anticipated to have negligible to minor, short-term, negative effects and minor, long-term, positive impacts to hydrology and water quality. See Section 6.2.1 Effects Common to All Alternatives Regarding Estuary Restoration for more information.

Minor, short-term impacts to water quality could occur under both alternatives, stemming from the control of invasive plant species. In situations where mechanical and cultural invasive plant control methods are ineffective, the Refuge may use approved herbicides in accordance with the Refuge's IPM program. Although mechanical removal has the potential to expose soils to wind and water erosion, this activity would be limited, largely due to the use of hand tools and would focus on individual plant removal, rather than the removal of large areas of vegetation. Therefore, the continuation of this control method is not expected to introduce substantial amounts of additional sediments into the estuary. The use of herbicides or pesticides to control invasive plants or animals also poses several environmental risks, including drift, volatilization, persistence in the environment, water contamination, and harmful effects to wildlife. The potential for such risks are considered minimal due to the types of herbicides used (nonpersistent) and the precautionary measures taken during application (see Appendix G.). Effects would not be considered significant under any alternative.

Under both alternatives, the Service is committed to working with partners in order to perform rapid response to oil spills or other contaminant events in Grays Harbor estuary in accordance with the Grays Harbor Geographic Response Plan. This strategy would provide moderate positive impacts in the event of contamination or water quality issues.

Under Alternative 2, the design and construction of viewing platforms, boardwalk/trail extensions, and interpretive panels would be strategic to minimize short-term and long-term negative impacts to water quality. BMPs would be incorporated into the placement, design, and construction to address potential short-term and long-term effects, such as stormwater runoff and erosion control. Anticipated effects would be minor negative in the short term and negligible to minor negative in the long term.

Overall Effects

Under both alternatives, Refuge hydrology and water quality would experience an overall negligible to minor, long-term, positive effect. Some localized, short-term, negative effects might occur associated with various invasive species removal efforts or other habitat management activities including the berm removal, although they would be minimized by implementing BMPs. Alternative 2 proposes the construction of viewing platforms, boardwalk/trail extensions, and interpretive panels which would result in slightly increased short-term negative impacts compared to Alternative 1. However, overall short-term impacts under both alternatives would be negligible to minor negative.

Effects to Topography, Geology, and Soils

Common to both alternatives, salt marsh restoration with berm removal would result in minor, short-term, negative effects but moderate, long-term, positive effects. See Section 6.2.1 Effects Common to All Alternatives Regarding Estuary Restoration for more information.

Under Alternative 2, inventory, monitoring, and research addressing questions such as sedimentation rates may have some temporary but negligible to minor, negative effects on the mudflat soils and benthic invertebrates. The proposed study would be beneficial by increasing our knowledge of how sediments move, accrete, and contribute to habitat changes in the Refuge, which would benefit habitat management in the long term.

In Alternative 2, the Refuge would likely use the pin foundation method to significantly reduce the amount of soil compaction and coverage while constructing the boardwalks and viewing platforms (Pin Foundation 2013). All equipment would move to the specific worksite on top of the existing boardwalks and significantly reduce the potential for soil compaction, rutting, or other damage. It is unlikely that heavy equipment would be used in the vicinity of estuarine saltmarsh or upland forest to accomplish one-time construction activities to improve public access with enhanced facilities. However, if heavy equipment is used it would only be during the summer dry season and if necessary at low tide. BMPs would be developed to ensure the least amount of disturbance possible in construction of new boardwalks and viewing platform facilities. Expected negative effects would be minor and short-term.

Overall Effects

In either alternative the overall proposed use of heavy equipment on specific projects may produce temporarily disturbed soils. BMPs would be used to minimize negative effects as much as possible on each construction project. The salt marsh restoration with berm removal would have minor, short-term, negative effects to the soils, but overall will have moderately beneficial effects on estuarine resources. Overall, under both alternatives, minor, short-term, negative effects may occur to specific, small locations of soil; however, in the long term, moderate, positive effects are anticipated.

Effects to Air Quality

The activities proposed may result in a slight and temporary increase in vehicle emissions due to the proposed salt marsh estuarine restoration and new visitor facilities construction identified in the CCP. Once completed, there would be no need for further active management with equipment on these lands.

A slight increase in vehicular emissions could be expected due to an increase in visitation with the proposed visitor services improvements under Alternative 2, including new boardwalk, trails, and viewing platforms.

Overall Effects

Overall, long-term effects to air quality should be negligible under all alternatives. None of the alternatives would be expected to have significant, long-term effects to air quality compared to the environmental baseline. Some minor, short-term impacts to local air quality may result from Refuge management actions.

6.2.3 Effects Common to All Habitats and Wildlife at Grays Harbor National Wildlife Refuge

Under Alternative 1, wildlife-dependent public uses and Refuge outreach programs would continue. These programs play a key role in fostering public understanding, appreciation, and support for the Refuge's native plants and habitats and would lead to long-term, indirect, and minor benefits to the conservation of these resources. Under Alternative 2, the quality and quantity of these programs would expand slightly and lead to similar benefits as in Alternative 1. Disturbance impacts to specific habitat types as a result of public use programs are discussed in the following sections.

Under Alternative 1, inventory, monitoring, research, and scientific assessments regarding natural and cultural resources, public uses, and interactions among these elements would continue as at present. Relative to habitats, plant communities, and wildlife, most of these activities would involve observation and measurement. Occasionally, tissues or whole specimens of native or nonnative plants would be taken, removed, transplanted, or outplanted. Additionally, some of these activities would involve implementing and assessing various habitat management techniques at small scales. Disturbance, including trampling and potentially transporting nonnative species, would be the primary effect of the vast majority of these activities. The effects of some of these activities, such as inventories of invasive plants or evaluations of the contributions of specific habitat management practices to achievement of goals and objectives, would be primarily local.

Management-related research would be evaluated on an individual basis depending on the value and need of the information gained and the short- and long-term impacts. Research that is beneficial and applicable to the Refuge's management programs is more likely to receive approval. Many research projects are conducted by Refuge partners (State, Federal, nongovernment organizations) and universities under the guidelines of a Special Use Permit and would provide positive effects ranging from minor, short-term to moderate, long-term.

Overall, these activities would generate information which would be analyzed and interpreted to help Refuge staff assess the efficacy of management practices and facilitate appropriate course corrections as part of the adaptive management process. The effects of these activities on habitats, plant communities, and wildlife would be negligible to minor and positive. Compatibility determinations included in Appendix B address the effects and conditions associated with these uses in greater detail.

Under Alternative 2, inventory, monitoring, research, and scientific assessments regarding natural and cultural resources, public uses, and interactions among these elements would increase compared to those occurring at present. In addition to generating the same types of effects described for Alternative 1, it would be expected that this would result in an increase in information about the habitats, plant communities, and wildlife within the Refuge. This would reduce uncertainty associated with wildlife and plant responses to habitat management, promote achievement of management goals and objectives, and facilitate adaptive management. For example, this would include better information about the efficacy of pest management programs.

Through application of adaptive management principles, enhanced knowledge would slowly lead to improved management and an increase in the health, productivity, and value of the Refuge's wildlife habitats and plant communities to native vegetation and wildlife and an increase in the abundance and diversity of native wildlife within the Refuge. The effects of these activities on the Refuge's habitats, plant communities, and wildlife would have beneficial minor to moderate effects. Compatibility determinations included in Appendix B address the effects of and conditions associated with these uses in greater detail.

Specific research projects on mudflat sedimentation and sea level rise are priority projects. Some of the associated fieldwork may cause minor, localized, short-term effects such as temporarily causing fish and wildlife to move away from the research site and minor habitat disturbances. Some identified contaminants research may require removing a few individual shorebirds to test for contaminant loads as recommended in the Contaminant Assessment Process (CAP). The collection would negatively affect the individuals, but would cause negligible long-term effects to the west coast shorebird population.

6.2.4 Effects to Estuarine Habitats and Associated Species at Grays Harbor National Wildlife Refuge

Effects of Habitat Management Actions

Common to both alternatives, salt marsh restoration with berm removal would result in minor, short-term, negative effects but moderate, long-term, positive effects. See Section 6.2.1 Effects Common to All Alternatives Regarding Estuary Restoration for more information.

Alternatives 1 and 2 are similar (see Section 6.2.1) in the proposed IPM treatments to control invasive plants and animals to promote and improve healthy native habitats for fish and wildlife; however, Alternative 2 is more encompassing. Under Alternative 1, there would be negligible to minor, long-term, positive effects from maintaining existing habitats utilizing the current IPM management priorities, partnerships, and techniques for habitat improvements.

Alternative 2 proposes the Refuge would actively seek new partnerships and strengthen existing partnerships to control priority invasive species within all habitats. The Refuge staff would focus on newly invading problematic plant and animal species while also expanding control efforts on existing infestations. Invasive species control efforts would be implemented, with systematic follow-up control efforts, mapping, resource monitoring, and follow-up control measures as necessary. This sequence of activities would provide moderate positive effects to wildlife by removing the invasive species and improving the health of the habitat over the long term.

Refuge staff would be watching for changes in State guidelines regarding the control of nonnative aquatic Japanese or Asian eelgrass and determine a course of action. The overall extent or degree of Japanese eelgrass infestation within the tidal open water and intertidal mudflat habitats inside the Refuge boundary is currently unknown. Under Alternative 2, staff would work with partners to identify the extent of the infestation. Partnerships would develop removal methods, map sites within the Refuge boundary, and implement effective aquatic plant control actions, with follow-up monitoring and necessary treatment. Invasive plant eradication would be localized, within the Refuge boundary, and would likely result in long-term positive effects on the native eelgrass beds and wildlife with the removal of invasive Japanese or Asian eelgrass. Results of the control efforts are expected to be quantifiable through active routine monitoring and mapping with staff and partners. Refuge wildlife would benefit extensively as native eelgrass beds would expand and offer forage and foraging areas for a variety of shorebirds and migrating waterfowl. Expanded and healthy native eelgrass beds offer benthic and water column invertebrates quality habitat for laying eggs. The effects of control measures would likely be positive in the short and long term with minor to moderate effects dependent on the overall size of the infestation.

The associated fieldwork of invasive plant control can temporarily cause fish and wildlife to move away and negligible habitat disturbances. Estuarine species dependent upon native habitats for foraging, prey, cover, and loafing benefit from invasive plant control. A conservative approach (using the least amount of herbicides practical to achieve results) with the application of herbicides to eliminate the invasive plant would result in minor to moderate short-term effects from chemical exposure and negligible long-term effects. Long-term negative effects are not expected, instead effects would likely be localized and minor with a positive effect on fish and wildlife as their respective habitats would be in healthier condition to support each species group.

Refuge management would place a greater focus on managing invasive species on Refuge specific habitats while continuing partnerships throughout the estuary. The effects would be a moderate, long-term habitat enhancement over the current conditions. The effects of the above actions to remove invasive plants would specifically improve the intertidal mudflat habitat (native eelgrass beds), salt and brackish marsh habitats. A variety of species directly affected by these proposed actions all rely on a healthy intertidal mudflat habitat, salt and brackish marsh habitats, and forest habitats to provide high-quality food, cover, resting, loafing, and for some species, nesting areas. A variety of species utilizing the Refuge would benefit from invasive species management, including dabbling and diving ducks; geese; waterbirds such as loon, cormorant, brown pelicans; marshbirds such as herons and rails; shorebirds and other wading bird species; gulls and terns; raptors; and passerines. Invertebrate and fish species are expected to respond positively to invasive species management, especially when the habitat becomes a more diverse assemblage plant species.

Effects of Visitor Services Actions

Currently, all public access on the Refuge is located on the boardwalk trails, the Sandpiper Trail, and the Red Knot Spur. These trails provide visitors with high-quality shorebird viewing and photography opportunities while protecting sensitive estuarine habitats. Disturbance associated with visitation and participation in programs such as wildlife observation, photography, and environmental education would have negligible long-term effects because birds and animals have shown habituation to human presence on and around the existing Refuge boardwalk.

Alternative 2 proposes several new construction projects, the Red Knot Spur Trail (250-foot extension) and three new observation platforms to view estuarine habitats. As proposed, these facilities would provide additional opportunities to observe and photograph wildlife and would result in less congestion during peak migration periods and special events. During construction of the proposed facilities, minor short-term disturbance to wildlife would likely occur at the worksite. The pin foundation is expected to be used for the proposed structures. It was used on the original boardwalk and has been found to have a negligible short-term effect on the habitat. Construction timing would be limited to nonsensitive times such as nonshorebird migration and nonpasserine nesting periods. Long-term loss of habitat would be minimal because of the small footprint of the projects.

Alternative 2 also identifies and increases the Refuge's outreach and education efforts for the local and visiting public through a variety of projects, including directional signage, interpretive panels, education programs, electronic and print media, and other techniques. Combined with the additional visitor services facilities, these projects could have an indirect neutral to minor beneficial effect in the long term by increasing public awareness and helping to foster a sense of appreciation for the Refuge and the estuarine resources.

Overall Effects

Under Alternative 1, the Refuge would continue to protect the tidal open water, intertidal mudflats, and tidal salt and brackish marsh habitats. Staff would continue to implement IPM for protection of habitats. The effects from invasive species removal would be localized and short- and long-term effects would be minor to moderate (dependent on the level of infestation), providing improved habitats for wildlife.

Under Alternative 2, increases in IPM would help improve estuarine habitat structure, plant diversity, and native plant composition. Temporary localized disturbance and damage would have minor short-term effects. Fieldwork to do inventory, monitoring, and research may also cause negligible to minor short-term disturbances. However, enhanced habitat structure and composition would have moderate long-term beneficial effects for fish and wildlife, especially shorebirds. Minor, short-term negative effects on wildlife would occur with additional boardwalk and viewing platform construction in the salt marsh habitat. In the long term, negligible direct effects are expected from the new facilities.

Overall, habitat management actions under Alternative 2 represent a minor to moderate positive effect to both estuarine habitat quantity and quality for associated species. This more than offsets the negligible to minor negative effects and short-term effects on habitats or associated wildlife resulting from additional visitor service actions. Visitor services programs could have indirect minor to moderate long-term beneficial effects as visitors learn more about habitat and wildlife conservation.

6.2.5 Effects to Forest Habitat and Associated Species at Grays Harbor National Wildlife Refuge

Effects of Habitat Management Actions

Alternatives 1 and 2 are similar, except in Alternative 2 additional effort would be made to create partnerships to control nonnative, invasive knotweed on the north side of the Refuge. The Refuge would actively seek new partnerships and strengthen existing partnerships to control knotweed and to stay abreast of newly developing problematic species that may invade the forest habitat. The Refuge would continue to work with Grays Harbor Noxious Weed Control Agency, Grays Harbor PUD, Grays Harbor County, State agencies, and others to assure the highest priority species are addressed.

Minor, long-term, positive effects of habitat management are anticipated. Active and collaborative control of aggressive invasive plant species enables native species to outcompete for resources and improves the quality of the forest habitat. The vegetative transition to a native successional stage with equitable vertical structure provides improved forage, cover, and nesting opportunities for a diversity of resident and migratory bird species, including songbirds, raptors, small mammals, black-tailed deer, reptiles, amphibians, and invertebrates.

Effects of Visitor Services Actions

The existing boardwalk has negligible effect on the habitat and with time, the surrounding vegetation has formed a natural blind that minimizes human-induced disturbance to wildlife while increasing the quality of the wildlife observation experience to visitors. The additional observation platforms and a 250-foot extension of the Red Knot Spur trail under Alternative 2 would have short-term effects during construction; however, the design, timing, and placement of this new structure would incorporate factors to decrease negative short- and long-term effects on wildlife and habitat.

Overall Effects

In summary, Alternative 1 has negligible effect and the use of the specified habitat management techniques of Alternative 2 would help maintain and improve forest habitat structure, plant diversity, and native plant composition by removing invasive plant and animal species. Minor, temporary, localized disturbance could occur as a result of using these habitat management techniques, but these

effects would be temporary and shortly eclipsed by enhanced habitat structure and composition. Overall, wildlife management actions under Alternative 2 represent a minor to moderate positive effect to both forest habitat and quality for associated species.

Considering visitor services, the long-term effect of these minor human disturbances would have a negligible impact to migratory and resident forest wildlife and may be balanced by the long-term beneficial effect of using boardwalks to prevent trampling of habitats and indirect minor to moderate long-term beneficial effects regarding visitor education on habitat and wildlife conservation. The overall effect may represent a minor positive effect forest habitat and migratory and resident forest wildlife.

6.2.6 Effects to Threatened and Endangered Species at Grays Harbor National Wildlife Refuge

Effects of Habitat Management Actions

It is the policy of the Service to protect and preserve all native species of fish, amphibians, reptiles, birds, mammals, invertebrates, and plants and their habitats, that are designated federally threatened or endangered. Listed species receive special consideration in terms of Refuge management. Federally listed species are trust resources that require additional consultation whenever an activity conducted by or permitted by the Refuge may have an effect on these species or their habitats.

Currently, federally listed anadromous green sturgeon, eulachon, and bull trout all pass through the greater Grays Harbor estuary twice in their lifetime (see Chapter 4). These listed fish are thought to seasonally use eelgrass beds, salt marshes, intertidal mudflats, and open water habitats of the Refuge. Information regarding probable fish use of Refuge habitats has been garnered from surveys conducted near the Refuge (see Chapter 4. Section 4.4.1 Major Species Groups and 4.5 Threatened, Endangered, and Sensitive Species).

Common to both alternatives, salt marsh restoration with berm removal would result in negligible to minor short-term negative effects but minor to moderate long-term positive effects. See Section 6.2.1 Effects Common to All Alternatives Regarding Estuary Restoration for more information.

Discussions regarding effects on fish and wildlife species from habitat management are assessed in Section 6.2.4, and impacts associated with the use of herbicides and pesticides are assessed in depth in Appendix G. Disturbances from invasive plant control may temporarily cause listed fish to move away from the worksite. A conservative approach with herbicides and BMPs would result in minor, long-term, positive effects to the habitats. Long-term effects to habitats would be expected to be beneficial to listed fish dependent upon healthy native estuarine habitats for foraging, prey, cover, and loafing.

As part of both alternatives, an Inventory and Monitoring Plan would be developed to guide needed baseline data, ongoing monitoring, and research to enhance habitat and species management of the Refuge or the greater estuary. Threatened and endangered species seasonality, needs, and tolerances will be explored and taken into account during the planning and implementation processes.

Effects of Visitor Services Actions

As explored in the Compatibility Determinations (Appendix B), wildlife observation, photography, interpretation, and environmental education activities would not likely pose impacts to these threatened and endangered species in Alternative 2. Visitor activities and access are not conducted within the estuarine or marsh habitats.

Overall Effects

Overall, under Alternative 1, minor, long-term, positive effects are expected on federally listed anadromous green sturgeon, eulachon, and bull trout and on their habitats as native habitats are restored and enhanced. Due to the increases in IPM and habitat improvements, under Alternative 2, minor to moderate, long-term, positive effects are expected to listed species.

6.2.7 Effects to Visitor Services at Grays Harbor National Wildlife Refuge

Welcoming visitors and providing opportunities for compatible wildlife-dependent activities such as wildlife observation, interpretation, wildlife photography, and environmental education are important parts of the National Wildlife Refuge System.

Effects of General Social Environment Actions

Several general social effects apply across the visitor services program and are not tied to specific wildlife-dependent recreation and education opportunities. Refuge management can influence the number of visitors. Refuge decisions about features of visitor services management—such as how many facilities to build, where to build those facilities, how much staff time to devote to programs, and how much parking to provide—all may influence visitation for years to come. Similarly, and often playing a greater role, demographic shifts, cultural preferences, and economics influence Refuge visitation. Even small annual shifts in visitation can have a profound effect over time.

Under Alternative 1, visitation is anticipated to remain at approximately the same level as the 2011 baseline. Under Alternative 2, the proposed increases in visitor opportunities, expanded outreach and information, enhanced environmental education program, new facilities (boardwalks and viewing areas), new communication tools, and general rising interest in the Refuge would increase visitation in the next 20 years by 20–40 percent, from 15,572 (2011) to approximately 21,750 visitors per year.

Increased contact with the public provides an opportunity for better visitor understanding and subsequent support of the Refuge and the Refuge System. Improvement of existing visitor facilities would lead to safer, more comfortable visitor experiences. On the other hand, increased visitation may lead to crowding at times such as weekends and during spring shorebird migration when visitation tends to be greatest. This could lead to a slight long-term negative effect to the quality of individual visitor experiences or may have a slightly beneficial effect for visitors exposed to the contagious excitement of seeing large numbers of shorebirds.

The overall general social effects would be minor to moderately positive for visitors. See remaining sections of Chapter 6 and Appendix B for more detailed analysis of wildlife-dependent recreation and education activities.

Effects of Facilities

Under Alternative 1, the Refuge would maintain the current 4,000-square-foot storage building (Map 1). Under Alternative 2, the Refuge storage facility would be converted to a Refuge maintenance shop. The building and parking footprint would not be expected to increase in size, therefore conversion to a maintenance shop and use of the building on a regular routine basis would cause negligible, long-term effects on habitat and wildlife; however, the new maintenance shop would benefit habitat management and trail and visitor facility maintenance programs and could lead to indirect, positive social effects.

As described within Section 6.2.1 Effects Common to All Alternatives Regarding Nature Center and Other Facilities Planning, further assessments of effects related to potential new visitor services facilities would be conducted in the future in association with more detailed planning and design, and, as appropriate, as part of a separate NEPA process and document.

Overall Effects

Overall impacts involving the visitor services program would offer a long-term positive improvement in the amount of onsite environmental education and wildlife-dependent recreation opportunities available to visitors on the north side of the greater Grays Harbor estuary. Priority visitor opportunities would increase and improve with the establishment of new information facilities and access. These improvements may also help address potential adverse effects to the habitat that may result as the human population and Refuge visitation increases; boardwalks and kiosks would aid in directing visitors to areas with minimal impacts to the habitat and wildlife.

6.2.8 Effects to Opportunities for Quality Wildlife Observation, Photography, Interpretation, and Environmental Education Experiences at Grays Harbor National Wildlife Refuge

Effects of Habitat Management Actions

Alternative 1 has negligible effects from existing habitat management. Alternative 2 provides an increase in the number of improved acres of habitat from invasive species treatment relative to Alternative 1. Through habitat management projects these improvements would likely result in enhanced opportunities to observe a variety of shorebirds, passerines, waterfowl, marshbirds, raptors, small mammals, insects, native wildlife, and native plants. There may be some negative short-term effects to the visitor experience as various habitat management actions are implemented but these are expected to be temporary and negligible and result in beneficial long-term effects.

Effects of Visitor Services

Currently, visitors concentrate on existing boardwalks and pull-out observation platforms. Alternative 2 provides a moderate increase in nonconsumptive recreational opportunities from increased boardwalks and viewing facilities, increased interpretation, and educational programs. Environmental education opportunities would be enhanced with a strong emphasis on partnerships, staffing, and volunteers (see Chapter 2. Goal 5). These additions would result in minor modifications of some habitats; these are discussed in the Effects from Facilities section in Section 6.2.7.

Alternative 2 provides increased efforts to reach visitors through additional signage, interpretive panels, electronic and print media, social networking, and other techniques that are expected to raise awareness of Grays Harbor NWR and what it has to offer. These proposed efforts to reach visitors would have negligible negative effects on fish, wildlife, or habitats and would have moderate short- and long-term beneficial effects for the public.

Overall Effects

Overall, implementing Alternative 2 would result in a minor to moderate beneficial, long-term improvement in the amount of opportunities for quality wildlife observation, photography, interpretation, and environmental education experiences available to the public. Priority public use opportunities could increase and would improve with the establishment of new public information and access. These improvements would also help address the adverse effects that may result as the human population continues to increase in the region and visitation grows over time. Long-term, beneficial effects would occur for visitors as increased opportunities to enjoy quality wildlife observation, photography, interpretation, and environmental education would exist under Alternative 2.

6.2.9 Effects to Cultural Resources at Grays Harbor National Wildlife Refuge

The Service is committed to protecting known cultural resources under both alternatives. Upland areas of the Refuge were former dump sites for dredge spoil, and cultural resources are not expected to be onsite. However, prior to implementing ground-disturbing projects, the applicable cultural resource compliance investigation would be undertaken. If cultural resources were found, appropriate procedures and protocols would be followed to protect them. Whenever possible, resources would be avoided or mitigated. Mitigation options, in addition to site avoidance by relocating or redesigning facilities, would include data recovery, using either collection techniques or in-situ site stabilization protection.

Native vegetation of cultural value such as sweetgrass, used in tribal basket weaving, would be monitored and managed to keep plant health stable as much as possible. However, sweetgrass is most likely going to be negatively affected by sea level rise over time.

Overall Effects

Compliance with cultural resource investigation protocols prior to conducting ground-disturbing actions, and subsequent compliance with procedures if cultural resources are found, would ensure that negative impacts to cultural resources from implementation of any of the alternatives are negligible.

6.2.10 Effects to the Economy at Grays Harbor National Wildlife Refuge

Refuge CCP planning includes a regional economic analysis as a way of estimating how current management (No Action – Alternative 1) and proposed management activities (Preferred Alternative – Alternative 2) would affect the local economy. This type of analysis provides two critical pieces of information: it illustrates a refuge's contribution to the local community, and it can help determine whether economic effects are a real concern in choosing between the management alternatives.

From an economic perspective, both Grays Harbor NWR and the Black River Unit of Billy Frank Jr. Nisqually NWR provide a variety of environmental and natural resource goods and services used by people either directly or indirectly. The use of these goods and services result in economic impacts to both local and state economies. The various services that refuges provide can be grouped into five broad categories: (1) maintenance and conservation of environmental resources, services, and ecological processes, (2) production and protection of natural resources such as fish and wildlife, (3) protection of cultural and historical sites and objects, (4) provision of educational and research opportunities, and (5) compatible outdoor and wildlife-dependent recreation. People who use these services benefit in the sense that their individual welfare or satisfaction level increases with the use of a particular good or service.

One measure of the magnitude of the change in welfare or satisfaction associated with using a particular good or service is economic value. Economic value is the economic trade-off people would be willing to make in order to obtain some good or service. It is the maximum amount people would be willing to pay in order to obtain a particular good or service minus the actual cost of acquisition. In economic theory this is known as net economic value or consumer surplus. In the context of this chapter, estimates of the economic value of particular recreational activities are used to determine the aggregate value of recreational use of Grays Harbor NWR and Black River Unit.

Use of the good or service usually entails spending money in some fashion. These expenditures, in turn, create a variety of economic effects collectively known as economic impacts. Economic impacts refer to employment, employment or labor earnings, economic output, and Federal, local, county, and State tax revenue that occur as the result of refuge activities. These impacts are analyzed using IMPLAN, a regional input-output model and software system. The following is a list of terms and definitions that are commonly used in economic impact analysis (Minnesota IMPLAN Group, Inc. 2004 and Miller and Blair 1985).

> *Economic output* includes three types of effects: direct, indirect, and induced. Direct effects are the expenditures associated with a particular activity (such as refuge recreation visits and management activities). Indirect effects result from changes in sales for suppliers to the directly affected businesses (including trade and services at the retail, wholesale, and producer levels). Induced effects are associated with further shifts in spending on food, clothing, shelter and other consumer goods and services as a consequence of the change in workers and payroll of directly and indirectly affected businesses (Weisbrod and Weisbrod 1997). The indirect and induced effects represent any multiplier effects. Both job income and tax revenue are derived from total economic output (aggregate sales). For example, labor costs are paid out of total sales revenue for a company, as are taxes. To add taxes and job income to output would double-count economic impacts.
>
> *Jobs* and *job income* include direct, indirect, and induced effects in a manner similar to economic output. Employment includes both full- and part-time jobs, with a job defined as one person working for at least part of the calendar year, whether one day or the entire year.
>
> *Tax revenue* is shown for business taxes, income taxes, and a variety of taxes at the local, state, and national level. Like output, employment, and income, tax impacts include direct, indirect, and induced tax effects.

A comprehensive economic profile (baseline) of a refuge and estimates of the economic effects of alternative management strategies would address all applicable economic effects associated with the

use of refuge-produced goods and services. However, for those goods and services having nebulous or non-existent links to the market place, economic effects are more difficult or perhaps even impossible to estimate. Some of the major contributions of a refuge to the natural environment, such as watershed protection, maintenance and stabilization of ecological processes, and the enhancement of biodiversity require extensive onsite knowledge of biological, ecological, and physical processes and interrelationships to begin to formulate economic benefit estimates. This is beyond the scope of this analysis.

This section focuses on a limited subset of refuge goods and services, primarily those directly linked in some fashion to the marketplace, such as recreation use and refuge budget expenditures. It should be kept in mind that the emphasis on these particular market-oriented goods and services should not be interpreted to imply that these types of goods and services are somehow more important or of greater value (economic or otherwise) than the non-market goods and services previously discussed.

Two types of economic impacts are addressed: (1) impacts associated with annual consumer expenditures on refuge-related recreation and (2) impacts associated with refuge budget expenditures. The economic impacts are presented as annual impacts over a 15-year time period. For Alternative 2, the analysis presents the impacts that would result assuming that all management objectives are implemented and achieved. Note that funds are not currently present to implement all objectives and strategies identified; however, the analysis for Alternative 2 represents the funding that would be manifested if implemented.

Two types of information are needed to estimate the economic impacts of recreational visits to a refuge: (1) the amount of recreational use on the refuge by activity; and (2) expenditures associated with recreational visits to the refuge. Recreational use (i.e., visitation and the distribution of resident visitors and non-resident visitors) was estimated by Refuge Complex staff. Expenditure patterns were obtained from the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Department of the Interior et al. 2007). These expenditures include travel-related expenses, such as food, lodging, transportation, and other travel-related miscellaneous expenses. With this information, total expenditures for each activity can be estimated. These expenditures, in turn, can be used in conjunction with regional economic models to estimate industrial output, employment, employment income and tax impacts associated with these expenditures. For Grays Harbor NWR, the economic impact area for recreational activities is defined as Grays Harbor County, which is located in the southwest of the state of Washington. For Black River Unit, the economic impact area for recreational activities is defined as Thurston County, which is located at the southern tip of Puget Sound in Washington. It is assumed that visitor expenditures occur primarily within these areas. The economic impacts from recreation expenditures estimated in this chapter are gross area-wide impacts. Information on where expenditures may occur locally and the magnitude and location of resident and non-resident expenditures (resident and non-resident relative to the geographical area of interest) is not currently available. Generally speaking, non-resident expenditures bring outside money into the area and thus generate increases in real income or wealth. Spending by residents is simply a transfer of expenditures on one set of goods and services to a different set within the same area. In order to calculate net economic impacts within a given area derived from resident expenditures, much more detailed information would be necessary on expenditure patterns and visitor characteristics. Since this information is not currently available, the gross area-wide estimates are the maximum impact for the net economic impacts of total resident and non-resident spending in Grays Harbor County (for Grays Harbor NWR) and Thurston County (for Black River Unit). The economic impacts of non-resident spending represent a real increase in wealth and income for the area (for additional information, see Loomis p. 191, 1993).

Recreational Activities

The Refuge receives visitors from across the United States; however, a majority of visitors live in the local area. The spending by recreational visitors when visiting the Refuge influences the local economy by creating jobs and generating tax revenue.

Alternative 1 (Current Management): Recreational Activities

Under Alternative 1, there would be no changes to the recreational activities offered at the Refuge. All programs would continue to follow current management goals. Grays Harbor NWR would continue to offer a variety of nonconsumptive public uses, including wildlife observation, photography, interpretation, and environmental education.

Table 6-3 shows the visitation for Grays Harbor NWR. The Refuge had 11,550 recreation visits in 2011. Pedestrian visits represented 91 percent of all visits. In addition to recreation visits, the Refuge also had about 4,022 environmental education visits, leading to a total visitation of 15,572.

Table 6-3. Grays Harbor NWR FY2011 Visitation

Activity	Residents	Nonresidents	Total
Nonconsumptive			
Pedestrian	7,875	2,625	10,500
Auto Tour	0	0	0
Boat Trail/Launch Visits	0	0	0
Bicycle Visits	0	0	0
Photography	750	250	1,000
Other Recreation	0	0	0
Interpretation	0	50	50
Environmental Education	4,022	0	4,022
Hunting			
Waterfowl	0	0	0
Other Migratory Birds	0	0	0
Upland Game	0	0	0
Big Game	0	0	0
Fishing			
Freshwater	0	0	0
Saltwater	0	0	0
Total Visitation	12,647	2,925	15,572

Regional Economic Analysis

Visitor recreation expenditures for Alternative 1 are shown in Table 6-4. Environmental education opportunities for residents do not contribute to the local economic impacts because the events

typically do not bring visitors who are spending money toward travel-related goods and services. Total annual expenditures were about $83,300 with nonresidents accounting for about $46,100, or 55 percent, of total expenditures. Under Alternative 1, these annual expenditures are expected to continue.

Table 6-4. Grays Harbor NWR Alternative 1: Visitor Recreation Expenditures (2011 dollars in thousands)

Activity	Residents	Nonresidents	Total
Nonconsumptive	$37.30	$46.10	$83.30
Hunting	–	–	–
Fishing	–	–	–
Total Expenditures	$37.30	$46.10	$83.30

Input-output models were used to determine the economic impact of expenditures on the Refuge's local economy. It is assumed that visitor expenditures occur primarily within Grays Harbor County. Table 6-5 summarizes the local economic effects associated with recreation visits. Economic output totaled $108,600 with associated employment of one job, $32,200 in employment income, and $7,400 in total tax revenue.

Table 6-5. Grays Harbor NWR Alternative 1: Local Economic Effects Associated with Recreation Visits (2011 dollars in thousands)

	Residents	Nonresidents	Total
Economic Output	$49.80	$58.80	$108.60
Jobs	0.50	0.60	1
Job Income	$14.80	$17.40	$32.20
State & Local Tax Revenue	$3.30	$4.20	$7.40

Alternative 2: Recreational Activities

Table 6-6 shows the visitation that would occur if Alternative 2 were fully implemented. Approximately 22,000 visits would be related to a variety of wildlife-dependent opportunities, interpretation programs, and environmental education. Pedestrian visits would continue to represent the majority of all visits. In addition to recreation visits, the Refuge also would support 4,400 environmental education visits.

Under Alternative 2, visits are projected to increase by 40 percent, compared to Alternative 1. Similar to Alternative 1, all visitors would participate in nonconsumptive activities.

Table 6-6. Grays Harbor NWR Alternative 2: Projected Annual Refuge Visitation

Activity	Residents	Nonresidents	Total
Nonconsumptive			
Pedestrian	11,025	4,725	15,750
Auto Tour	0	0	0
Boat Trail/Launch Visits	0	0	0
Bicycle Visits	0	0	0
Photography	1,050	450	1,500
Other Recreation	0	0	0
Interpretation	10	90	100
Environmental Education	4,400	0	4,400
Hunting			
Waterfowl	0	0	0
Other Migratory Birds	0	0	0
Upland Game	0	0	0
Big Game	0	0	0
Fishing			
Freshwater	0	0	0
Saltwater	0	0	0
Total Visitation	16,485	5,265	21,750

Regional Economic Analysis

Visitor recreation expenditures associated with a fully implemented Alternative 2 are shown in Table 6-7. Total annual expenditures would be about $200,000 with nonresidents accounting for about $122,000, or 61 percent, of total expenditures. Expenditures associated with nonconsumptive activities would account for all expenditures.

Table 6-7. Grays Harbor NWR Alternative 2: Visitor Recreation Expenditures (2011 dollars in thousands)

Activity	Residents	Nonresidents	Total
Nonconsumptive	$77.30	$122	$199.20
Hunting	–	–	–
Fishing	–	–	–
Total Annual Expenditures	$77.30	$122	$199.20

Input-output models were used to determine the economic impact of expenditures on the Refuge's local economy under Alternative 2. The estimated economic impacts are expected to occur in Grays Harbor County. Table 6-8 summarizes the local economic effects associated with recreation visits.

Under Alternative 2, economic output would total $258,800 with associated employment of three jobs, $76,800 in employment income, and $17,800 in total tax revenue.

Table 6-8. Grays Harbor NWR Alternative 2: Local Economic Effects Associated with Recreation Visits (2011 dollars in thousands)

	Residents	Nonresidents	Total
Economic Output	$103.11	$155.70	$258.80
Jobs	1	2	3
Job Income	$30.75	$46	$76.80
State & Local Tax Revenue	$6.76	$11	$17.80

Alternative 2: Summary of Recreational Visitation Impacts

Table 6-9 provides a summary of the potential economic impacts related to recreational visitation for each alternative. Under Alternative 2, recreation visitation would increase after the management alternative is fully implemented. As a result, economic output, jobs, job income, and tax revenue would increase.

Table 6-9. Annual Economic Effects Associated with Recreation Visits (2011 dollars in thousands)

	Alternative 1	Alternative 2
Recreation Visits	11,550	17,350
Expenditures	$83.30	$199.20
Economic Output	$108.60	$258.80
Jobs	1	3
Job Income	$32.20	$76.80
State & Local Tax Revenue	$7.40	$17.80

Refuge Budget

Annual 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. Nonsalary expenditures are primarily operational costs including fuel, administrative costs, brochures, utilities, operation of the Grays Harbor Shorebird and Nature Festival, boardwalk and trail maintenance, invasive plant monitoring and control, and visitor services programs, including environmental education.
Table 6-10 shows the average annual expenditures would be about $74,000 for Alternative 1 and $738,000 for Alternative 2. The estimated expenditures for Alternative 2 assume that the alternative is fully funded as described in the CCP. Increased needs identified for Alternative 2 include eight additional full time employees (FTEs), existing building operational and maintenance costs, a new building operation and maintenance costs, nature center-associated programs, an enlarged visitor services program, increased invasive plant monitoring and control work, and habitat management, among other increased programs.

Table 6-10. Grays Harbor National Wildlife Refuge Average Annual Expenditures (2011 dollars in thousands)

Expenditure	Alternative 1	Alternative 2
Salary	$49.10	$570.60
Nonsalary	$25.10	$167.70
Total	$74.20	$738.30

Table 6-11 shows the economic impact of average annual (salary and nonsalary) expenditures. Impacts associated with annual expenditures would continue to occur throughout the 15-year timeline of the CCP if the alternative is fully funded. Under Alternative 1, the Refuge's annual expenditures would generate approximately $53,300 in economic output, one job, $23,700 in job income, and $2,700 in tax revenue. Annual expenditures under Alternative 2 would generate economic output of about $517,900, five jobs, $207,900 in job income, and $28,500 in total tax revenue.

Table 6-11. Local Annual Economic Effects Associated with Average Annual Refuge Budget (2011 dollars in thousands)

	Alternative 1	Alternative 2
Economic Output	$53.30	$517.90
Jobs	1	5
Job Income	$23.70	$207.90
State & Local Tax Revenue	$2.70	$28.50

Revenue Sharing Payments

Under provisions of the Refuge Revenue Sharing Act (Public Law 95-469), the Service would annually reimburse Grays Harbor County for tax revenue which is lost as a result of the Service's acquisition of private property. This law states that the Secretary of the Interior (Secretary) shall pay to each county in which any area acquired in fee title is situated, the greater of the following amounts:

- An amount equal to the product of 75 cents multiplied by the total acreage of that portion of the fee area that is located within such county.
- An amount equal to three-fourths of one percent of the fair market value, as determined by the Secretary, for that portion of the fee area that is located within such county.
- An amount equal to 25 percent of the net receipts collected by the Secretary in connection with the operation and management of such fee area during such fiscal year. If a fee area is located in two or more counties, however, the amount for each county shall be apportioned in relationship to the acreage in that county.

The appraisal estimate value is based on the current local land values at the time of the appraisal. The Refuge Revenue Sharing Act payments to Grays Harbor County have averaged $3,135 annually from Fiscal Years 2011 to 2013.

Forecasting revenue sharing payments is complex. Actual payments are a function of the appraised value and appropriations. The Refuge Revenue Sharing Act requires Service lands be reappraised every 5 years to ensure that payments to local governments remain equitable. However, some payments are less than the legislated amounts due to governmental funding deficits. Congress may appropriate, through the budget process, supplemental funds to compensate local governments for any shortfall in revenue sharing payments. The final calculation for the payment to local governments depends on the total amount of funds available from revenue receipts collected on refuges nationwide and any appropriations. As a result, payments fluctuate based on the revenue receipts and appropriations. Due to the size of the revenue sharing payment, economic impacts would be negligible.

Overall Effects

This section summarizes the economic impacts generated by Refuge management activities for each alternative. Table 6-12 summarizes the economic impacts in Grays Harbor County for Alternative 1. Under Alternative 1, Refuge activities would generate an estimated $161,900 in economic output, two jobs, $55,900 in job income, and $10,100 in state and local tax revenue. These economic impacts under Alternative 1 would be negligible as they represent less than 1 percent of total income and total employment in the local area economy.

Table 6-12. Summary of Annual Economic Impacts for Alternative 1 (2011 dollars in thousands)

	Economic Output	Jobs	Job Income	State & Local Tax Revenue
Recreation Visits	$108.60	1	$32.20	$7.40
Budget	$53.30	1	$23.70	$2.70
Total	$161.90	2	$55.90	$10.10

Table 6-13 summarizes the economic impacts for Alternative 2. Under Alternative 2, Refuge activities would generate an estimated $776,700 in economic output, eight jobs, $284,700 in job income, and $46,300 in tax revenue. These economic impacts under Alternative 2 would also be negligible as they represent less than 1 percent of total income and total employment in the local area economy.

Table 6-13. Summary of Annual Economic Impacts for Alternative 2 (2011 dollars in thousands)

	Economic Output	Jobs	Job Income	State & Local Tax Revenue
Recreation Visits	$258.80	3	$76.80	$17.80
Budget	$517.90	5	$207.90	$28.50
Total	$776.70	8	$284.70	$46.30

One-time costs related to Refuge management were not taken into account in this analysis. However, large capital investments, such as the potential development of new facilities, would be expected to provide minor to moderate short- and long-term economic benefits. For example, if the 2007 nature center design is implemented, costs have been estimated at $6.18 million (June 2008 dollars). These direct expenditures would be expected to generate indirect and induced (i.e., multiplier) effects which would provide minor economic benefits to the local community.

6.2.11 Cumulative Effects at Grays Harbor National Wildlife Refuge

Effects of Reasonably Foreseeable Future Refuge Activities

Alterations and loss of native habitats continue at the landscape scale, and human development and climate change pose complex and persistent threats. The Refuge, although relatively small, may become increasingly valuable for the persistence of native wildlife. Active improvement of habitats would increase or maintain the value of Refuge lands and waters for a diversity of native fish and wildlife and would improve and maintain biological diversity. Both alternatives protect and maintain Refuge habitats valuable to wildlife; however, there is a greater emphasis on IPM and pursuing priority inventory, monitoring, and research needs in Alternative 2.

In concert with other protected lands, the Refuge has an important role to conserve resident, threatened, and rare species, as well as migratory wildlife species, and to provide places where the public can enjoy and experience nature. Additionally, the Service contributes to the regional availability and quality of wildlife-dependent recreational opportunities. Implementing the CCP would have overall beneficial effects to habitats, species, and the American public. In the context of all of the factors (both natural and human-caused) that negatively affect habitats and species (e.g., food availability, human disturbance, and contaminants) the positive contributions associated with CCP implementation represent a moderate, beneficial effect.

Other Reasonably Foreseeable Events and Activities from Others

Although the communities of Aberdeen, Hoquiam, and Westport, along the shores of the Grays Harbor estuary, have experienced an economic downturn, there is potential for recovery and associated growth. Any future growth and development of businesses and industries that use the estuary could stress the ecosystem through both direct and indirect loss. Habitat loss would be direct; indirect loss would result from fragmentation and degradation of the estuary fish and wildlife habitat and increasing demands on water.

Coal and oil industries are examples of business that would use the estuary. Currently there are two State Environmental Policy Act permit requests to increase oil storage and transfer facilities in Aberdeen/Hoquiam; these facilities would require deep channelization for large ships, which would change the sedimentation and turbidity of the estuary. Expansion of these facilities and transportation and storage of products would need to be evaluated for the potential impacts to the estuary and surrounding habitats. Incidents, both natural (severe storms, flooding, and sea level rise) and man-induced (spills) are potential impacts to the habitats on- and off-Refuge.

6.3 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

6.3.1 Effects Common to All Alternatives at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects Common to All Alternatives from Integrated Pest Management (IPM)

Under both alternatives, the Unit would continue to control invasive species, but to varying degrees with respect to target species and acreage treated. IPM under Alternative 1 is minimal, with concerted efforts toward specific species (reed canarygrass, purple loosestrife, yellow flag iris) in patches, focusing on new establishments compared to a higher level of effort and resources that would be directed to invasive species under Alternative 2.

Mechanical, cultural, biological, and chemical control methods would be evaluated for eradication, control, or containment of invasive species in order to achieve resource management objectives (Appendix G. IPM). Pesticide chemical selection and usage will be subject to regionally reviewed State regulations, State and federally approved herbicides and adjuvants, Service-approved PUPs, and EPA's PGP. Pesticide chemical selection will also conform to the specific pesticide label requirements and be applied by licensed applicators. Service guidelines direct the Unit to use the most efficacious pesticide available with the least potential to degrade environmental quality (soils, surface water, groundwater, and air) as well as minimizing potential effect to native nontarget species. Additionally, adjuvants (an additive that increases herbicide effectiveness such as increasing adhesion to target plants) should have the least potential effect to native nontarget species.

Potential effects to the biological and physical environment are associated with the proposed site-, time-, and target-specific use of pesticides. PUPs on the Unit would be evaluated using scientific information and analyses documented in "Chemical Profiles" (see Appendix G). These profiles provide quantitative assessment/screening tools and threshold values to evaluate potential effects to species groups (birds, mammals, and fish) and environmental quality (water, soil, and air). Any pesticide use must be approved through a PUP. PUPs (including appropriate BMPs) would be approved where the Chemical Profiles provide scientific evidence that potential impacts to the Unit's biological resources and its physical environment are likely to be only minor, temporary, or localized in nature.

Based on scientific information and analyses documented in Chemical Profiles, most pesticides allowed for use on Unit lands and waters would be of relatively low risk to nontarget organisms as a result of low toxicity or short-term persistence in the environment. Thus, potential impacts to Unit resources and neighboring natural resources from pesticide applications would be expected to be minor, temporary, or localized in nature.

Some risks may still occur via factors not assessed under current protocols, such as intermingling of unlike chemicals in the field, species-specific sensitivity that differs from surrogate species sensitivity, exposure through inhalation, exposure through ingestion of pesticide-contaminated soil, and other factors (see Appendix G).

The effects of nonpesticide IPM strategies (e.g., mowing) to address pest species on the Unit would be similar to those effects described elsewhere in this chapter, where they are discussed specifically as habitat management techniques to achieve resource management objectives on the Unit.

The associated fieldwork of invasive plant control can temporarily cause wildlife to move away and slight habitat disturbances. Invasive species may be spread by moving equipment from site to site. These species may also become established where soils and existing plant cover is disturbed. The refuge equipment operators would be required to clean equipment before moving between sites to reduce the spread of seeds and plant parts. The Unit would continue to monitor habitats for invasive weeds, aggressively control invasive plants, and restore sites to vegetation with high wildlife value. If mechanical methods are not expected to be effective or would have undesirable consequences such as the destruction of desirable vegetation that is interspersed with weed species, then the Unit may decide to use an herbicide. Employment of a conservative approach with herbicides would result in minor, localized, short-term negative effects and negligible long-term effects from chemical exposure. Long-term negative effects are not expected, instead the effects should be positive on fish and wildlife as their respective habitats would be in better condition to support each species group.

Effects Common to All Alternatives from Prescribed Fire

Under both alternatives, prescribed fire is listed as one of the available IPM strategies (Obj. 1.6, 1.7, 2.1). If utilized, objectives may include (1) maintenance of ecological processes, specifically by retarding succession in sites where woody shrub or tree invaders are present; (2) maintenance of vigorous stands of native grasses and forbs; (3) providing open spaces that increase landscape diversity; and/or (4) reducing or maintaining the density of nonnative species.

The effects of prescribed fire are relative to ecosystem condition, season (fuel and soil moisture), and the characteristics of the ignited fire. In stands with invading woody shrubs or trees, restoration fires are often more intense so that they injure and kill invading species. In stands with substantial nonnative species present, single fires can have no effect or even stimulate regrowth in nonnative species (DiTomaso et al. 2006, Keeley 2006). With repeated prescribed fires, particularly those that target sensitive phenological stages (peak vegetative stage or prior to seed dispersal), many nonnative herbs and invading shrubs tend to decline (DiTomaso et al. 2006).

Immediately after a prescribed fire, there is an immediate reduction in prey for ground- and aerial-foraging species, especially those that prey on invertebrates. There is the potential for direct mortality of surface-dwelling and ground-nesting species if fire occurs during breeding season. Nesting habitat for ground-nesting species would be completely removed. Burrowing species would be minimally directly affected by surface fires. Direct mortality for large mammals is not expected to occur for prescribed fires in grassland habitat. These fires are relatively quick-moving, but the ample sight distances would allow animals to react in time to reach safety. All large mammals would incur some stress from flight and avoidance behaviors along with temporary displacement from home ranges. Studies associated with landscape-scale fires indicate that most large mammals do not appear to be substantially affected (Smith 2000). Effects to predators would be similar to the large mammals. Predators can also suffer from increased competition if they are forced to migrate to already occupied home ranges of other predators. There would be limited impacts to reptile and amphibian species and individuals with access to suitable escape habitat (wetlands, burrows, or large unburned fuels). It has been suggested that most reptile and amphibian species are relatively unaffected by prescribed fire and there is limited mortality (Russell et al. 1999). Some mortality to other species and individuals would be expected depending on duration and intensity of the fire. The effect of prescribed fire on

invertebrates depends on the life-stage of the species of concern when the fire occurs and fire intensity. Some mobile forms that can fly or otherwise escape a burn would be minimally affected; however, others may not be able to escape a fast-moving fire. Those life stages that are immobile (e.g., eggs, larvae, or pupae) and exposed to the fire would be expected to suffer a higher rate of mortality. High-intensity fires can result in soil heating to the level where invertebrates found in the near-surface soils are killed (Nealy et al. 1999). Temperatures rapidly decline below the surface, so insects found in the soil would be less affected than terrestrial species when burn intensities are relatively low.

In the short term (i.e., next growing season), grasslands would be expected to rapidly regenerate in the spring following the burn; however, vegetative forage in wetland areas would likely continue to be reduced from pre-burn levels. Winter rainfall would allow the existing seedbank to germinate. In turn, this would provide forage for species that graze on the vegetation. Predators could improve hunting success because of improved visibility, but conversely could also suffer from lower small mammal abundance. Granivores would find limited food sources until late in the summer when grasses matured. Much of the burn area would be unsuitable as nesting habitat for those species that require dense grass cover for their nests; however, those species that prefer more open habitat may find somewhat improved nesting habitat. Overall, there would be a reduction in habitat for ground-nesting species caused by removal of the vegetation which formerly provided cover. There would be a reduction in habitat for small mammals that require dense cover. Conditions would gradually improve as the vegetation regrew through the growing season. There may be a limited amount of seed-based forage until summer, but most species would benefit from increased herbaceous production. The increased production of forage typically increases large mammal use of burned sites. Depending on the season of fire, recolonization can occur almost immediately after the fire is extinguished (Smith 2000). Predators would be expected to follow the prey back into the area. Until the prey base is available to support them, recolonization by herbivores and small mammals may be slower and in lower numbers than were present before the fire. Because reptile and amphibian mortality is expected to be minimal, an extensive and slow recolonization would generally not be required. However, similar to small mammals, the removal of tall grass and ground litter that formerly provided cover would limit habitat suitability, at least in the early part of the growing season. Species that rely on these habitats may be slow to recolonize as this material reaccumulates post-burn (Russell et al. 1999). For invertebrates, recolonization is expected from adjacent unburned areas through natural dispersal methods as forage and egg-laying habitat regenerates during the first growing season. Species with life stages that occur within the soil would be affected to a lesser degree.

In the long term, overall there would be a beneficial effect to birds as native forage became reestablished, invasive species were reduced, and the vegetation was maintained as a native-dominated community and free of encroaching shrubs, trees, and invasive plant species. Because they rapidly regenerate, grasslands may reach pre-burn conditions in only a couple of growing seasons. Wetter areas would return to pre-fire conditions somewhere between 5 and 20 years, depending on the community and management actions, especially periods and depths of inundation. The increased production of native ground cover would be expected to support target native wildlife species.

The following measures could reduce the negative effects of prescribed fire on wildlife and encourage faster recovery. These measures are conceptual and some could conflict. Measures that are applicable to a specific fire plan would need to be adjusted to the local conditions. Measures to minimize harm to these species include:

1. To minimize direct mortality, conduct prescribed fire outside the nesting and calving or fawning period for birds and large mammals.
2. Conduct surveys for priority resources of concern to document locations and areas of use, allowing for more accurate fire planning and thereby minimizing adverse effects.
3. To minimize direct mortality to focal species of invertebrates, conduct burns during the underground life-stages, or during the flight period.
4. Minimize indirect effects to amphibian breeding areas and waterways by protecting them with erosion control measures that restrict sediment-laden water from entering wetlands and ponds.

Because of the short residence times, low fuel loads, and patchiness of fuels, few concerns exist over soil heating in most Pacific Northwest dry grasslands and wetlands (Walstad et al. 1990). Removal of larger woody material may be prescribed through cut-and-pile treatments. The effects of pile burning on underlying soil heating are well-studied and reviewed elsewhere (DeBano et al. 1998). In short, piles can generate substantial heat and combust soil organic matter, alter soil structure, and increase the hydrophobic nature of underlying mineral soil. Pile burning can also lead to subsequent nonnative species invasion in areas of localized soil disturbances. In even heavily encroached grasslands, piles typically cause only minor, patchy effects (piles typically cover less than 5 percent of the burned landscape). If pile burning is required, minimization measures could include scattering severity across the landscape with small piles ignited conservatively or removing slash from units prior to burning. Pile burning effects can also be minimized if the small piles are burned over wet soil (during the dormant season), where the soil moisture will resist temperature rise (DeBano et al. 1998). Pile burning locations may require focused follow-up to prevent nonnative species establishment.

Impacts to air quality would occur from the actual burning activities and also from emissions associated with equipment used to facilitate and manage the prescribed burn for fire control purposes. Emissions associated with equipment for prescribed burning are assumed to be minimal in comparison with the emissions associated with the actual prescribed burn. Through effective planning and methods by which prescribed burns are controlled, emissions associated with prescribed burns can be limited to such a degree that ambient air quality standards are not exceeded, and impacts would be adverse but not significant. Additionally, properly planned and executed prescribed fire can reduce the frequency and intensity of wildfire, thereby reducing the massive effects wildfire can have on air quality.

There are several methods by which emissions associated with prescribed burning can be limited so as not to exceed ambient air quality standards. The majority of such measures involve limiting the level of fuel consumed. Measures that can be implemented include: (1) removal of fuel within the prescribed burn area, (2) limiting the size of the prescribed burn area, (3) seasonal timing of prescribed burn, (4) meteorologically driven timing of prescribed burn, (5) increased frequency of burning, (6) condensed burning areas, and (7) active monitoring. Additionally, public service announcements would inform the local populations of potential air emissions associated with prescribed burning and allow people to make accommodations to limit potential secondary health effects (e.g., use of personal humidifiers, staying indoors, personal respiratory aids, and reduced activity).

Because this analysis has been conducted at a programmatic level, site-specific evaluation will be necessary when planning prescribed fires. These individual evaluations should contain a higher level of detail than is presented in this document. The Service prepares and implements a step-down Wildland Fire Management Plans consistent with Federal Wildland Fire Management Policy (USDA

and DOI 2009) and to achieve refuge resource objectives. Plans were last finalized for the Billy Frank Jr. Nisqually NWR in 2003. Under all alternatives, an update would be developed using guidance from the Service's Wildland Fire Management Handbook (USFWS 2015). This handbook defines the Service-wide goal of wildland fire management to achieve resource objectives through prevention of human-caused wildland fires, to minimize the negative impacts on resources from all wildland fires that occur, and to guide the use of prescribed fire as an integral part of the resources management in a manner that minimizes the risk to the lives of employees, visitors, neighbors, and their property. Articulation of wildland fire management goals and objectives would be integrated with management goals and objectives from the CCP and other sources, as appropriate.

6.3.2 Effects to the Physical Environment at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects to Hydrology and Water Quality

Under both alternatives, BMPs would be used to minimize the negative impacts of habitat management and public use actions. Habitat management activities with the potential to affect hydrology and/or water quality include the use of pesticides or herbicides and herbivore grazing, which may have negative impacts in the short term, depending upon the location and related wildlife. Only State and Federally approved herbicides, including wetland-related, may be used on the Unit. Staff that apply pesticides are required to retain a public applicator license. See Section 6.3.1 for more information on effects of IPM and Appendix G for more information on the IPM methods. The long-term effect is expected to be minor.

Under both alternatives, grazing is included as an available tool for managing vegetation (Obj. 1.6, 1.7, 2.1). A potential negative impact from grazing activity on the Unit is a decline in water quality, as measured by turbidity and fecal coliforms from manure. The potential decline in water quality can be partially mitigated by reducing pathways for manure to enter waterways, accomplished through maintenance of electric and wire fences preventing cattle access to waterways, and by managing timing and location of grazing to avoid cattle presence while areas are flooded or have standing water.

Under both alternatives, the removal or replacement of fish passage barriers on new acquisitions would improve overall connectivity, including improvements to water flow and velocity. This would result in a minor to moderate, beneficial effect to hydrology.

Under Alternative 2, the Service would complete a detailed Water Resources Inventory and Assessment (WRIA) that would assist staff by identifying various management options to improve habitat conditions, water quality, and hydrologic regimes in the river system. The Service would coordinate and partner with appropriate agencies to sustain and enhance hydrological conditions needed to support channel habitat and ensure an appropriate water budget and delivery, including water quantity and quality.

Standard enhancement techniques (riparian plantings, IPM, placement of large woody debris, etc.) would be used, as appropriate, to improve tributary channel and riparian habitat conditions. There may be minor, short-term, negative effects of these enhancement techniques including disturbance to the waterways, local erosion, and sediment inputs. Riparian plantings and the placement of large woody debris would result in the following positive effects to hydrology:

- Increasing the stability of the stream channel by absorbing the energy of flood flows, reducing water velocity at low and moderate flows, protecting developing thickets of riparian vegetation, and reducing erosion of the stream bank and stream bed
- Affecting channel form and morphology by slowing and directing flood flows and temporarily storing sediment
- Promoting diverse hydrological and physical structure, including pools, hydraulic complexity, and roughness.

To address reed canarygrass in seasonally flooded, nonnative grassland habitat (Obj. 1.7), seasonally ponded areas would be evaluated and enhanced with improved water management capabilities as needed, through installation of water control structures, ditches, or culvert removal. Implementation of water control methods would negatively affect natural hydrology in the short and long term; however it may be necessary for invasive species control.

Construction of observation platforms and associated parking lots would not impact surface water quality as these facilities are not scheduled to be built over the river or tributaries. The enhanced boat launch and the small parking lot in the nearby upland would reduce sediments entering the river channel.

Overall Effects

Under Alternative 1, the overall effect to hydrology and water quality would be negligible to minor, negative in the short term and negligible to minor, positive in the long term. Under Alternative 2, the overall effect would be short-term, negligible to minor, and negative, and long-term, minor, positive impacts.

Effects to Topography, Geology, and Soils

Under both alternatives, habitat management actions may involve heavy equipment such as tractors or track vehicles to mow, hay, and disk, or otherwise manipulate the vegetation, especially to reduce the negative impacts of nonnative and invasive reed canarygrass. The use of heavy equipment could cause soil compaction. Repeated mowing, haying, or disking over an extended period of time regularly compacts soils, reduces natural soil porosity, and leads to less percolation and more runoff. However, negative impacts to the soils and geology of the area are anticipated to be localized and minor. Best management practices (e.g., not mowing over wet soils) would be followed to minimize impacts.

Herbivore grazing is included within the suite of IPM techniques under both alternatives (Obj. 1.6, 1.7, 2.1). The physical and structural impacts of grazing include removing healthy standing vegetation, trampling of other vegetation, and reducing populations of pioneering woody plants. If areas are grazed too early in spring when they are saturated or flooded, herbivores can break through the sod. This damages the underlying structure and creates an extremely uneven surface. This potential negative impact could be reduced by restricting grazing to the less wet seasons. Compaction can result from both grazing and the use of heavy equipment, causing undesirable increases in bulk density.

Under Alternative 2, the placement of large woody debris into tributary channel habitat may locally displace some soil and lead to bank erosion, although this effect is expected to be minor, short-term,

and local. Over the long term, moderate, positive effects are expected as stream bank stability increases and riparian vegetation grows in the stabilized, stored sediment. Soil productivity is expected to increase in the affected areas.

Forest management practices in the mixed forest habitat are expected to improve soil quality in the long term as more stable, native ground cover becomes established and organic matter increases. However these actions may also have short-term, adverse impacts such as erosion, compaction, and some loss of soil organic matter.

Under Alternative 2, the construction of new public use facilities would result in soil disturbance. During the construction of these facilities, soils would be disturbed to form graded surfaces and adequate foundations for the proposed paved areas and observation platforms. However, equipment and material staging areas would be identified to minimize soil disturbance and compaction onsite. Erosion control measures would be incorporated into site development plans to reduce or eliminate loss of site soils during construction. Since the collective footprint of these facilities would be relatively small, the overall anticipated adverse impacts to soil would be minor.

Overall Effects

Under both alternatives, the use of heavy equipment and grazing animals may produce temporarily impacted soils. Under Alternative 2, negative effects due to habitat management activity and construction projects would be minimized through use of BMPs. Minor, short-term, negative effects to the soils may occur, but an overall moderate, beneficial effect is expected over the long term.

Effects to Air Quality

The activities proposed may result in a slight and temporary increase in vehicle emissions due to the proposed use of heavy equipment in enhancing habitats for wildlife resources. Additionally, a slight increase in vehicular emissions could be expected due to an increase in visitation with the proposed viewing platforms, interpretive information, and parking areas.

Overall Effects

Overall, long-term effects to air quality should be negligible under all alternatives. Both alternatives would not be expected to have significant long-term effects to air quality compared to current management. Some minor, short-term impacts to local air quality may result from Unit management actions.

General Pollution Control

The Service has policies regarding pollution control at all of its facilities, including national wildlife refuges. These policies direct all Service employees to (1) comply with all applicable environmental laws and regulations, (2) reduce pollution, (3) inventory and properly treat or handle any hazardous substances; and (4) clean up or remove hazardous materials on contaminated sites. These policies are discussed in the Service's Manual in the 500 Series, which can be accessed at http://www.fws.gov/policy/manuals/. The Unit would comply with these policies under all alternatives.

With the proposed actions of Alternative 2, the overall water quality, water chemistry, temperature, and risk of contaminant release would remain unchanged. Some localized, short-term effects might occur associated with various land management activities, although they would be offset by implementing BMPs and would be temporary and localized.

Overall Effects

Some minor, short term, negative impacts may occur in habitat enhancement but may be offset by the positive wildlife response. Long-term soils, air quality, and water quality would remain the same as in Alternative 1.

6.3.3 Effects Common to All Habitats and Wildlife at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Under Alternative 1, no public uses would occur on the Unit, although public uses would continue to occur within the adjacent river channel. Under Alternative 2, the Unit would be opened to compatible wildlife-dependent public uses, including wildlife observation, interpretation, and wildlife photography. Disturbance impacts to specific habitat types as a result of public use programs are discussed in the following sections.

Under Alternative 1, inventory, monitoring, research, and scientific assessments regarding natural and cultural resources, public uses, and interactions among these elements would continue as at present. Relative to habitats, plant communities, and wildlife, most of these activities would involve observation and measurement. Occasionally, tissues or whole specimens of native or nonnative plants would be taken, removed, transplanted, or outplanted. In rare situations, tissues or whole specimens of native or nonnative animals would be purposefully or accidentally taken. Additionally, some of these activities would involve implementing and assessing various habitat management techniques, at small scales. Disturbance, including trampling and potentially transporting nonnative species, would be the primary effect of the vast majority of these activities. The effects of some of these activities, such as inventories of invasive plants or evaluations of the contributions of specific habitat management practices to achievement of goals and objectives, would be primarily local.

Overall, these activities would generate information which would be analyzed and interpreted to help staff assess the efficacy of management practices and facilitate appropriate course corrections as part of the adaptive management process. The effects of these activities on habitats, plant communities, and wildlife would be negligible to minor and positive. Compatibility determinations included in Appendix B address the effects and conditions associated with these uses in greater detail.

Under Alternative 2, inventory, monitoring, research, and scientific assessments regarding natural and cultural resources, public uses, and interactions among these elements would increase compared to those occurring at present. In addition to generating the same types of effects described for Alternative 1, it would be expected that this would result in an increase in information about the habitats, plant communities, and wildlife within the Unit. This would reduce uncertainty associated with wildlife and plant responses to habitat management, promote achievement of management goals and objectives, and facilitate adaptive management. For example, this would include better information about the efficacy of pest management programs.

Through application of adaptive management principles, enhanced knowledge would slowly lead to improved management and an increase in the health, productivity, and value of the Unit's wildlife habitats and plant communities to native vegetation and wildlife and an increase in the abundance and diversity of native wildlife within the Unit. The effects of these activities on the Unit's habitats, plant communities, and wildlife would have beneficial, minor to moderate effects. Compatibility determinations included in Appendix B address the effects and conditions associated with these uses in greater detail.

6.3.4 Effects to River and Tributary Channels and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

There are approximately 7.5 miles of river within the current acquisition boundary and 16 miles of tributaries passing through or along the Unit boundary. Under both alternatives, the Service would work with WDNR to develop an interagency agreement or similar instrument that promotes cooperative management of the river channel between WDNR and the Service within the acquisition boundary. Cooperative management would help both the Service and WDNR protect fish and wildlife that use the river channel, allow the enforcement of Unit laws and regulations on the river channel, and define public access restrictions and management needed to provide improved wildlife protection from disturbance. The Service would also continue to maintain tributary channel habitat features that benefit a diversity of species (federally listed Oregon spotted frog, State endemic Olympic mudminnow, native fish, salmonids, and invertebrates). Efforts would be directed towards target invasive species (e.g., purple loosestrife) along the river and tributaries. These actions would result in short- and long-term, minor to moderate, beneficial effects.

The proposed removal of fish barriers on newly acquired lands with tributaries under both alternatives would benefit salmonids and other fish and wildlife that use channel habitats. Minor short-term, negative effects (e.g., soil disruption, increase in suspended sediment during removal, trampling of river bank from foot traffic, potential use of heavy equipment) would take place during the actual removal; however, these effects would be mitigated by scheduling the work at an appropriate time to minimize or eliminate impacts and employing best management practices.

Many of the issues associated with hydrological conditions in the river and tributaries are due to influences beyond the reach of the Unit alone. Alternative 1 does not include a WRIA. In Alternative 2, the Unit would pursue the completion of a WRIA to help identify hydrologic needs and proposes partnerships with appropriate agencies to sustain and enhance hydrological conditions needed to support the Black River and associated tributaries and ensure an appropriate water budget and water delivery takes place. Effects of this effort are expected to result in short- and long-term benefits for wetland habitats, fish, and wildlife associated with the Unit.

Under Alternative 2, the Service would actively seek new partnerships and strengthen existing partnerships to control priority invasive species and to stay abreast of newly developing problematic species. In both alternatives, the Unit would continue to work with Thurston County Noxious Weed Control Agency, WDFW, WDNR, and the Service's Washington Field Office (WFO) to assure the highest priority species threatening the river and tributary channel habitats are addressed.

Ideally, river and tributary channel habitat should have less than 15 percent cover of nonnative plant species (excluding reed canarygrass). To achieve this characteristic under Alternative 2, approximately 0.25 river miles of reed canarygrass would be treated each year. The Unit would also evaluate methods to control nonnative vertebrate species such as bullfrogs and nonnative fish that use channel habitats (see Appendix G). Control of these species would provide short- and long-term benefits to Oregon spotted frogs and mudminnows that occur in the same habitat. The Unit would partner with other agencies to determine the best course of action regarding nonnative fish.

In Alternative 2, more time and effort would be directed to controlling nonnative plant species that threaten the channels themselves and negatively impact the species that use them. As described in detail throughout Chapter 4, reed canarygrass is a major threat that has changed the ecology of the channels by reducing channel size from edge growth and rooting in the channel on submerged vegetation; growing over the water surface and thus reducing light penetration; impeding water flow and most likely wildlife and fish movement; restricting human movement through the channel; giving more surface area for algae attachment and coverage during annual summer algal blooms; and other effects not yet understood. Mapping of reed canarygrass infestation sites is needed to document and track areas in need of control. Reducing reed canarygrass impacts in this habitat type is very challenging, and cooperation, coordination, and assistance from partners familiar with this problem would be sought to determine the best control methods to deter growth and reduce reinfestation of channels and channel edges. Surveys for submerged nonnative plants would determine if other control efforts are needed. Other priority nonnative plant species that cause habitat degradation and need control with herbicide spot treatments include purple loosestrife and yellow flag iris. Other nonnative new species such as knotweed would need treatment as it invades from nearby uncontrolled sites.

The field work associated with invasive plant control can temporarily cause wildlife to move away and result in negligible habitat disturbances. Channel species dependent upon native habitats for foraging, cover, and loafing benefit from invasive plant control. The Black River is known for its low oxygen levels, primarily due to the extremely slow current (9-inch drop per mile), lack of ripples to break the surface, high organic content of the channel bottom and sides, and high nutrient loads. The lowest levels are in late summer and early fall. To avoid exacerbating the low dissolved oxygen condition, care would be taken during invasive plant control to minimize decomposition of biomass. This would cause less impact to native fish and invertebrates. If herbicides are used, a conservative approach is expected to produce minor to moderate, short-term, negative effects from chemical exposure with minor, long-term, negative effects depending upon the area of each treatment. The negative effects may be minor or moderate depending upon how much treatment is applied over time, but reclaiming the river and channel habitats from the threat posed by the nonnative, aggressive invasive plants would have an overall beneficial effect on all aspects of river and channel habitat, and the dependent fish and wildlife. The Unit would control nonnative bullfrogs, as needed, after presence/absence surveys are conducted in key locations (see Chapter 2 and Appendix G). Control of invasive species (reed canarygrass, warm-water fish, and bullfrog) provides both short- and long-term benefits to native animals, especially the Oregon spotted frog population. The Unit would partner with other agencies to determine the most effective, lowest impact method to control nonnative fish.

The effects of the above actions are expected to benefit an array of species including amphibians such as the Oregon spotted frog, red-legged frog, Pacific treefrog, rough-skinned newt, northwest and long-toed salamanders; waterbirds such as pied-billed grebe, belted kingfisher, great blue and green herons; fish such as Olympic mudminnow, three spine stickleback, prickly sculpin, cutthroat and

steelhead trout, chinook and coho salmon; benthic and aquatic invertebrates including freshwater mussels; insects such as Pacific clubtail dragonfly; freshwater sponge species; and mammals such as bat species, mink, muskrat, otter, beaver, and black bear.

Effects of Visitor Services Actions

The existing gravel right-of-way and boat ramp alongside the 123rd Avenue bridge provides access into Black River. Under Alternative 2, the Service would explore a partnership with Thurston County to facilitate improvements to this access. If not improved (Alternative 1), bank erosion from vehicles and trailers would continue to deposit sediment into the river channel (continue negative impacts). The improved boat ramp and parking area (Alternative 2) would be expected to result in moderate, short-term impacts during construction but long-term benefits by reducing the amount of bank erosion and sediment into the channel.

The boat ramp at this location would be a beneficial site to provide information about the Service and the Refuge System, as well as specific Unit rules and regulations which would minimize human footprints and disturbance to wildlife. The improved boat ramp and parking area would create the potential for additional visitors on and near the river channel habitat which could result in some minor additional disturbance to river-associated species and an increase in litter, especially fishing line. Abandoned fishing lines are known to entrap wildlife such as birds and may also entrap aquatic animals. The potential for greater disturbance and litter is a minor, negative effect over time.

With greater public use of the river, greater appreciation of the habitat and Unit would be expected, as well as an increase in conservation awareness.

Overall Effects

Under both alternatives, there would be positive effects from working with WDNR on cooperative management of the river channel and the removal of fish barriers, which would reconnect wetland habitats. Otherwise, Alternative 1 maintains existing resources that result in minimal effort directed toward active management of the river channel and larger landscape restoration and continued bank erosion from vehicles adjacent to the 123rd Avenue bridge. Overall, this is expected to have negligible to minor, negative effects. The overall effects of Alternative 2 would provide minor to moderate, beneficial effects. In particular, a greater effort to control nonnative, invasive plants and animals would reduce potential noxious seed sources and reduce weeds spreading to nearby wetland habitats in water flow through channels.

6.3.5 Effects to Bog Habitats and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Only a partial assessment of the bog habitat characteristics within the Unit boundary has been achieved and this would remain under Alternative 1. In Alternative 2, more time and effort would be directed towards controlling nonnative plant species that threaten or compromise habitats, including bog areas, and negatively impact the wildlife species inhabitants. Although little of the bog habitat has been explored, the initial impression is that nonnative and invasive plants do not appear to be a large problem. However, the sensitivity of this particular habitat would require a conservative

approach to controlling nonnative plants that would result in negligible or minor, short-term effects (hand cutting vs. chemical treatments).

In Alternative 2, consideration would be given to possibly translocating or introducing rare species into the bog area. Habitat function and resident species would be evaluated and expertise would be consulted to provide specific habitat management actions and minimize negative impacts. Only species missing from this south Puget Sound lowland bog habitat would be considered and would be investigated to determine how their presence could change the balance of the ecosystem. Specific protocols would be established including rigorous monitoring and decision tree.

Under Alternative 2, the designation of a Research Natural Area (RNA) would be evaluated, if warranted. If proposed and approved, the designation would provide greater conservation protection and awareness for this habitat. The short- and long-term effects of RNA designation would provide minor to moderate benefits to bog habitat by giving the area greater protection from human disturbance. The information gained would provide a baseline to which future changes can be compared (e.g., hydrology, water quality, species richness).

In total, these habitat management actions are expected to benefit species that are reliant on the bog complex, such as the rare Beller's ground beetle, Hatch's click beetle, and Queen Charlotte's copper butterfly. In addition, other species associated with bogs would benefit from an intact bog, including western bog laurel, bog cranberry, sundew, bog orchids, cotton grass, and if present, the federally listed water howellia.

Effects of Visitor Services Actions

Bog habitat within the Unit would remain closed to visitors under both alternatives due to the sensitivity of this unique area.

Overall Effects

In summary, the effects under Alternative 1 would remain negligible with no work or access to this habitat. The proposed actions of Alternative 2 are expected to have negligible to minor, short-term, negative effects primarily because they entail initial access into the unique bog habitat for inventory and habitat assessments. In the long term, the inventory and habitat assessments would be expected to provide moderate, beneficial, indirect effects to both the bog habitat and associated species.

6.3.6 Effects to Shrub Swamp and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Little of the 512 acres of shrub swamp habitat has been assessed and the amount of nonnative plants and animals is unknown. Access is very difficult and conducting a baseline survey on portions away from the edge of river channel habitat would be among the first steps addressing action on priority nonnative weed species. The shrub swamp habitat that joins the river channel habitat shows significant reed canarygrass infestation. Additionally, a small amount of purple loosestrife and a moderate amount of yellow flag iris infest the edge of the shrub swamp near the river channel.

Under Alternative 1, control of reed canarygrass would be minimal in this habitat where the vegetation density is difficult to access and maintain. The level of effort would continue to be directed at specific invasive plants (i.e., yellow flag iris, purple loosestrife) to prevent spread and new establishments resulting in minor, short-term, negative impacts as wildlife disturbance may occur during treatments. In Alternative 2, more acreage (minimum of 5 percent or 25.6 acres) and effort would be put into controlling nonnative plant species that threaten or compromise Unit habitats and negatively impact the species that use them. A greater effort to survey the habitat is expected to have negligible to minor short-term negative effects. Reclaiming the transition between river channel and shrub swamp habitats from the threats posed by reed canarygrass would have a moderate beneficial effect on all aspects of channel habitat and the fish and wildlife that depend in its resources.

Positive effects of the invasive plant control actions promoted by Alternative 2 would enhance habitats to a greater degree than Alternative 1. They are expected to diversify vegetation composition and resources and benefit an array of wildlife species, including amphibians such as Oregon spotted frog, red-legged frog, Pacific tree frog, rough-skinned newt, northwest and long-toed salamanders; waterbirds such as pied-billed grebe, belted kingfisher, great blue and green herons; migratory and resident passerines such as willow and Pacific slope flycatchers, downy woodpecker, marsh wren, flycatcher species, warblers such as McGillivray's, Wilson's, orange-crowned, yellow-rumped, and common yellowthroat; song sparrow; some fish such as Olympic mudminnow, three spine stickleback, prickly sculpin, and, perhaps during high water periods, cutthroat and steelhead trout, chinook and coho salmon would benefit; benthic and aquatic invertebrates, including freshwater mussels, insects such as Pacific clubtail dragonfly, and freshwater sponge species; terrestrial pollination insects; and mammals such as bat species, mink, muskrat, otter, beaver, and black bear.

Effects of Visitor Services Actions

Unit lands such as the shrub swamp adjacent to the river channel are not open to the public, and would remain closed under both alternatives. No negative or positive effects to the habitat from public use or visitor services actions should be incurred.

Overall Effects

In summary, Alternative 1 would have negligible overall effects because of limited staffing and access into the areas. The overall effect of the proposed habitat actions in Alternative 2 is minor to moderately beneficial to the habitat, long-term, especially for invasive plant control near the interface with the river channel.

6.3.7 Effects to Riparian Habitat and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Approximately 265 acres of riparian habitat is mapped, however, little of it has been visited to gain baseline biological information. Under Alternative 1, this is not expected to change due to limited resources (i.e., staffing); however, under Alternative 2, a concerted effort would be made to identify the biological and ecological integrity along the Black River and its tributaries.

Enhancing the riparian habitat structure and function can be accomplished by controlling priority invasive plants (e.g., purple loosestrife) and preventing them from dispersing and becoming established in other areas. Alternative 1 would maintain the few current areas whereas Alternative 2 would include additional areas to control invasive species and enhance habitat by planting native trees and shrubs. Habitat strategies (Chapter 2) suggest a minimum of 20 percent (53 acres) of riparian habitat be annually managed to control priority problem plants. Following established forestry practices would augment riparian habitat structure and function and to increase plant diversity (Carey 2003, 2006).

Control of priority nonnative plants is expected to produce minor, short-term, negative effects primarily due to potential wildlife disturbance. There are a limited number of herbicides that are approved within riparian corridors for water quality concerns; therefore, negative impacts are expected to be minor and short-term. The long-term benefits of species native to the habitat would be minor to moderate as a diverse habitat would also benefit wildlife, including some amphibians such as the rough-skinned newt, northwest and long-toed salamanders, and Pacific tree frog; green heron, migratory and resident passerines such as McGillivray's, Wilson's, orange-crowned, black-throated gray, and yellow-rumped warblers, warbling vireo, willow and Pacific slope flycatchers, rufous hummingbird, American robin, spotted towhee, purple finch, song and fox sparrows, black-headed grosbeak, Bewick's and winter wrens, cedar waxwing, red-breasted sapsucker and downy woodpecker; raptors such as sharp-shinned and Cooper's hawks; and tree–cavity-nesting waterfowl such as wood duck and hooded merganser; terrestrial pollination insects; and mammals such as bat species, mink, muskrat, otter, coyote, black bear, bobcat, and cougar. This list is not exhaustive and could include other species. Benefits should have short- and long-term effects.

Effects of Public Use Actions

Under both alternatives, the Unit's riparian forest is not open to the public. Neither negative nor positive effects to the habitat from public use or visitor services actions should be incurred.

Overall Effects

In summary, the overall effect of the proposed habitat actions in Alternative 2 would be minor to moderately beneficial to the habitat because a greater effort to control invasive plants would be made. Alternative 1 would have negligible overall effects because of limited staff and funding to complete management and biological projects.

6.3.8 Effects to Emergent Marsh Habitat and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Over 34 acres of emergent marsh occur on the Unit. The marsh is important to the federally threatened and State-listed Oregon spotted frog for breeding, egg laying, and developing tadpoles. However, emergent marsh habitat is perhaps the most vulnerable and degraded of all wetland habitats on the Unit due to the establishment of invasive reed canarygrass. Reed canarygrass tends to form dense monocultures and displace native herbaceous plants and grasses. Because shallow areas retain water into the late summer and are composed of unstable soils, it is difficult to control reed canarygrass in any of the emergent marsh locations and create optimal or even acceptable habitat

conditions for Oregon spotted frog breeding and egg laying. Under Alternative 1, the Unit would continue to conduct limited invasive plant management, scheduled to minimize impacts to wildlife, and would be expected to result in negligible impacts.

In Alternative 2, a minimum of 20 percent of emergent marsh habitat would be managed annually to control nonnative plant species and enhance habitat, especially for Oregon spotted frog. A variety of IPM techniques would be used to manage the vegetation, particularly to control reed canarygrass. These techniques have potential impacts to other plant species and wildlife. For example, mechanical methods such as mowing can cause direct mortality to various birds, small mammals, reptiles, and amphibians. Not only are these species subject to mortality from machinery, but the dense vegetation cover is converted to sparse vegetation and pockets of short vegetation until wetland plants reestablish. The use of equipment can cause soil compaction or soils/water contamination. To minimize these impacts, mowing would be performed only when soils are dry enough to support equipment. The impacts of management could be reduced by delaying operations until after most wetland bird species have completed nesting.

To minimize the risk of contamination, equipment would be regularly maintained and inspected before each use. Spill kits would be available onsite and all maintenance would be sited away from wetlands and waterbodies. Equipment operators would be trained in spill prevention and response and they would be provided appropriate personal protective equipment.

The impacts of IPM methods are expected to be minor and negative in the short term. In the long term, if maintained, the condition of emergent marsh habitat on the Unit would improve, leading to minor, positive, long-term effects.

Under both alternatives, Unit staff would share information and collaborate with other agencies and partners to determine the most effective control methods, or alternative methods to reduce the negative effect of this grass on Oregon spotted frog and other wildlife species (e.g., migratory and resident birds).

Under both alternatives and within policies and guidelines for the threatened Oregon spotted frog, egg masses may need to be moved as seasonal water recedes. This activity would allow the eggs to develop into tadpoles and would be expected to have negligible, negative effects in the short term, which are outweighed by moderate, positive effects in the long term through recruitment into the population.

Habitat management activities are expected to promote a more diverse assemblage of plant species, and a mosaic of water and vegetation that provides foraging opportunities and cover for a diversity of wildlife species, including amphibians such as Oregon spotted frog, red-legged frog, Pacific tree frog, rough-skinned newt, northwest and long-toed salamanders; shorebirds such as green heron and Wilson's snipe; migratory and resident waterfowl such as mallard, American wigeon, northern shoveler, northern pintail, American green-winged, blue-winged, and cinnamon teal; coot, Canada and cackling geese; migratory and resident passerines such as purple martin, tree-, violet-green, and rough-winged swallow, northern harrier, red-winged blackbird; migrating shorebirds including greater yellowlegs; raptors such as northern harrier; mammals including mouse, shrew, vole, mole, bat species, coyote, black-tailed deer, elk, black bear, bobcat, and perhaps cougar; garter snake species; and freshwater and terrestrial invertebrates. This list is not exhaustive, and could include other species. Benefits should have short and long-term effects.

Effects of Visitor Use Actions

Under Alternative 1, the emergent marsh lands would remain closed to the public. However, a strategically located viewing platform under Alternative 2 would provide observation and educational (interpretive panels) opportunities. Negative effects to the emergent marsh habitat from visitors are not expected.

Overall Effects

In summary, the overall effect of Alternative 1 is negligible as current conditions would persist. The overall effects of habitat actions under Alternative 2 are expected to be minor, short-term, and negative; however, the long-term effects would benefit the integrity of the emergent marsh habitat and the diversity of species using the areas, especially Oregon spotted frog. Additional moderate long-term benefits include public environmental education through observation and interpretation.

6.3.9 Effects to Seasonally Flooded, Nonnative Grassland and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Over 82 acres of seasonally flooded, nonnative grassland habitat is composed of 95–100 percent reed canarygrass. This tall, densely growing grass successfully outcompetes or crowds out virtually all other native herbaceous plants (see Chapters 2 and 4). The Unit's objective would be to manage these areas as short-grass or no-grass to promote use by Oregon spotted frog. Attempts to restore wetland habitats with such a high percentage of reed canarygrass have mixed success in the Pacific Northwest without a major investment in water management capabilities such as dikes, water level control structures, water pumps, and methods to mechanically or chemically disturb the grass.

Currently, small patches of lowland depressions dry out enough to be mowed or hayed, resulting in a more open area that then becomes flooded with fall, winter, and spring seasonal rains. With late-fall mowing, waterfowl and small wetland obligate mammals use the sites in winter, and because grass grows slowly that time of year, the sites can become adequate Oregon spotted frog egg-laying habitat in early spring. This habitat can also provide temporary foraging sites for greater yellowlegs, killdeer, Wilson's snipe, and Canada and cackling geese. A small pilot project was tried to determine herbivore impacts on reed canarygrass and whether herbivores could be used as a tool to reduce grass biomass and to enhance frog egg-laying conditions. Initial indications are that it may be an effective tool. Another site is now being similarly managed. Other sites are managed with combinations of techniques. These management options and others have the potential to improve wildlife habitat quality given the compromised conditions.

Both alternatives promote cooperation, coordination, and creative partnerships to identify effective methods to create a short-grass or no-grass condition for spring Oregon spotted frog egg-laying season and shallow water areas from late winter to fall, if possible. Under Alternative 2, up to 25 acres would be actively managed (as opposed to the current 0.75 acres). Additionally, seasonally ponded areas would be evaluated and enhanced and water management capabilities would be improved as needed, through installation of water control structures, ditches, or culvert removal. The potential negative impacts to wildlife as a result of habitat management activities are expected to be

short-term and minor as a result of scheduling activities when frogs are least active (seasonal) and employing different methods of treatment (mowing vs. hand cutting) based on habitat conditions (moist soil vs. dry ground) to minimize impacts. In accordance with Service policies, species-specific management strategies would be thoroughly documented in the Service's biological opinion and section 7 consultation prior to performing activities.

In some situations, Oregon spotted frog egg masses can be stranded or suffer desiccation from loss of surface water as water recedes. Moving egg masses short distances into more appropriate water levels is occasionally the only option for tadpole development and survivorship. In both alternatives, moving eggs a short distance to sites with adequate water conditions would be beneficial in allowing normal development from egg to tadpole stage. Given the limited amount of quality breeding sites and the variability in weather conditions affecting surface water levels, this activity is expected to result in moderately beneficial to the frog population.

The effects of management activities in seasonally flooded, nonnative grasslands is expected to also benefit other wildlife (salamanders, migratory and resident waterfowl species, passerines, and mammals) to varying degrees depending on the water and vegetation conditions.

Effects of Visitor Services Actions

Seasonally flooded, nonnative grassland habitat areas would not be open to the public under Alternative 1; therefore, the effects are expected to be negligible. Alternative 2 includes a short trail and viewing deck on higher ground for wildlife observation in one area east of Endicott Road. Construction of the deck is expected to incur minor, short-term, negative effects, but these would be mitigated by scheduling the work when wildlife use is lowest. Consideration would be made to locate the deck in an area that would result in minimal, if any, long-term impact to wildlife and with appropriate structures to keep visitors on designated paths.

Overall Effects

In summary, under both alternatives, the overall negative effects are expected to be minor to moderate in the short term. Under Alternative 2, long-term, moderate, beneficial effects for wildlife outweigh the negative effects. Effects are moderately beneficial for Oregon spotted frog and those wetland species that rely on wetlands not dominated by reed canarygrass. The viewing platform and associated interpretive panels are expected to have beneficial, long-term effects in promoting the conservation of grassland and wetland habitats and their inhabitants.

6.3.10 Effects to Dry, Nonnative Grassland Habitat and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Control of priority nonnative species using IPM methods discussed in Appendix G would occur under both alternatives. As described above, the nonnative grasses would be managed for short-grass conditions. Reed canarygrass does not thrive in well-drained upland soils, so it is not a management concern; however, wild chervil is a concern. Minor, short-term effects may occur, but beneficial, short-term effects would also occur. Beneficial, minor to moderate, long-term effects would occur depending upon which species use the habitat.

Under Alternative 2, management would perpetuate early seral stage, upland, short-grass areas that support wildlife associated with the habitat type. Under Alternative 1, the dry, nonnative grasslands (or former pastures) are hayed. Under Alternative 2, the areas would continue to be managed similarly but approximately 15 acres would be enhanced to achieve greater composition of native grasses and forbs (native herbaceous flowering plants) by using a variety of techniques that may include mowing, haying, herbivore grazing, planting, seeding, prescribed burning, or regular maintenance work. Management techniques would not be used from spring to mid-summer or until passerine nesting season is completed, as many bird species nest upon the ground in this habitat type. Adjacent prairies support species that rely predominantly on that habitat type. Some of the generalist species may use both the prairie and upland short grass habitats. Grasslands on the Unit consist primarily of nonnative grasses as a result of previous land use practices (agriculture, grazing) and are not considered native prairies with specific soils. For this reason, full-scale dry prairie restoration is not considered under either Alternative 1 or 2.

Some wildlife species benefiting from this management could include American kestrel, savannah sparrow, western meadowlark, lazuli bunting, western bluebird, killdeer, common nighthawk, Canada and cackling goose, northern shrike, red-tailed hawk, western screech owl, barn owl, possibly short-eared owl; reptile species such as snake species and northern alligator lizard; pollination insects; and mammals such as bat species, mouse, vole, mole, weasel, spotted skunk, Roosevelt elk, black-tailed deer, coyote, black bear, bobcat, and possibly cougar. Those species associated with native prairies may also benefit as the sites are discovered by those specialists. Management techniques would not be used from spring to mid-summer or until passerine nesting season is completed, as many bird species nest upon the ground in this habitat type. The effect of management actions may displace wildlife temporarily but the impact would be short lived. Long-term effects would be moderately beneficial for wildlife dependent upon this habitat type.

Effects of Visitor Services Actions

A portion of the upland, nonnative grasslands would be open to visitor viewing off Endicott Road. On the west side of the road a vehicle pull-off area that would hold between 5 and 10 vehicles and 1 bus would be created, as would a viewing platform and interpretive signage. On the east side of Endicott Road another small parking lot (five vehicles) and a viewing platform with interpretive signs would be built. These structures would remove habitat from wildlife use, however, the loss would be less than 3 acres. The habitat loss is not irrevocable and is minor in both the short- and long-term. If visitors remain on the viewing platforms and do not enter the habitats, wildlife would remain undisturbed. The benefit of providing public viewing sites and interpretive panels would be to encourage visitors to learn about the Service, the National Wildlife Refuge System, Black River Unit, and habitats and the wildlife that use them.

Overall Effects

Under Alternative 1, negligible to minor, positive impacts would occur due to the limited management. Under Alternative 2, minor, negative, short-term impacts are expected; however, in the long term, the additional habitat enhancement would provide minor positive impacts. Public use actions would result in negligible to minor, negative impacts. In summary, the positive effects outweigh the potentially negative effects regarding habitat and associated wildlife.

6.3.11 Effects to Mixed Forest Habitat and Associated Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

The Unit includes approximately 394 acres of upland mixed forest habitat. Management activities, including IPM techniques to control invasive or undesirable plant and animal species, would continue under Alternative 2 as they have under Alternative 1. In addition, approximately 20 percent of the habitat would be assessed annually for nonnative plant infestation, and control efforts would take place if necessary. Standard forestry management practices would be used to enhance former restoration plantings to create functional, young forests with a mid-story and understory (see Chapter 4 and Carey 2003, 2006). Existing forests would be evaluated and enhanced as needed. Minor, temporary, localized disturbance and damage from habitat management could occur as a result of using these actions, including displacement of wildlife, ground disturbance, and potential weed spread. However, it is expected that these effects would be temporary and localized and shortly eclipsed by enhanced stand structure and composition.

The effects of the above actions should benefit an array of species, including early to mid-successional associated species such as black-capped chickadee, yellow-rumped and orange-crowned warbler, white-crowned and song sparrow, rufous-sided towhee, dark-eyed junco, Steller's jay, crow species, butterfly and moth species, garter snake species, northern alligator lizard, western red-backed salamander, mouse, shrew, vole, bat species, weasel, opossum, raccoon, spotted skunk, coyote, bobcat, black bear, cougar, Roosevelt elk, black-tailed deer. In mid- to mature successional forests with well-developed understories, chestnut-backed chickadee, pileated woodpecker, varied thrush, band-tailed pigeon, bald eagle, Cooper's and sharp-shinned hawk, western screech owl, northern saw-whet, great horned owl, Vaux's swift, winter wren, Pacific-slope flycatcher, brown creeper, Townsend's warbler, hermit thrush, and Steller's jay, snake species, Townsend's chipmunk, Douglas squirrel, flying squirrel, spotted skunk, bat species, weasels, mouse, shrew, voles, opossum, coyote, bobcat, black bear, cougar, Roosevelt elk, black-tailed deer. Mature to old growth forests may support the federally listed northern spotted owl. This list is not exhaustive, and could include other species. Benefits should have short- and long-term effects.

Effects of Visitor Services Actions

Under both alternatives, mixed forest habitats would not be open to the public. No negative or positive effects to the habitat from public use actions should be incurred.

Overall Effects

Overall, a minor, positive, long-term effect would occur for mixed forest habitat and associated species under Alternative 2 because habitat management would create a higher quality of habitat that has fewer invasive species and a more diverse vegetation structure. Although there are some short-term, negative impacts that would occur from habitat management actions, they are considered minor relative to the overall benefit that would be realized in the long term through higher habitat quality. A negligible effect would occur under Alternative 1 since there is currently a limited active management program.

6.3.12 Effects to Threatened and Endangered Species at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Listed species receive special consideration in terms of Unit management. Federally listed species are trust resources that require additional consultation whenever an activity conducted by or permitted by the Unit may have an effect on these species or their habitats. Impacts to these species from wildlife-dependent recreation and habitat management are assessed in this chapter. Impacts associated with the use of herbicides and pesticides are assessed in the IPM plan in Appendix G.

The only federally listed species known to occur within the Black River Unit is Oregon spotted frog. Activities to enhance the habitats for the frog primarily target invasive species using an integrated approach that includes mowing, haying, disking, grazing, and application of Service-approved herbicide. Specialized guidelines and permits would be developed under both alternatives; however, the level of effort would vary from maintenance of habitat (Alternative 1) to an increased effort to not only maintain minimal habitat but also larger-scale habitat enhancement (Alternative 2). The Unit would work in partnership with the Service's WFO and WDFW to assure required evaluations, biological opinions, and assessments are completed and approved prior to habitat management activities. Overall, repeated habitat enhancements (Alternative 2) are expected to have great beneficial effect on the frog both in the short and long term, as has been shown in a few recent habitat modifications undertaken by the Service, WDFW, and private land owners.

Water howellia status on the Unit is unknown. In Alternative 2, inventories to determine presence or absence would be undertaken (Chapter 2, Goals 1 and 4; Chapter 4). If it is discovered, habitat enhancement efforts would be started. Until found and assessed, no effects can be determined; however, if habitat modifications are needed to enhance the plant's survivorship, the actions would be moderately beneficial for the short- and long-term existence of the population.

Effects of Visitor Services Actions

No effects from public use are expected to Oregon spotted frog or water howellia if present on the Unit, assuming the public respects the regulations and access restrictions planned in Alternative 2.

Overall Effects

In the case of Oregon spotted frog, repeated habitat enhancements may cause the loss of a few individual frogs, but would also have great beneficial short- and long-term effects on the frog's habitat. As has been shown in a few recent habitat modifications undertaken by the Service, WDFW, and private land owners, Oregon spotted frog can respond by rapidly increasing numbers and sustain those numbers for a while, even as the habitat may again degrade with re-encroaching invasive plants.

6.3.13 Effects to Social Environment at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of New Facilities

With the proposed construction of two visitor observation decks with interpretive panels, posted regulations, parking lots, an enhanced boat launch area, and current rising interest in the Unit, visitation is estimated to grow to nearly 4,000 visitors per year during the 15-year life of the CCP. This increased interpretive contact is expected to result in better understanding and support for the Unit and the Refuge System; more visitors from diverse backgrounds, particularly urban residents; increased environmental awareness of natural resources; better protection of natural resources; and more involvement by community members, volunteers, and partners. The planned new facilities would lead to a safer and more comfortable visitor experience. However, increased visitation may lead to more crowding at times such as weekends when visitation tends to be greatest. If visitors do not follow regulations and enter closed habitats, wildlife may be disturbed to a greater degree. This activity could lead to a slight, long-term, negative effect to the quality of individual visitor experience.

Effects of Visitor Services Actions

The Unit has been closed to the public during this acquisition stage; therefore, visitation numbers are not collected. The projected visitation for the future 15 years is nearly 4,000 visits per year.

Overall Effects

Under Alternative 2, the overall social effects would be beneficial because for the first time, the public would have visitor viewing areas and could learn more about the Black River Unit and National Wildlife Refuge System.

6.3.14 Effects to Opportunities for Quality Wildlife Observation and Photography at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Habitat Management Actions

Enhancing habitat through nonnative plant reduction, especially along the river and in marshes, would provide greater opportunity for visitors to observe wildlife and wildlife interactions. There may be some negative, short-term effects to the visitor experience as some enhancement work proceeds, but the public could observe habitat enhancement efforts.

Enhancing dry, grassland habitat would encourage observation of wildlife associated with that habitat. Enhancing emergent marsh and nonnative, seasonally flooded, grasslands would encourage greater use by appropriate wildlife species that are also popular for observation and photography. These beneficial management effects for wildlife also are greatly beneficial for the visitor experience.

Partnering with Thurston County to improve to the county boat launch at 123rd Avenue and create a small parking area on Service lands away from the river would benefit river water quality and nearby

habitats in both the short- and long term. In addition, the enhanced boat ramp and parking area would create the potential for additional visitors on and near the river channel habitat over the course of 15 years. Easier boat access, resulting in greater opportunities to observe wildlife, would be both a short- and long-term beneficial effect; however, the increased chance of litter would be a minor negative effect.

With greater public use of Refuge lands adjacent to the river, minor to moderate positive effects from greater appreciation of the habitat and Unit would be expected, as well as an increase in conservation awareness. Minor to moderate short- and long-term negative effects related to wildlife disturbance, and related threats from nonnative vegetation increased litter could occur but may be offset by posted regulations and interpretive panels.

Overall Effects

Overall the effects to opportunities for quality wildlife observation and photography from the described activities (above) would be minor to moderately beneficial for various groups of visitors in both the short and long term. The positive benefits outweigh the few negative aspects of litter and the risk of nonnative animal or plant introduction.

6.3.15 Effects to Cultural Resources at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

The Service is committed to protection of known cultural resources under both alternatives. Cultural resources can be of significant cultural, scientific, and educational importance. It is essential that the Service look beyond mere compliance with cultural resource laws to ensure protection of these nonrenewable resources. Of critical importance is the development of close working relationships with organizations that express affinity with the Unit's cultural resources such as Native Americans, historians, and educators.

There are no recorded prehistoric sites and four recorded historical sites within the Black River Unit boundaries. Other historic sites and features may exist on the Unit which have not been recorded. Several prehistoric and historic sites or features have been recorded within 1 mile of the Unit. Three of the historic sites within Unit boundaries have been evaluated and determined ineligible for the National Register of Historic Places (NRHP). One site has been evaluated and 9 of its 20 structures were determined to be contributing elements to the eligibility of the site to the NRHP. All of the contributing structures were documented to meet the stipulations of a Memorandum of Agreement between the Service and the SHPO in 2005 to mitigate for eventual demolition of all structures on the property that pose a safety risk to humans or wildlife (USFWS 2011).

Prior to implementing any ground-disturbing projects, the applicable cultural resource compliance investigation would be undertaken. If cultural resources are found, appropriate procedures and protocols would be followed to protect them. Whenever possible, resources would be avoided or mitigated. Mitigation options, in addition to site avoidance by relocating or redesigning facilities, would include data recovery, using either collection techniques or in-situ site stabilization protection.

Overall Effects

The short- and long-term effects of planned Unit actions that may impact cultural resources would follow Service and SHPO requirements and would be considered minor and beneficial under Alternative 2. Compliance with cultural resource investigation protocol prior to conducting ground-disturbing actions, and subsequent compliance with procedures if cultural resources are found, would ensure that negative impacts to cultural resources from implementation of any of the alternatives are negligible.

6.3.16 Effects to Economy at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

See section 6.2.10 for Grays Harbor NWR for a discussion on economic effects and how they are estimated.

Recreational Activities

Alternative 1 (Current Management): Recreational Activities

Under Alternative 1, the Black River Unit, including lands that adjoin the river, would continue to be closed to public use. There are no economic impacts generated by recreational visitation because the Unit is currently closed to the public. Activities that occur within the river channel are not under the Service's jurisdiction and thus are not taken into account in this analysis.

Alternatives 2: Recreational Activities

Under Alternative 2, the Unit would open to a variety of nonconsumptive uses. Visitors would enjoy access for boat launching, observation, photography, and interpretation opportunities. Table 6-14 shows the visitation that would occur if Alternative 2 is fully implemented. Approximately 3,910 visits would be related to a variety of recreational opportunities. All recreational visitors would participate in nonconsumptive activities.

Table 6-14. Alternatives 2: Projected Annual Unit Visitation

Activity	Residents	Nonresidents	Total
Nonconsumptive			
Pedestrian	2,628	657	3,285
Auto Tour	0	0	0
Boat Trail/Launch Visits	195	65	260
Bicycle Visits	0	0	0
Photography	292	73	365
Other Recreation	0	0	0
Interpretation	2,628	657	3,285
Hunting			
Waterfowl	0	0	0
Other Migratory Birds	0	0	0

Activity	Residents	Nonresidents	Total
Upland Game	0	0	0
Big Game	0	0	0
Fishing			
Freshwater	0	0	0
Saltwater	0	0	0
Total Visitation	3,115	795	3,910

Regional Economic Analysis

Visitor recreation expenditures associated with a fully implemented Alternative 2 are shown in Table 6-15. Total annual expenditures would be about $52,100 with nonresidents accounting for about $26,800 or 51 percent of total expenditures.

Table 6-15. Alternatives 2: Visitor Recreation Expenditures (2011 dollars in thousands)

Activity	Residents	Nonresidents	Total
Nonconsumptive	$26.80	$25.30	$52.10
Hunting	–	–	–
Fishing	–	–	–
Total Annual Expenditures	$26.80	$25.30	$52.10

Input-output models were used to determine the economic impact of expenditures on the Unit's local economy under Alternative 2. The estimated economic impacts are expected to occur in Thurston County. Table 6-16 summarizes the local economic effects associated with recreation visits. Under Alternative 2 economic output would total $79,400 with associated employment of one job, $24,600 in employment income and $11,100 in total tax revenue.

Table 6-16. Alternatives 2: Local Economic Effects Associated with Recreation Visits (2011 dollars in thousands)

	Residents	Nonresidents	Total
Economic Output	$40.80	$38.60	$79.40
Jobs	0.4	0.4	1
Job Income	$12.60	$12.00	$24.60
Tax Revenue	$5.70	$5.40	$11.10

Summary of Recreational Visitation Impacts

Table 6-17 provides a summary of the potential economic impacts related to recreational visitation for each alternative. Under Alternative 2, recreation visitation would increase after the management alternative is fully implemented. As a result, economic output, jobs, job income, and tax revenue would increase.

Table 6-17. Annual Economic Effects Associated with Recreation Visits (2011 dollars in thousands)

	Alternative 1	Alternative 2
Recreation Visits	–	3,910
Expenditures	–	$52.10
Economic Output	–	$79.40
Jobs	–	1
Job Income	–	$24.60
Tax Revenue	–	$11.10

Unit Budget

Annual costs reflect spending of base funds allocated each year. These are also known as recurring costs and are usually associated with day-to-day operations. Nonsalary expenditures are primarily fixed costs such as utilities, office supplies, vehicle gas and maintenance, habitat restoration and management, fencing and posting, and invasive plant monitoring and management.

Table 6-18 shows that average annual expenditures would be about $53,000 for Alternative 1 and approximately $527,000 for Alternative 2. The estimated expenditures for Alternative 2 assume that the alternative is fully funded as described in the CCP.

Costs estimated for Alternative 2 include a higher number of additional employees to help manage habitat and visitor services programs. Increased nonsalary expenditures would include habitat management and restoration, invasive plant monitoring and management, and visitor services facilities maintenance and operations, among other costs.

Table 6-18. Average Annual Expenditures (2011 dollars in thousands)

Expenditure	Alternative 1	Alternative 2
Salary	$32.30	$408.10
Non Salary	$20.60	$119.00
Total	$52.90	$527.20

Table 6-19 shows the economic impact of average annual (salary and nonsalary) expenditures. Impacts associated with annual expenditures would continue to occur throughout the timeline of the CCP if the alternative is fully funded. Under Alternative 1, the Unit's annual expenditures would generate approximately $78,700 in economic output, one job, $33,500 in job income, and $11,100 in tax revenue. Economic impacts for Alternative 2 would be higher due to a larger budget. Annual expenditures under Alternative 2 would generate approximately $763,900 in economic output, six jobs, $288,800 in job income, and $104,800 in tax revenue.

Table 6-19. Local Annual Economic Effects Associated with Average Annual Unit Budget (2011 dollars in thousands)

	Alternative 1	Alternative 2
Economic Output	$78.70	$763.90
Jobs	1	6

	Alternative 1	Alternative 2
Job Income	$33.50	$288.80
Tax Revenue	$11.10	$104.80

Table 6-20 shows the change in economic impacts associated with the Unit budget compared to the baseline (Alternative 1). Once fully funded, annual expenditures for Alternative 2 would increase by $474,200, respectively, compared to Alternative 1. Under Alternative 2, economic impacts associated with annual expenditures would increase by $685,200 in economic output, five jobs, and $255,300 in job income compared to Alternative 1.

Table 6-20. Change in Annual Expenditures Compared to the Baseline (Alternative 1) (2011 dollars in thousands)

	Alternative 2
Annual Expenditures	+$474.20
Economic Output	+$685.20
Jobs	+5
Job Income	+$255.30
Tax Revenue	+$93.70

Revenue Sharing Payments

Under provisions of the Refuge Revenue Sharing Act (Public Law 95-469), the Service would annually reimburse Thurston County for tax revenue which is lost as a result of the Service's acquisition of private property. This law states that the Secretary of the Interior (Secretary) shall pay to each county in which any area acquired in fee title is situated, the greater of the following amounts:

- An amount equal to the product of 75 cents multiplied by the total acreage of that portion of the fee area that is located within such county.
- An amount equal to three-fourths of one percent of the fair market value, as determined by the Secretary, for that portion of the fee area that is located within such county.
- An amount equal to 25 percent of the net receipts collected by the Secretary in connection with the operation and management of such fee area during such fiscal year. If a fee area is located in two or more counties, however, the amount for each county shall be apportioned in relationship to the acreage in that county.

The appraisal estimate value is based on the current local land values at the time of the appraisal. The Refuge Revenue Sharing Act payments to Thurston County for the Black River Unit and portions of the main unit of Billy Frank Jr. Nisqually NWR within the county have averaged $15,721 annually from Fiscal Years 2011 to 2013.

Forecasting revenue sharing payments is complex. Actual payments are a function of the appraised value and appropriations. The Refuge Revenue Sharing Act requires Service lands be reappraised every 5 years to ensure that payments to local governments remain equitable. However, some

payments are less than the legislated amounts due to governmental funding deficits. Congress may appropriate, through the budget process, supplemental funds to compensate local governments for any shortfall in revenue sharing payments. The final calculation for the payment to local governments depends on the total amount of funds available from revenue receipts collected on refuges nationwide and any appropriations. As a result, payments fluctuate based on the revenue receipts and appropriations. Due to the size of the revenue sharing payment, economic impacts would be negligible.

Overall Effects

This section summarizes the economic impacts generated by Unit management activities for each alternative. Table 6-21 summarizes the economic impacts in Thurston County for Alternative 1. Under Alternative 1, Unit activities would generate an estimated $78,700 in economic output, one job, $33,500 in job income, and $11,100 in state and local tax revenue. These economic impacts under Alternative 1 represent less than 1 percent of total income and total employment in the local area economy.

Table 6-21. Summary of Annual Economic Impacts for Alternative 1 (2011 dollars in thousands)

	Economic Output	Jobs	Job Income	Tax Revenue
Recreation Visits	–	–	–	–
Budget	$78.70	1	$33.50	$11.10
Total	$78.70	1	$33.50	$11.10

Table 6-22 summarizes the economic impacts for Alternative 2. Under Alternative 2, Unit activities would generate an estimated $849,000 in economic output, seven jobs, $315,200 in job income, and $116,700 in tax revenue. These economic impacts under Alternative 2 represent less than 1 percent of total income and total employment in the local area economy.

Table 6-22 Summary of Annual Economic Impacts for Alternative 2 (2011 dollars in thousands)

	Economic Output	Jobs	Job Income	Tax Revenue
Recreation Visits	$79.40	1	$24.60	$11.10
Budget	$763.90	6	$288.80	$104.80
Total	$843.30	7	$313.40	$115.90

6.3.17 Cumulative Effects at Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Effects of Reasonably Foreseeable Future Refuge Activities

Alterations and loss of native habitats continue at the landscape scale as challenges such as human development and climate change pose complex and persistent threats. Within this context, region-wide biological integrity may be at risk. Over time, the Unit, although relatively small, may become increasingly valuable for the persistence of native wildlife. Active improvement of habitats would increase or maintain the value of Unit lands and waters for a wide variety of native fish and wildlife,

and biological diversity. Both alternatives protect and maintain Unit habitats valuable to wildlife; however, there is a greater emphasis on habitat enhancement and management, IPM, and pursuing priority inventory, monitoring, and research in Alternative 2.

In concert with other protected lands, the Unit has an important role to conserve resident, threatened, and rare species, as well as migratory wildlife species, and to provide places where visitors can enjoy and appreciate nature. Under Alternative 2, the Service would increase the availability and quality of wildlife-dependent recreation, contributing to increased regional recreational opportunities. Implementing the CCP would have overall beneficial effects to habitats, species, and the American public. In the context of all of the factors (both natural and human-caused) that negatively affect habitats and species (e.g., food availability, human disturbance, and contaminants) the positive contributions associated with CCP implementation represent long-term, beneficial effects.

Other Reasonably Foreseeable Events and Activities from Others

Thurston County population increased (21 percent) from 2001 to 2011, compared with a 14 percent increase for Washington and a 9 percent increase for the United States as a whole. The county population in 2011 was 256,600. The population is expected to continue its rapid rise in the local area, especially with the rapid enlargement of Joint Base Lewis-McChord. The Unit's proximity to this growing population will cause former rural land to become developed more rapidly than in the past. For example, the Unit is very close to the city complex of Olympia, Lacey, and Tumwater, has lower land values, and is an easy 5–10-mile commute. The loss of the rural, forested, agricultural, or "un-used" lands result in direct loss of remaining habitats, and indirect loss through fragmentation and degradation of the lowland's remaining parcels of wildlife habitat. These expected losses create a situation where the Unit may become increasingly valuable for the persistence of native habitats and the wildlife that rely upon them.

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Appendices A-M

Vaughn Ruppert /USFWS

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. The policy provides refuge managers with a consistent procedure to screen and document decisions concerning public uses, with the use of the following questions:

a) Do we have jurisdiction over the use?
b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?
c) Is the use consistent with applicable executive orders and department and Service policies?
d) Is the use consistent with public safety?
e) Is the use consistent with goals and objectives in an approved management plan or other document?
f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
g) Is the use manageable within available budget and staff?
h) Will this be manageable in the future within existing resources?
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?
j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality, compatible, wildlife-dependent recreation into the future?

Uses marked "no" for questions (a) or (b) are not evaluated further. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. 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.

During the CCP process, the refuge manager reviewed all existing and proposed refuge uses for Grays Harbor NWR and Black River Unit of Billy Frank Jr. Nisqually NWR that are associated with the Preferred Alternative (Alternative 2). Appropriateness findings for the six wildlife-dependent uses identified in the Improvement Act (hunting, fishing, wildlife photography, observation, environmental education, and interpretation) are not included in this appendix because they are appropriate by definition. They are, however, evaluated for compatibility in Appendix C

Compatibility Determination. All other Refuge and Unit 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 Appropriate

Refuge Use	Appropriate
Grays Harbor Research, Surveys, and Scientific Collections	Yes
Sweetgrass Gathering	Yes
Black River Research, Surveys, and Scientific Collections	Yes
Black River Grazing, Haying, Mowing	Yes

Finding of Appropriateness of a Refuge Use

Refuge: Grays Harbor National Wildlife Refuge, Grays Harbor County, Washington

Use: Research, Surveys, and Scientific Collections

This form is not required for compatible 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, 603 FW 1, 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 X No ___

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

Refuge Manager: _____ Date: _____

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: _____

A compatibility determination is required before the use may be allowed.
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02/06

Justification for "Appropriate" finding.

The proposed use evaluated herein for appropriateness is more fully described and evaluated in the compatibility determination (CD) for this use and the documents referenced in that CD.

Criterion (a): The area proposed for this use lies within Grays Harbor National Wildlife Refuge (Refuge). The U.S. Fish and Wildlife Service (Service) owns and administers the Refuge and, consistent with Title 50 of the Code of Federal Regulations (Wildlife and Fisheries), has jurisdiction over public uses of the Refuge.

Criterion (b): This use would comply with applicable laws and regulations. Permittees would be required to obtain necessary local, State, and Federal permits.

Criterion (c): This use would be consistent with applicable Executive orders and U.S. Department of the Interior and Service policies, including the policies on Research and Management Studies (4 RM 6) and Administration of Specialized Uses (5 RM 17).

Criterion (d): This use would be consistent with public safety. Permittees would be required to limit their use of the Refuge to specifically designated areas and access routes, and review and understand Refuge rules and regulations, and any hazardous conditions.

Criterion (e): This use would not be inconsistent with any draft Refuge goals, and would usually support several goals. Each research proposal would need to be evaluated individually to determine the degree of support.

Criterion (f): This is not the first time this use has been proposed on the Refuge. Research as a Refuge use and research projects have been approved in earlier analyses.

Criterion (g): The Refuge has adequate budget and staff to manage the current number of research, survey, and scientific collection projects.

Criterion (h): It is expected that the Refuge will have adequate budget and staff in the future to manage research, surveys, and scientific collection projects at the rate they are occurring at present.

Criterion (i): Almost all research, surveys, and scientific collections on refuges are inherently valuable because they contribute to our understanding and appreciation of a refuge's natural or cultural resources. This is beneficial because it enhances our understanding and often our ability to properly manage these resources. Proposed research projects that did not result in these benefits would not be a priority for the Refuge and would likely not be authorized.

Criterion (j): Almost all visitation at the Refuge occurs on the Sandpiper Trail and Red Knot Spur Trail and the blacktop access road leading to the trailhead. This area is relatively small and crowding can occur, especially during special Refuge events. If research was conducted from the Trail during the spring (especially late April through early May), it could result in crowding on the Trail, and it could reduce the quality of viewing and photography by other Refuge visitors. If field research was conducted on or near the mudflats or marshlands during this same time period, it could result in flushing of shorebirds and other wildlife, and thereby reduce viewing and photography opportunities.

General and project-specific stipulations and permit conditions regarding the locations and scheduling of research would be used to greatly minimize the likelihood that such activities would impair wildlife observation and photography and environmental education and interpretation. The exception could be research and surveys specifically focused on public use. In such cases, approved study protocols would help ensure that such projects would not significantly reduce the quality of compatible wildlife-dependent public uses.

Finding of Appropriateness of a Refuge Use

Refuge: Grays Harbor National Wildlife Refuge, Grays Harbor County, Washington

Use: Sweetgrass Gathering

This form is not required for compatible 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, 603 FW 1, 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 X No ___

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

Refuge Manager: _____ Date: _____

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: _____

A compatibility determination is required before the use may be allowed.
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02/06

Justification for "Appropriate" finding.

The proposed use evaluated herein for appropriateness is more fully described and evaluated in the compatibility determination (CD) for this use and the documents referenced in that CD.

Criterion (a): The area proposed for this use lies within Grays Harbor National Wildlife Refuge (Refuge). The U.S. Fish and Wildlife Service (Service) owns and administers the Refuge and, consistent with Title 50 of the Code of Federal Regulations (Wildlife and Fisheries), has jurisdiction over public uses of the Refuge.

Criterion (b): This use would comply with applicable laws and regulations. Those Tribes that wish to gather sweetgrass would work with their tribal representative to acquire a Special Use Permit for each member. The representative would be in contact with the Refuge manager. Any other necessary local, State, and Federal permits would be required. Permittees would be required to limit their use of the Refuge to specifically designated areas and access routes to reach sweetgrass stands. They would also review and understand Refuge rules, regulations, special use requirements, and restrictions.

Criterion (c): This use would be consistent with applicable Executive orders and U.S. Department of the Interior and Service policies including the Service's Native American Policy.

Criterion (d): This use would be consistent with public safety. Permittees would be required to limit their use of the Refuge to specifically designated areas and access routes, and review and understand Refuge rules, regulations, special use requirements, restrictions, and any hazardous conditions.

Criterion (e): This use would not be inconsistent with any draft Refuge goals. Each Tribal request to gather sweetgrass would be evaluated individually.

Criterion (f): This is not the first time this use has been proposed on the Refuge. Sweetgrass gathering by local Tribal members has been approved in earlier analyses.

Criterion (g): The Refuge has adequate budget and staff to manage the current number of Tribal requests to gather sweetgrass.

Criterion (h): It is expected that the Refuge would have adequate budget and staff in the future to manage Tribal requests to gather sweetgrass at the rate they are occurring at present.

Criterion (i): This activity contributes to appreciation of the Refuge's natural resources and is a beneficial use of the Refuge's natural resources because it supports the continuance of western Washington Tribal culture. Through mitigation measures it supports conservation of sweetgrass restoration on Tribal lands. This activity supports the Service's Native American Policy.

Criterion (j): The use can currently be accommodated under the guidance of a Special Use Permit that has certain criteria and limits sweetgrass gathering to local western Washington Tribes. Limitation to Tribal members was decided after reviewing a study showing negative impacts to the resource when gathering was allowed to basket weavers of the general public. The health and quality of sweetgrass stands will be monitored over time and continued gathering may be subject to monitoring results.

Finding of Appropriateness of a Refuge Use

Refuge: Black River Unit of Billy Frank Jr.Nisqually National Wildlife Refuge, Thurston County, Washington

Use: Research, Surveys, and Scientific Collections

This form is not required for compatible 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, 603 FW 1, 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 X No __

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**

Refuge Manager: _____ Date: _____

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: _____

A compatibility determination is required before the use may be allowed.
FWS Form 3-2319
02/06

Justification for "Appropriate" finding.

The proposed use evaluated herein for appropriateness is more fully described and evaluated in the compatibility determination (CD) for this use and the documents referenced in that CD.

Criterion (a): The area proposed for this use lies within the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge (Unit). The U.S. Fish and Wildlife Service (Service) owns and administers the Refuge and, consistent with Title 50 of the Code of Federal Regulations (Wildlife and Fisheries), has jurisdiction over public uses of the Refuge.

Criterion (b): This use would comply with applicable laws and regulations. Permittees would be required to obtain necessary local, State, and Federal permits.

Criterion (c): This use would be consistent with applicable Executive orders and U.S. Department of the Interior and Service policies, including the policies on Research and Management Studies (4 RM 6) and Administration of Specialized Uses (5 RM 17).

Criterion (d): This use would be consistent with public safety. Permittees would be required to limit their use of the Unit to specifically designated areas and access routes, and review and understand Unit rules and regulations and any hazardous conditions.

Criterion (e): This use would not be inconsistent with any draft Unit goals, and would usually support several goals. Each research proposal would need to be evaluated individually to determine the degree of support.

Criterion (f): This is not the first time this use has been proposed on the Unit. Research as a Unit use and research projects have been approved in earlier analyses.

Criterion (g): The Unit has adequate budget and staff to manage the current number of research, survey, and scientific collection projects.

Criterion (h): It is expected that the Unit would have adequate budget and staff in the future to manage research, survey, and scientific collection projects at the rate they are occurring at present.

Criterion (i): Almost all research, surveys, and scientific collections on refuges are inherently valuable because they contribute to our understanding and appreciation of a refuge's natural or cultural resources. This is beneficial because it enhances our understanding of and often our ability to properly manage these resources. Proposed research projects that did not result in these benefits would not be a priority for the Unit and would likely not be authorized.

Criterion (j): Because the Unit is closed to general public use, research, surveys, and scientific collections would have no effects on other visitors at this time. However, subject to evaluations for compatibility, it is proposed that the Unit also be opened in specific locations for wildlife observation and photography, environmental interpretation, and fishing.

If research was conducted at one of the proposed new visitor facilities, it is possible that it could result in some crowding, especially with school groups. If field research was conducted in Unit habitats near one of these new facilities, it could result in flushing of birds and other wildlife, or it

could cause some animals to move farther afield. This would reduce the quality of experience for observers and photographers. Such conflicts would be expected to be infrequent and temporary.

General and project-specific stipulations and permit conditions regarding the locations and scheduling of research would be used to greatly minimize the likelihood that such activities would impair compatible, wildlife-dependent uses. The exception could be research and surveys specifically focused on public use. In such cases, approved study protocols would help ensure that such projects would not significantly reduce the quality of compatible, wildlife-dependent public uses.

Finding of Appropriateness of a Refuge Use

Refuge: Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge, Thurston County, Washington

Use: Grazing, Haying, and Mowing

This form is not required for compatible 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, 603 FW 1, 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**

Refuge Manager: _____ Date: _____

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: _____

A compatibility determination is required before the use may be allowed.
FWS Form 3-2319
02/06

Justification for "Appropriate" finding.

The proposed uses evaluated herein for appropriateness are more fully described and evaluated in the compatibility determination (CD) for these uses and the documents referenced in that CD.

Criterion (a): The areas proposed for these uses lie within the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge (Unit). The U.S. Fish and Wildlife Service (Service) owns and administers the Unit and, consistent with Title 50 of the Code of Federal Regulations (Wildlife and Fisheries), has jurisdiction over public uses of the Refuge.

Criterion (b): These uses would comply with applicable laws and regulations, including 50 C.F.R. 29.1. It is expected that properly managed grazing, haying, and mowing could be used as valuable management techniques to increase wildlife values in dry, nonnative grasslands; seasonally flooded, nonnative grasslands; and emergent marshes. It is expected that these management practices would contribute to achievement of Unit purposes and the National Wildlife Refuge System mission by reducing encroachment of woody plants, removing thatch, and increasing the vigor of native plants in overgrown and rank grasslands and marshes; maintaining a habitat mosaic in grasslands and marshes by setting back succession in treated areas; and controlling or reducing the presence of invasive plants. CD stipulations and conditions of special use permits, cooperative land management agreements, or other agreements would help ensure that potential adverse effects of these practices were minimized or avoided.

Criterion (c): These uses would be consistent with applicable Executive orders and U.S. Department of the Interior and Service policies, including the policy on Administration of Specialized Uses (5 RM 17). If found appropriate and determined compatible, grazing, haying, and mowing would be authorized through issuance of special use permits, cooperative land management agreements, contracts, or other agreements. Appropriate fees or in-kind exchanges of services would be charged to those grazing or haying.

Criterion (d): This use would be consistent with public safety. Most if not all areas where these uses are proposed are and would remain closed to general public use. There would be no more risks to public safety associated with these uses on the Unit than exist in agricultural areas across America.

Criterion (e): When properly managed, these uses would directly support draft Unit goal numbers 1, 2, 3, and 4.

Criterion (f): Haying and mowing uses currently occur on the Unit. They have been found compatible and approved in the past.

Criterion (g): The Unit has adequate budget and staff to manage grazing, haying, and mowing, as proposed.

Criterion (h): It is expected that the Unit would have adequate budget and staff in the future to continue to manage these uses.

Criterion (i): Grazing, haying, and mowing would not be expected to directly contribute to the public's understanding and appreciation of the Unit's natural or cultural resources. However, use of these habitat management techniques would provide an interpretive opportunity for the Unit to explain to visitors the value of such practices. For the reasons described earlier, properly managed

grazing, haying, and mowing would be expected to be beneficial to the Unit's natural and cultural resources.

Criterion (j): The Unit is closed to general public use, so grazing, haying, and mowing would have no effects on compatible, wildlife-dependent, or other recreational uses at this time. However, subject to evaluations for compatibility, it is proposed that the Unit also be opened for fishing, wildlife observation and photography, environmental interpretation, and boating.

The presence of grazing livestock, fencing, corrals, loading ramps, and dung and associated insects could adversely affect the quality of experience for those who visited the Unit for fishing, wildlife observation or photography, environmental interpretation, or boating. Workers conducting grazing, haying, or mowing programs could flush wildlife from treatment sites and reduce or enhance their observation or photography by Unit visitors. Activities associated with these management programs would not be ongoing and these effects would be infrequent. As noted above, it is expected that the larger effect of these proposed uses would be an improvement of grassland and marsh habitats, and an increase in abundance and diversity of wildlife using these habitats. This would enhance observation and photography opportunities in the future.

Appendix B. Compatibility Determinations

B1. Introduction

The compatibility determinations (CDs) developed during this planning process evaluate uses proposed under Alternative 2, the preferred alternative, for Grays Harbor National Wildlife Refuge and Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge's Comprehensive Conservation Plan and Environmental Assessment (CCP/EA). The evaluation of funds needed for management and implementation of each use also assumes implementation as described in Chapter 2 under Alternative 2. Chapter 6 of the draft CCP/EA also contains analysis of the impacts of public uses to wildlife and habitats. That portion of the 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 the Refuge and Unit uses that are required to be evaluated. According to Service policy, CDs will be completed for all uses proposed under a CCP that have been determined to be appropriate. Existing compatible, wildlife-dependent recreational uses must also be reevaluated and new CDs prepared during development of a CCP.

The uses listed in Tables B-1 and B-2 have been evaluated and are included in this document, as applicable, for public review.

Table B-1. Grays Harbor Refuge Uses, Determinations made in this CCP, and Year for Reevaluation

Refuge Use	Compatible?	Year Due for Reevaluation
Wildlife Observation, Photography, and Interpretation	Yes	2031
Environmental Education	Yes	2031
Research, Surveys, and Scientific Collections	Yes	2026
Sweetgrass Gathering	Yes	2026

Table B-2. Black River Unit Uses, Determinations made in this CCP, and Year for Reevaluation

Refuge Use	Compatible?	Year Due for Reevaluation
Wildlife Observation, Photography, and Interpretation	Yes	2031
Research, Surveys, and Scientific Collections	Yes	2026

Refuge Use	Compatible?	Year Due for Reevaluation
Grazing, Haying, and Mowing	Yes	2026

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, 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, the six priority wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) designated by the Refuge Administration Act 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 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 over-flights, 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 (603 FW 1). 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 regarding the existing uses on the Grays Harbor NWR and proposed uses on the Black River Unit (currently there are no approved uses) are based on the professional judgment of Refuge and Unit staff and regional planning personnel, including observations of current uses and reviews of appropriate scientific literature.

In July 2006, the Service published its Appropriate Refuge Uses Policy (603 FW1). Under this policy, most proposed uses must also undergo a review prior to a compatibility determination. Uses excepted from the policy include priority wildlife-dependent public uses and uses under reserved rights—see policy for more detail. Appropriate use reviews are in Appendix A.

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: Wildlife Observation, Photography, and Interpretation

Refuge: Grays Harbor National Wildlife Refuge, Grays Harbor County, Washington

Establishing and Acquisition Authorities:

Act to Establish the Grays Harbor National Wildlife Refuge (Pub L. 100-406, 102 STAT. 1041)

Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742m)

Refuge Purposes:

> . . . (1) to conserve fish and wildlife populations and their habitats, including but not limited to those of western sandpiper, dunlin, red knot, long-billed dowitcher, short-billed dowitcher, other shorebirds, and other migratory birds, including birds of prey; (2) to fulfill international treaty obligations of the United States with regard to fish and wildlife and their habitats; (3) to conserve those species known to be threatened with extinction; and (4) to provide an opportunity, consistent with the purposes set forth in paragraphs (1), (2), and (3), for wildlife-oriented recreation, education, and research (Pub L. 100-406, 102 STAT. 1041).
>
> . . . 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)).

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, as amended (16 U.S.C.668ddet seq.).

Description of Uses:

Interpretation is the communication of information about, or the explanation of, the nature, origin, and purpose of historical, natural, or cultural resources, objects, sites, and phenomena using personal or non-personal methods. The National Association for Interpretation defines interpretation to be, "a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in the resource. For national wildlife refuges, the purposes of interpretation are to convey an understanding of and appreciation for refuge resources, the issues that affect them, and the conservation techniques and programs pursued in their

management (USFWS 2006b). For purposes of this compatibility determination (CD), interpretation addresses environmental and cultural resources and values.

Wildlife observation and photography and interpretation are often enhanced with the provision of brochures, wildlife and plant lists, interpretive signs and displays, trails, auto tour routes and vehicle pullouts, viewing platforms or towers, viewing equipment, photography or viewing blinds, interpretive presentations and tours, visitor stations or centers, and bookstores or similar retail outlets. Many of these facilities and information sources serve all three activities. In addition, refuge visitors often enjoy all three activities together. Information can be conveyed in person, in writing, with images, with sound, and, increasingly, through a diversity of electronic media and devices.

For purposes of this CD, wildlife observation, photography, and interpretation include viewing and capturing images of wild plants and animals, wildlife habitats, wildlands, waters, landscapes, cultural resources, and cultural activities, noncommercial recording of all types (e.g., filming, videography, audiography, writing, and drawing or painting), and general nature study and appreciation. This CD does not address recording of images and audio for commercial purposes. Nor does it address observation, photography, and interpretation opportunities offered by commercial tours, sometimes referred to as ecotourism.

As noted above, one of the purposes of Grays Harbor National Wildlife Refuge (NWR or Refuge) is to provide opportunities for wildlife-oriented recreation and education, consistent with the conservation of fish and wildlife and their habitats, and fulfilling associated international treaty obligations.

The Refuge provides several opportunities for visitors to enjoy wildlife observation, photography, and interpretation. Habitats and wildlife can be viewed from the road on Paulson Road or Airport Way. However, the Refuge's Sandpiper Trail currently provides the best views and it is the focus of public use at present. This 1-mile boardwalk allows visitors to easily travel through the dense riparian and salt marsh vegetation adjacent to Bowerman Airport and approach the edge of the intertidal mudflats. The trail includes a terminal loop, interpretive panels, benches, and wide top board on the railing for steadying binoculars, spotting scopes, and cameras for enhanced viewing or photography. Vegetation is clipped along some sections of the trail to allow visitors to better observe and photograph shorebirds, waterfowl, waterbirds, and raptors and in other locations, the vegetation provides viewing of songbirds. Peak viewing for shorebirds occurs in the spring (late April through mid-May) when these birds stop to feed in Grays Harbor's intertidal mudflats in route from South American wintering areas to Arctic breeding grounds. The best times for viewing and photography occur 2 hours on each side of high tide, when the extent of exposed mudflats is the least and the feeding birds are most concentrated. Except when groups of birders or school groups visit, and except in association with the Grays Harbor Shorebird Festival (see below), current visitor group size is usually small (i.e., individuals, couples, and families).

The Sandpiper Trail is accessed by traveling west on Airport Way to the Port of Grays Harbor locked gate, parking in the narrow strip adjacent to the road (this strip can potentially accommodate 30–50 passenger vehicles), and then walking west around the gate and approximately 1/3 of a mile further along the road on Port property. The road and trail are fully accessible for those with limited mobility. An information kiosk by the entry gate provides Refuge orientation and interpretive information.

Each year, the Refuge collaborates with the Grays Harbor Audubon Society and City of Hoquiam to host the Grays Harbor Shorebird Festival. This 2- to 3-day festival is held in late April or early May and draws an average of 1,500 people annually. On average, approximately 75 percent of those attending the festival visit the Refuge (an average of approximately 1,100). Most festival activities occur offsite, but during the festival, the Refuge building and parking area are used for storage of supplies and to provide visitor orientation and information, festival registration, restrooms, and trashcans. Other on-Refuge activities include guided walks by volunteers (2 free walks with 20–40 participants per walk and 1 paid walk with approximately 40 participants), and unguided wildlife observation and photography opportunities on the Sandpiper Trail.

Comments received during the comprehensive conservation planning process reveal interest by several members of the public in additional trails, guided walks and talks, additional and improved signage, and a visitor or interpretive center on the Refuge. It is proposed that the surface of the narrow parking strip along Airport Way be improved and signed, and that two new wildlife viewing decks or platforms be developed on the south side of the Refuge: one near the port gate and Refuge information kiosk, and one adjacent to the intertidal mudflats partway between the port gate and the Sandpiper Trailhead. Visitors would access this latter viewing site by walking through the narrow strip of forest. It is also proposed that the western end of the Sandpiper Trail be lengthened by up to 250 feet and identified as the Red Knot Trail. Extension of the trail would provide enhanced viewing and photography opportunities to the west and views further into the bay. These and all new Refuge facilities would be accessible to persons of all abilities. New interpretive panels are proposed for the Sandpiper Trail and the Red Knot Trail.

A modestly sized nature center is planned for construction if funding becomes available. This nature center would be constructed near the eastern boundary of the Refuge and would be accessed from Paulson Road. The nature center would include information or exhibit areas, a classroom/meeting room, offices, restrooms, and a modestly sized parking area. Additionally, a short, raised boardwalk with railing (similar to that used for the Sandpiper Trail) would be built west-northwest through the marsh toward the intertidal mudflats and have a new viewing deck/platform. This facility would serve visitors participating in wildlife observation and photography, and interpretation and education. It is unknown how many additional visitors the proposed nature center might attract. Until further details are developed, this CD includes a conceptual level evaluation of anticipated impacts, many of which are the same as for the other wildlife observation and photography and interpretive facilities. At present, no funding is available to construct the nature center and associated facilities, although many decisions have been made regarding the details of this development. An evaluation of its environmental impacts has been made in a formal review process.

The Refuge is open for visitation every day of the year, from sunrise to sunset. There are no public restrooms, no potable water, and no entrance or user fees. Currently an estimated 13,000 people visit the Refuge each year. Almost 10 percent of those visitors enjoy the Refuge while attending the Grays Harbor Shorebird Festival. A cadre of volunteers who assist with special events and trail roving (providing visitors with interpretive and other information) supports the Refuge visitor services program. It is proposed that the Refuge work with partners to provide additional guided walks and interpretive programs on the Refuge. Visitor use of the Refuge is expected to grow over the next 15 years.

Wildlife observation, photography, and interpretation are wildlife-dependent general public uses and are to be given special consideration in refuge planning and management. When determined compatible on a refuge-specific basis, a wildlife-dependent use becomes a priority public use for that

refuge and is to be facilitated and encouraged (see National Wildlife Refuge System Administration Act, 16 U.S.C. 668dd-668ee).

This CD has been developed and made publicly available concurrent with the comprehensive conservation plan (CCP) and associated environmental assessment (EA) for Grays Harbor NWR and the Black River Unit of Nisqually NWR. Much of the information and some of the analyses contained in this CD are addressed in detail in the CCP and EA.

Availability of Resources:

Following is an estimate of one-time costs associated with the proposed improvements to the Refuge's wildlife observation and photography and interpretive facilities. These projects would serve visitors enjoying observation, photography, and interpretation, and those participating in environmental education. Therefore, one-time project costs would be split between these uses.

Table B-3. Costs to Administer and Manage Wildlife Observation and Photography and Interpretation under the Preferred Alternative

Category	One-time Expense ($)	Recurring Expense ($/year)
1. New observation platform	65,000	1,000
2. Red Knot Trail Extension	50,000	1,000
3. New interpretive panels and signage	35,000	500
4. Improvements to kiosk area	125,000	3,000
5. Construct Nature Center with the associated facilities; parking lot, boardwalk trail, and observation deck/platform.	6,000,000	100,000
6. Administration and management	25,000	125,000
7. Maintenance	40,000	35,000
8. Law Enforcement	20,000	18,000
Total Costs	6,360,000	283,500

Monies raised by partner groups during the Grays Harbor Shorebird Festival (a few thousand dollars each year) are used in part to help fund efforts at the Refuge, including construction of boardwalk, benches, and interpretive signing.

Additional funding would be sought to develop new facilities and programs. The Refuge would expect to receive adequate budget and staffing to support the annual costs associated with the proposed facilities for wildlife observation, photography, and interpretive program on the Refuge.

Anticipated Impacts of the Uses:

Refuge Goals and NWRS Mission

The Refuge has developed the following seven draft goals as part of its comprehensive conservation planning process.

1. Protect, maintain, and restore estuarine habitats representative of the Grays Harbor ecosystem for the benefit of shorebirds, other migratory birds, fish, and a diverse assemblage of other native species.
2. Protect and maintain upland habitat representative of the Grays Harbor ecosystem for the benefit of migratory passerines and other wildlife.
3. Contribute to the protection and long-term environmental health of the Refuge and greater Grays Harbor estuary and ecosystem.
4. Collect scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.
5. Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance their understanding and appreciation of the Refuge's natural resources and foster a connection with nature.
6. Provide environmental education opportunities that initiate a sense of wonder and foster a connection with nature and the Refuge for students both on and off the Refuge.
7. Support and strengthen an active volunteer work force and Friends Groups to assist in providing quality visitor services programs and outreach.

Observation, photography, and interpretation activities would directly support draft Refuge goal 5 and indirectly support goal 7. It is expected that these uses would enhance the public's understanding of and appreciation for the importance of conservation and for the Refuge's management programs; therefore, they would also indirectly support the Refuge System mission and draft goals 1, 2, and 3.

Fish, Wildlife, Plants, and Their Habitats

As noted earlier, purposes of Grays Harbor NWR include conservation of fish and wildlife populations and their habitats, with emphasis upon shorebirds, other migratory birds, birds of prey, and species threatened with extinction. Refuge purposes also include fulfilling international treaty obligations of the United States with regard to fish and wildlife and their habitats. Examples of such treaties include the Ramsar Convention and treaties between the U.S. and Canada, Japan, Mexico, Russia, the Soviet Union, and Western Hemisphere nations. These treaties address the conservation and protection of migratory birds and species in danger of extinction, protection of wetlands, and establishment and management of nature preserves (I.L.M. 11:963-976; 39 Stat. 1702, T.S. 628; 25 U.S.T. 3329, T.I.A.S. 7990; 50 Stat. 1311, T.S. 912; 23 U.S.T. 845, T.I.A.S. 7345; T.I.A.S. 9073, 92 Stat. 3110; and 56 Stat. 1354, T.S. 981).

Wildlife species of special management concern at the Refuge include shorebirds such as western sandpiper (*Calidris mauri*), dunlin (*Calidris alpina*), semi-palmated plover (Charadrius semipalmatus), black-bellied plover (*Pluvialis squatarola*), red knot (*Calidris canutus roselaari*), long-billed dowitcher (*Limnodromus scolopaceus*), short-billed dowitcher (*Limnodromus griseus*), and greater yellowlegs (*Tringa melanoleuca*); birds of prey such as bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Cirus cyaneus*), merlin (*Falco columbarius*), and peregrine falcon (*Falco peregrinus*); waterfowl, other waterbirds, and other migratory birds including ducks and geese, gulls, terns, mergansers, common loon (*Gavia immer*), brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*) and other waterbirds; and neotropical songbirds. Management also focuses on species threatened with extinction which, when the Refuge was established, included the peregrine falcon, bald eagle, and brown pelican. All these species have since been removed from the Federal endangered species list and are considered recovered in this area of the U.S. Shorebirds and other fauna at the Refuge provide prey for these raptors, so the Refuge will continue to ensure that

management decisions support continued recovery of these birds. It is possible that the following three fishes listed as threatened under the Federal Endangered Species Act (16 U.S.C. 1531-1544) occur on the Refuge: green sturgeon (*Acipenser medirostris*), bull trout (*Salvelinus confluentus*), and eulachon (*Thaleichtys pacificus*, aka smelt).

Refuge management focuses on providing quality intertidal mudflat roosting and foraging habitat for migrating shorebirds. This is especially important during the spring (late April through May) when hundreds of thousands of these birds use the entire Grays Harbor estuary as a refueling stop on their northern migration from wintering areas in South America. While at Grays Harbor, the birds enhance fat reserves for the nonstop flight to their Arctic breeding grounds. Grays Harbor is one of four major North American staging areas for shorebirds and hosts one of the largest concentrations of these birds on the West Coast south of Alaska. In 1995, in recognition of its high value to over 500,000 shorebirds annually, Grays Harbor estuary was designated a site of hemispheric importance (the highest ranking) by the Western Hemisphere Shorebird Reserve Network). Bowerman Basin (within the Refuge) has been designated a Globally Important Bird Area and is listed as priority wintering habitat for peregrine falcons by the Washington Department of Fish and Wildlife (Audubon Washington, Jun 2001). Although shorebird numbers are especially high in the spring, a diversity of wildlife use Refuge habitats throughout the year. For example, shorebirds also visit and feed in the estuary from June through October, during their southward migration, and dunlin and black-bellied plover winter at the Refuge.

Refuge habitats of special management concern include open water, intertidal mudflats, tidal salt and brackish marsh, and forest. Native plants of special concern include native eelgrass (*Zostera marina*) and sweetgrass (*Schoenoplectus pungens*). Because Refuge mudflats are some of the last in the estuary to flood during twice-daily high tides, they are especially valuable for foraging shorebirds. The Refuge's mudflat habitat is dense with nutrient-rich, invertebrate bird foods, such as polychaete worms, tubeworms, and the shrimp-like Corophium amphipod (*Corophium spp.*). Red alder (*Alnus rubra*) dominates the forest that provides roost sites for raptors and cover and forage for passerines. Invasive species of actual or potential concern include common reed (*Phragmites australis*), three different species of Spartina (*Spartina spp.*), a few knotweed species (*Polygonum spp.*), Asian or Japanese eelgrass (*Zostera japonica*), yellow flag iris (*Iris pseudacorus*), Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), Canada and bull thistle (*Cirsium arvense* and *Cirsium vulgare*, respectively), Griffins isopod (*Orthione griffenis*), green crab (*Carcinus maenas*), and invasive mussels and snails.

It is expected that the greatest effects upon wildlife of visitors engaging in wildlife observation and photography and interpretation would likely be associated with disturbance. Human disturbance has differential effects on wildlife and is dependent upon, among other variables, the species involved and its age; the time of year; the breeding cycle stage (if applicable); the surrounding environment; whether the activity involves vehicles; the intensity, speed, noise, nature, and frequency of the disturbing activity; and the directness of approach to an animal (Blanc et al. 2006, Goss-Custard and Verboven 1993, Holmes et al. 2005, Hammitt and Cole 1998, Kirby et al. 1993, Knight and Cole 1995a, Knight and Cole 1995b, Lafferty 2001a). Disturbance can cause animals stress and to alter their normal behavior, cause them to stop feeding, cause abandonment of nests and young, and allow predators access to nests and young, reduce parental attention to young, and otherwise impact survival of individual birds, eggs, nestlings, or broods (Burger and Gochfeld 1991; Haysmith and Hunt 1995; Lafferty 2001b). The effects of disturbance on individual animals are likely additive.

Distance of observers/photographers from wildlife subjects and the numbers of observers/ photographers involved are important disturbance variables. Holmes et al. (2007) found that vigilance behavior of Gentoo penguins (*Pygoscelis papua*) increased as the numbers of observers increased. A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004).

A variety of factors affect flushing and flushing distances among waterbirds, including the species involved; the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed); whether the species is hunted; and the type, size, speed, and noise of disturbance (e.g., dogs versus humans, cycling versus walking, or approaching birds by walking versus in a motorized boat) (Goss-Custard and Verboven 1993, Lafferty 2001b, Rodgers and Smith 1997, Rodgers 1991, Smit and Visser 1993). Flushing of birds or even raising their alert levels (which usually occurs at a greater distance than that for flushing) creates stress and requires animals to expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing.

In a study of the effects of disturbance on feeding shorebirds in a British estuary, Goss-Custard and Verboven (1993) found that flushed birds normally flew just a short distance and quickly resumed feeding. They noted that although disturbance (by walkers, observers, anglers, dog-walkers, and shell fisherman) had increased over a 15-year period, populations of oystercatchers had not diminished because there were ample areas away from disturbance for the birds to move and continue feeding; birds could feed at other hours of the day and night when people were not present; feeding intensity could be increased somewhat to compensate for lost feeding time; some of the best feeding areas, the mudflats, were areas not usually accessed by humans; and the birds might habituate to certain types of disturbance. Importantly, if enough people were present in some of the smaller habitats, all of the feeding shorebirds were displaced and as the density of feeding shorebirds increased elsewhere, older birds stole more food from subordinate birds.

In another study of the effects of disturbance on British shorebirds, Gill et al. (2001) found that there was a strong relationship between the density of desirable prey species and the numbers of godwits using a site, and that human disturbance had no effect on the numbers of godwits supported at preferred forage sites. In a study of the effects of trail users (walkers, joggers, bicyclists, and in-line skaters) on shorebirds in San Francisco Bay, Trulio and Sokale (2008) found there was no difference in shorebird use between sites without trail use and those sites with low numbers of trail users. However, after a certain point on high use days, increasing numbers of trail users resulted in reduced numbers of foraging shorebirds. Similar to the situation at Grays Harbor, these trails were elevated and aligned parallel to the adjacent mudflats.

In a study of sanderlings (*Calidris alba*) on a California beach, Thomas (5-2000) found that the number, proximity, and activity of recreationists all affected foraging time by the birds. The presence of dogs off-leash was especially disturbing. Smit and Visser (1993) reviewed numerous shorebird studies from the coasts of The Netherlands and Germany. They found that, when disturbed, entire flocks of nonterritorial shorebirds departed feeding sites and moved to other feeding sites. They also found that one person or a group of people could cause most or all territorial shorebirds (e.g., redshanks, oystercatchers, and curlews) to abandon a preferred feeding site until the disturbance ceased and then often a smaller number of these birds returned. Finally, they noted that their review

argued for keeping visitors to nature reserves at sufficient distance from high-tide roosts. These studies suggest that disturbance response varies considerably among foraging shorebirds and perhaps among feeding sites. It would appear that in some situations, certain shorebird species are somewhat more tolerant of modest levels of human disturbance than some other bird species and that such disturbance may not affect the birds' ability to satisfy nutritional requirements or their populations if the areal extent of quality foraging habitats is adequate.

Wildlife disturbance can be a special concern with wildlife observation and photography (Cline et al. 2007; DeLong 2002; Knight and Cole 1995). Observers and photographers often want to enhance their view or photograph by encroaching closer and closer to their subject. This can cause increased stress in wildlife and eventually lead to flushing. If a bird is nesting or brood rearing, disturbance can cause temporary or permanent nest desertion. Even if only temporary, eggs and nestlings can face survival challenges associated with temperature extremes and predation.

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife are often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Holmes et al. 2007; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993). Lafferty et al. (2006) studied the effects of erecting educational signing, employing docents, and placing a rope barrier that directed recreationists away from a western snowy plover (*Charadrius alexandrinus nivosus*) nesting area on a California beach. Despite the fact pedestrians were easily seen and continued to routinely pass by the nesting area, human-related disturbance was reduced by more than half, plover numbers increased within the barrier area, and plover reproductive success was enhanced. Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

Observers, photographers, or participants in interpretation programs could also cause trampling of native plants, erosion, and introduction or spread of exotic species, including invertebrates, plants, and invasive species. All of these impacts could adversely affect native fish, wildlife, plants, and their habitats. The degree of actual effects upon important life history parameters such as foraging, predator avoidance, reproduction, and survival of individuals and diversity and abundance of native species (community health) would depend on specific circumstances.

The primary area of the Refuge open to public use is the Sandpiper Trail: a boardwalk that is built on piers and rises above the underlying brackish and salt marsh along the southern boundary of the Refuge. Access to this trail is on the hardened black top road. Confining visitors to the trail and associated access route avoids potential problems associated with trampling of vegetation and erosion of soils. Additionally, although visitors are provided an avenue through the forest and across the marsh to the edge of the mudflats, they are not allowed to venture onto the mudflats themselves, thus keeping this critical foraging area disturbance-free. The proposed new facilities on the Refuge's south side (two observation decks/platforms and associated trails/boardwalks, the Red Knot Trail addition, new interpretive panels and signage, and improvements to the parking strip) would be sited in this same area and share the same design features as the current facilities. It is expected that these

new facilities and associated public uses would have the same effects on wildlife and their habitat as those at present. Anecdotal observations from the decades since the Sandpiper Trail has been opened to the public reveal that visitor use of this facility does not disturb shorebirds foraging on the mudflats. There are perch sites in trees on three sides of the Refuge allowing raptors to move to other locations should they be disturbed by visitors on the Sandpiper Trail.

To preserve views at specific viewpoints along the Sandpiper Trail, staff or volunteers would trim or remove a modest amount of native and nonnative vegetation. Maintenance of some vegetation growth is not expected to effect on the overall health of the forest or marsh habitat.

The existing small parking area is partially paved and partially graveled. This minimizes erosion potential. It is proposed that this narrow parking area be repaved to improve the existing parking surface, which would reduce vehicle-related erosion potential from this area.

The proposed nature center and parking lot would be built adjacent to Paulson Road. The proposed boardwalk and observation deck/platform would be elevated above the marsh, similar to the Sandpiper Trail, at a distance to reduce disturbance of foraging shorebirds. When visitors use the trail and observation deck/platform, raptors might be discouraged from perching in immediately adjacent trees. Upland forest habitat occupies a much larger area at this location, so these birds should have no problem finding acceptable alternative perching sites.

Visitors would be required to stay on trails or blacktop thus reducing the potential for impacts upon native fish, wildlife, and their habitats. Due to the denseness of vegetation and insubstantial nature of sediments, almost all other areas of the Refuge are, difficult for visitors to access; off-trail use or free-roaming would not allowed.

Public Use

Not including research, the other general public use allowed (and proposed for authorization) on the Refuge is environmental education. This use occurs during the school year, primarily in the spring. It is unlikely that a handful of visitors enjoying wildlife observation, photography, or interpretation would adversely affect those participating in environmental education.

Cultural Resources and Values

There are no recorded prehistoric or historic sites on the Refuge and, to date, the Service has not conducted or authorized any other party to conduct cultural resource surveys on the Refuge. Development, including construction of the proposed visitor facilities described above, can impact cultural resources. However, because Refuge facilities would be built in areas that were formerly mudflats, but were filled in with dredge spoils in modern times, it is unlikely that there exist cultural resources at these sites. Nonetheless, prior to construction of any new facilities, the Service would undertake appropriate surveys and engage in consultations consistent with requirements of the National Historic Preservation Act (16 U.S.C. 470). This process would result in avoiding, minimizing, or mitigating any potential effects.

As noted earlier, all existing and proposed visitor uses, including observation, photography, and interpretation, occurs or would occur on hardened surfaces (i.e., gravel, pavement, or boardwalk). This further reduces the potential that these public uses would adversely affect cultural resources at the Refuge.

Public Review and Comment:

Public availability of this CD has been widely announced together with announcement of the availability of the Refuge's draft CCP. The review and comment period has also been the same as for the draft CCP.

Determination: (check one below)

____ Use is Not Compatible

_X_ Use is Compatible with following Stipulations

Stipulations Necessary to Ensure Compatibility:

General

In addition to the stipulations listed here visitors would be required to comply with Refuge System-related and other applicable laws, regulations, and policies including "Prohibited Acts" listed in the Code of Federal Regulations (50 C.F.R. 27).

1. To access and use Refuge areas for wildlife observation, photography, and interpretation, visitors would be required to angle park in the narrow strip of pavement/gravel just east of the port gate and adjacent to Airport Way, or at the proposed new nature center, and stay on hardened surfaces, including designated roads, trails, and boardwalks.

2. Rules to help ensure public safety and minimize adverse effects upon native fish, wildlife, plants, and their habitats would be posted on the kiosk and enforced by Refuge staff.

3. Interpretive materials would be provided to inform visitors of desired behaviors when viewing and photographing wildlife. Examples include the "Principles of Ethical Field Practices" developed by the North American Nature Photography Association. Among others, these principles include not distressing or otherwise interfering with animal behaviors, using telephoto lenses to photograph animals from afar, and adherence to local regulatory requirements. Other practices that can reduce wildlife disturbance when observing or photographing include use of binoculars or spotting scopes to enable good viewing while maintaining a respectable distance from individuals or flocks.

4. Observers and photographers would be prohibited from using attractants such as food or recorded audio playback devices (e.g., those used to attract birds and other wildlife). This includes tape and digital recorders, portable computers (e.g., laptops, notebooks, and tablets), and smart phones. Also, photography through use of kites, remote-controlled aircraft, drones, or extended poles (anything taller than a standard photographic tripod or monopod) would not be allowed.

5. Group size for guided/interpretive walks would be limited to help ensure a quality visitor experience and minimize potential effects on wildlife from large groups of visitors. To ensure that visitors are provided high quality orientation, information, and interpretation, the Refuge

would continue to provide regular training to volunteer roving interpreters and other Refuge volunteers.

6. In order to avoid harassment, disease, or death of native wildlife, or transport of exotic or invasive plant parts, insects, or other undesirable species, individuals participating in observation, photography, and interpretation would be prohibited from bringing dogs or other pets with them onto the Refuge. The exceptions would be leashed, certified service animals.

7. Cutting of vegetation to maintain views to the mudflats would be limited to that necessary, and conducted by staff or volunteers only.

8. No changes could be made to any of these stipulations without specific, prior written approval of the refuge manager or refuge complex manager.

9. Periodic monitoring and evaluation of facilities, programs, habitats, and wildlife would be conducted by staff to assess if program objectives are being met with little or no additional or unexpected impacts to resources (budgetary, staffing, wildlife, facilities, etc.).

Justification:

Service policy states that, "Viewing and photographing wildlife in natural or managed environments should foster a connection between visitors and natural resources" (USFWS 2006a). Policy also advises that wildlife observation and photography can promote understanding and appreciation of natural resources and their management across the Refuge System (USFWS 2006c and USFWS 2006d). Participation in Refuge interpretive and informational programs can instill a sense of wonder, cultivate a connection with nature, foster a life-long relationship with a Refuge and the Refuge System, encourage a conservation ethic, and enhance the public's understanding of and appreciation for fish, wildlife, plants, their habitats, cultural resources, and Refuge management programs to conserve these valuable resources.

Service policy and Federal law require that wildlife-dependent public uses (including wildlife observation and photography and interpretation) be given special consideration in refuge planning and management, and opportunities to allow these uses are to be considered in each refuge CCP (USFWS 2000 and NWRS Administration Act). When determined compatible on a refuge-specific basis, a wildlife-dependent use becomes a priority public use for that refuge and is to be facilitated and strongly encouraged. Safe and compatible opportunities for families, including children, to participate in wildlife-dependent uses are to be provided across the Refuge System.

Potentially these activities could cause some wildlife disturbance. However, they have been available on the Refuge for decades and existing facilities and program management have appropriately minimized effects upon native wildlife, plants, their habitats, and cultural resources. The stipulations included herein continue those efforts and provide additional protection.

The Refuge would monitor wildlife and habitat disturbance and other potential impacts to determine if these stipulations were resulting in expected and desirable outcomes. The Refuge would apply adaptive management principles to modify stipulations or adjust objectives, as necessary, to achieve desirable results (see USDI 2008 and Williams et al. 2009).

The Refuge would reserve the right to add to or otherwise modify the stipulations listed herein in order to ensure the continued compatibility of these uses. New or modified stipulations could be instituted as a result of new information generated by ongoing or new studies; new legal, regulatory, or policy requirements; significant changes to the Refuge environment or status of native fish, wildlife, plants, or their habitats; or for other legitimate reasons. Visitors would be appropriately advised of any such changes.

The Refuge would also reserve the right to terminate permission for these uses if individuals were violating Refuge rules or regulations; if unacceptable impacts were occurring to native fish, wildlife, plants, or their habitats, cultural resources or Refuge facilities, or other Refuge visitors; or for other legitimate reasons.

Compatibility Standard.

As noted earlier, the purposes of Grays Harbor NWR include providing opportunities for wildlife-oriented recreation and education, consistent with the conservation of fish and wildlife and their habitats, and fulfilling associated international treaty obligations. Providing opportunities for wildlife observation and photography and interpretation is directly supportive of these congressionally established Refuge purposes.

The several stipulations associated with these uses have been designed to greatly reduce the likelihood and magnitude of potential biological effects. Potential impacts associated with observation, photography, and interpretation are greatly limited because visitors would access and use key interpretive facilities, and viewing and photography opportunities via a paved road, and hardened and raised boardwalks and viewing decks or platforms.

In order to be allowed on the Refuge, observation, photography, and interpretation would need to be determined compatible. By allowing these uses to occur under the stipulations described above, it is anticipated that wildlife which were disturbed would find sufficient food resources and resting places elsewhere on the Refuge or Grays Harbor so their abundance and use would not be measurably lessened. Additionally, it is anticipated that monitoring and adaptive management would prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats; other public uses; and cultural resources. For the several reasons stated above and consistent with the stipulations described herein, these uses would not materially interfere with or detract from maintenance of the Refuge's biological integrity, diversity, and environmental health; fulfillment of Grays Harbor NWR's purposes; or the Refuge System's mission.

Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for "allowed" uses only)

_____ 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

This compatibility determination has being developed and issued concurrent with the CCP and EA for Grays Harbor NWR and the Black River Unit.

Compatibility Determination for Wildlife Observation, Photography, and Interpretation at Grays Harbor NWR:

Uses are compatible with stipulations.

Refuge Determination

Prepared by: _____
(Signature) (Date)

Approved by Project Leader, Nisqually National Wildlife Refuge Complex: _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____
(Signature) (Date)

Regional Chief, National Wildlife Refuge System, Pacific Region: _____
(Signature) (Date)

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Compatibility Determination

Use: Environmental Education.

Refuge: Grays Harbor National Wildlife Refuge, Grays Harbor County, Washington

Establishing and Acquisition Authorities:

Act to Establish the Grays Harbor National Wildlife Refuge (Pub L. 100-406, 102 STAT. 1041)

Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742m)

Refuge Purposes:

> . . . (1) to conserve fish and wildlife populations and their habitats, including but not limited to those of western sandpiper, dunlin, red knot, long-billed dowitcher, short-billed dowitcher, other shorebirds, and other migratory birds, including birds of prey; (2) to fulfill international treaty obligations of the United States with regard to fish and wildlife and their habitats; (3) to conserve those species known to be threatened with extinction; and (4) to provide an opportunity, consistent with the purposes set forth in paragraphs (1), (2), and (3), for wildlife-oriented recreation, education, and research (Pub L. 100-406, 102 STAT. 1041).
>
> . . . 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)).

Description of Use:

U.S. Fish and Wildlife Service (Service) policy defines environmental education to be, "…a process designed to teach citizens and visitors the history and importance of conservation and the biological and the scientific knowledge of our Nation's natural resources. Through this process, …[the Service]… can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively towards the conservation of our Nation's environmental resources. Environmental education within the Refuge System incorporates onsite, offsite, and distance learning materials, activities, programs, and products that address the audience's course of study, refuge purpose(s), physical attributes, ecosystem dynamics, conservation strategies, and the Refuge System mission" (USFWS 2006).

Environmental education is a formal, structured program that incorporates measurable learning objectives and uses audience-appropriate curricula to satisfy State or other standards. Environmental education activities can be provided by Refuge personnel, a volunteer(s), or other Service-authorized agent(s), or through partnerships with groups that share similar goals (e.g., a Refuge friends group). For purposes of this compatibility determination (CD), environmental education includes education regarding natural and cultural resources and values.

As noted above, one of the purposes of Grays Harbor National Wildlife Refuge (NWR or Refuge) is to provide opportunities for wildlife-oriented education, consistent with the conservation of fish and wildlife and their habitats, and fulfilling associated international treaty obligations. At present, the Service partners with several local organizations to offer an environmental education program that reaches over 4,000 students and adults annually, both on the Refuge and offsite in local schools throughout Grays Harbor County. Formal environmental education efforts focus on third and fourth grade students (the goal is to reach at least 500 students annually). In the spring, following classroom trainings, students enjoy a field trip to the Refuge (800 students participated in such field trips in 2012). Environmental education programs are provided by Service staff, interns, and trained volunteers, and since 2002, are coordinated by an AmeriCorps Volunteer who serves as the Refuge's environmental education coordinator. As funding and staffing allow, the Refuge also assists with local summer camp programs, which include natural history activities and lessons.

Formal teacher training is an important component of the Refuge's environmental education program. Trainings address both Refuge-specific topics and watershed issues. Training participants receive "An Educator's Guide to Grays Harbor National Wildlife Refuge" which customized the Shorebird Sisters School Program for local use. The "Growing Up Wild" program guide has been used for training early childhood teachers. The Service often partners with local educational organizations (e.g., Educational Service District 113 and the Chehalis Basin Education Consortium) to provide these trainings. Volunteers who assist with the education program also receive training.

There are currently no public restrooms, no potable water, and no specialized facilities on the Refuge to serve environmental education. The Sandpiper Trail is the focus of onsite education efforts. The Port of Grays Harbor allows school buses to travel beyond the port gate and drive to the trailhead of the Sandpiper Trail. There, students can readily access the trail to observe wildlife, plants, and their habitats, and learn about Refuge management programs and conservation issues. The trail is fully accessible for those with limited mobility.

Comments received during the comprehensive conservation planning process reveal interest by members of the public in more educational opportunities throughout the year, guided walks and talks, additional trails, additional and improved signage, and a visitor/interpretive center on the Refuge. It is proposed that the surface of the narrow parking strip along Airport Way be improved and signed, and that two new wildlife viewing decks/platforms be developed on the south side of the Refuge: one near the port gate and Refuge information kiosk, and one adjacent to the intertidal mudflats partway between the port gate and the Sandpiper Trailhead. Students, teachers, and other visitors would access this latter viewing site by walking through the narrow strip of forest. It is proposed that the western end of the Sandpiper Trail be lengthened by approximately 250 feet and identified as the Red Knot Trail. Extension of this trail would provide enhanced viewing and photography opportunities to the west and further into the bay. These and all new Refuge facilities would be accessible to persons of all abilities. New interpretive panels are proposed for the Refuge information kiosk, and Sandpiper and Red Knot trails.

A modestly sized nature center, associated parking, and trails are proposed for construction when funding is available. The nature center would be sited at the eastern boundary of the Refuge and would be accessed from Paulson Road. The nature center would include an information/exhibit area, a classroom/meeting room, offices, restrooms, and a modestly sized parking area. Additionally, a short, raised boardwalk with railing (similar to that used for the Sandpiper Trail) would be built through the marsh toward the intertidal mudflats and have a new viewing deck/platform. This facility

would serve students and teachers participating in environmental education along with those enjoying wildlife observation and photography, and environmental interpretation. It is unknown how many additional visitors the proposed nature center might attract.

Until further details are developed, this CD includes a conceptual level evaluation of anticipated impacts, many of which are the same as for the other wildlife observation and photography, and environmental interpretive facilities. At present, no funding is available to construct the proposed nature center and associated facilities.

Students often participate in wildlife observation, photography, and environmental interpretation opportunities during their participation in formal environmental education activities at the Refuge. Observation, photography, and interpretation opportunities at Grays Harbor NWR are addressed in a separate CD (see CD for Wildlife Observation, Photography, and Interpretation).

Environmental education is a wildlife-dependent general public use and is to be given special consideration in refuge planning and management. When determined compatible on a refuge-specific basis, a wildlife-dependent use becomes a priority public use for that refuge and is to be facilitated and encouraged (see National Wildlife Refuge System Administration Act, 16 U.S.C. 668dd-668ee).

This CD has been developed and made publicly available concurrent with the comprehensive conservation plan (CCP) and associated environmental assessment (EA) for Grays Harbor NWR and the Black River Unit of Nisqually NWR. Much of the information and some of the analyses contained in this CD are addressed in greater detail in the CCP and EA. The CCP and EA are incorporated through reference herein.

Availability of Resources:

Following is an estimate of one-time costs associated with the proposed improvements to Refuge facilities used in the environmental education program. These projects would serve students and teachers participating in environmental education. Therefore, onetime project costs would be divided between these uses.

Table B-4. Costs to Administer and Manage Environmental Education under the Preferred Alternative

Category	One-time Expense ($)	Recurring Expense ($/year)
1. Manage Environmental Education curriculum and programs	23,000	91,000
9.1 Conduct on and off site Refuge programs	10,000	55,000
Total Costs	33,000	146,000

Monies raised by partner groups during the Grays Harbor Shorebird Festival (a few thousand dollars each year) are used in part to help fund efforts at the Refuge, including the environmental education program, and construction of boardwalk, benches, and interpretive signing. To date, the Refuge has partnered with other organizations and used grant funding to annually support the environmental education coordinator position (AmeriCorps Volunteer) and provide bus transportation for students as part of the environmental education program. This funding, especially the bus transportation, is not guaranteed annually.

Costs associated with the current environmental education program are funded through combined nonprofit and Service sources. Funding is needed annually to hire the education specialist (Americorps) position. This position is temporary. Additional permanent funding would be sought to develop all proposed facilities, staff needs, and programs.

Anticipated Impacts of the Use(s):

This CD addresses anticipated impacts of the Refuge's onsite environmental education program. It is likely that offsite environmental education activities, such as those conducted in area schools, would not have measurable impacts on the Refuge or its natural or cultural resources.

Refuge Goals and NWRS Mission

The Refuge has developed the following seven draft goals as part of the comprehensive conservation planning process.

1. Protect, maintain, and restore estuarine habitats representative of the Grays Harbor ecosystem for the benefit of shorebirds, other migratory birds, fish, and a diverse assemblage of other native species.
2. Protect and maintain upland habitat representative of the Grays Harbor ecosystem for the benefit of migratory passerines and other wildlife.
3. Contribute to the protection and long-term environmental health of the Refuge and greater Grays Harbor estuary and ecosystem.
4. Collect scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.
5. Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance their understanding and appreciation of the Refuge's natural resources and foster a connection with nature.
6. Provide environmental education opportunities that initiate a sense of wonder and foster a connection with nature and the Refuge for students both on and off the Refuge.
7. Support and strengthen an active volunteer workforce and Friends Groups to assist in providing quality visitor services programs and outreach.

Environmental education activities would directly support draft Refuge goal 6. It is expected that these activities would enhance the public's understanding of and appreciation for the importance of conservation and for the Refuge's management programs; therefore, they would indirectly support the Refuge System mission and draft goals 1, 2, and 3. Additionally, volunteers are recruited and trained to assist with the environmental education program; these activities would also indirectly support draft goal 7.

Fish, Wildlife, Plants, and Their Habitats

As noted earlier, the purposes of Grays Harbor NWR include conservation of fish and wildlife populations and their habitats, with emphasis upon shorebirds, other migratory birds, birds of prey, and species threatened with extinction. Refuge purposes also include fulfilling international treaty obligations of the United States with regard to fish and wildlife and their habitats. Examples of such treaties include the Ramsar Convention and treaties between the U.S. and Canada, Japan, Mexico, Russia, the Soviet Union, and Western Hemisphere nations. These treaties address the conservation

and protection of migratory birds and species in danger of extinction, protection of wetlands, and establishment and management of nature preserves (I.L.M. 11:963-976; 39 Stat. 1702, T.S. 628; 25 U.S.T. 3329, T.I.A.S. 7990; 50 Stat. 1311, T.S. 912; 23 U.S.T. 845, T.I.A.S. 7345; T.I.A.S. 9073, 92 Stat. 3110; and 56 Stat. 1354, T.S. 981).

Wildlife species of special management concern at the Refuge include shorebirds such as western sandpiper (*Calidris mauri*), dunlin (*Calidris alpina*), semi-palmated plover (Charadrius semipalmatus), black-bellied plover (*Pluvialis squatarola*), red knot (*Calidris canutus roselaari*), long-billed dowitcher (*Limnodromus scolopaceus*), short-billed dowitcher (*Limnodromus griseus*), and greater yellowlegs (*Tringa melanoleuca*); birds of prey such as bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Cirus cyaneus*), merlin (*Falco columbarius*), and peregrine falcon (*Falco peregrinus*); waterfowl, other waterbirds, and other migratory birds including ducks and geese, gulls, terns, mergansers, common loon (*Gavia immer*), brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*) and other waterbirds; and neotropical songbirds. Management also focuses on species threatened with extinction which, when the Refuge was established, included the peregrine falcon, bald eagle, and brown pelican. Each of these species, have since been removed from the Federal endangered species list and are considered recovered in this area of the U.S. Shorebirds and other fauna at the Refuge provide prey for these raptors, so the Refuge will continue to ensure that management decisions support continued recovery of these birds. It is possible that the following three fishes listed as threatened under the Federal Endangered Species Act (16 U.S.C. 1531-1544) occur on the Refuge: green sturgeon (*Acipenser medirostris*), bull trout (*Salvelinus confluentus*), and eulachon (*Thaleichtys pacificus*, aka smelt).

Refuge management focuses on providing quality intertidal mudflat roosting and foraging habitat for migrating shorebirds. This is especially important during the spring (late April through May) when hundreds of thousands of these birds use the entire Harbor estuary as a refueling stop on their northern migration from wintering areas in South America. While at Grays Harbor, the birds enhance fat reserves for the nonstop flight to their Arctic breeding grounds. Grays Harbor is one of four major North American staging areas for shorebirds and hosts one of the largest concentrations of these birds on the west coast south of Alaska. In 1995, in recognition of its high value to over 500,000 shorebirds annually, Grays Harbor Estuary was designated a site of hemispheric importance (the highest ranking) by the Western Hemisphere Shorebird Reserve Network. Bowerman Basin (within the Refuge) has been designated a Globally Important Bird Area and is listed as priority wintering habitat for peregrine falcons by the Washington Department of Fish and Wildlife (Audubon Washington Jun 2001). Although shorebird numbers are especially high in the spring, a diversity of wildlife use Refuge habitats throughout the year. For example, shorebirds also visit and feed in the estuary from June through October, during their southward migration, and dunlin and black-bellied plover winter at the Refuge.

Refuge habitats of special management concern include open water, intertidal mudflats, tidal salt and brackish marsh, and forest. Native plants of special concern include native eelgrass (*Zostera marina*) and sweetgrass (*Schoenoplectus pungens*). Because Refuge mudflats are some of the last in the estuary to flood during twice-daily high tides, they are especially valuable for foraging shorebirds. The Refuge's mudflat habitat is dense with nutrient-rich, invertebrate bird foods, such as polychaete worms, tubeworms, and the shrimp-like Corophium amphipod (*Corophium spp.*). Red alder (*Alnus rubra*) dominates the forest that provides roost sites for raptors and cover and forage for passerines. Invasive species of actual or potential concern include common reed (*Phragmites australis*), three different species of Spartina (*Spartina spp.*), a few knotweed species (*Polygonum spp.*), Asian or

Japanese eelgrass (*Zostera japonica*), yellow flag iris (*Iris pseudacorus*), Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), Canada and bull thistle (*Cirsium arvense* and *Cirsium vulgare*, respectively), Griffins isopod (*Orthione griffenis*), green crab (*Carcinus maenas*), and invasive mussels and snails.

It is expected that the greatest effects upon wildlife of school groups and others participating in environmental education would likely be associated with disturbance. Human disturbance has differential effects on wildlife and is dependent upon, among other variables, the species involved and its age; the time of year; the breeding cycle stage (if applicable); the surrounding environment; whether the activity involves vehicles; the intensity, speed, noise, nature, and frequency of the disturbing activity; and the directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Holmes et al. 2005; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole, 1995a; Knight and Cole 1995b; Lafferty 2001a). Disturbance can cause animals stress and alter their normal behavior; cause them to stop feeding; cause abandonment of nests and young; and allow predators access to nests and young, reduce parental attention to young, and otherwise impact survival of individual birds, eggs, nestlings, or broods (Burger and Gochfeld, 1991; Haysmith and Hunt, 1995; Lafferty, 2001b). The effects of disturbance on individual animals are likely additive.

Distance of observers or photographers from wildlife subjects and the number of observers or photographers involved are important disturbance variables. Holmes et al. (2007) found that vigilance behavior of Gentoo penguins (*Pygoscelis papua*) increased as the numbers of observers increased. A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004).

A variety of factors affect flushing and flushing distances among waterbirds, including the species involved; the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed); whether the species is hunted; and the type, size, speed, and noise of disturbance (e.g., dogs versus humans, cycling versus walking, or approaching birds by walking versus in a motorized boat) (Goss-Custard and Verboven 1993; Lafferty 2001b; Rodgers and Smith 1997; Rodgers 1991; Smit and Visser 1993). Flushing of birds or even raising their alert levels (which usually occurs at a greater distance than that for flushing) creates stress and requires animals to expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing.

In a study of the effects of disturbance on feeding shorebirds in a British estuary, Goss-Custard and Verboven (1993) found that flushed birds normally flew just a short distance and quickly resumed feeding. They noted that although disturbance (by walkers, observers, anglers, dog-walkers, and shell fisherman) had increased over a 15-year period, populations of oystercatchers had not diminished because there were ample areas away from disturbance for the birds to move and continue feeding; birds could feed at other hours of the day and night when people were not present; feeding intensity could be increased somewhat to compensate for lost feeding time; some of the best feeding areas, the mudflats, were areas not usually accessed by humans; and the birds might habituate to certain types of disturbance. Importantly, if enough people were present in some of the smaller habitats, all of the feeding shorebirds were displaced and as the density of feeding shorebirds increased elsewhere, older birds stole more food from subordinate birds.

In another study of the effects of disturbance on British shorebirds, Gill et al. (2001) found that there was a strong relationship between the density of desirable prey species and the numbers of godwits using a site, and that human disturbance had no effect on the numbers of godwits supported at preferred forage sites. In a study of the effects of trail users (walkers, joggers, bicyclists, and in-line skaters) on shorebirds in San Francisco Bay, Trulio and Sokale (2008) found there was no difference in shorebird use between sites without trail use and those sites with low numbers of trail users. However, after a certain point on high use days, increasing numbers of trail users resulted in reduced numbers of foraging shorebirds. Similar to the situation at Grays Harbor, these trails were elevated and aligned parallel to the adjacent mudflats.

In a study of sanderlings (*Calidris alba*) on a California beach, Thomas (5-2000) found that the number, proximity, and activity of recreationists all affected foraging time by the birds. The presence of dogs off-leash was especially disturbing. Smit and Visser (1993) reviewed numerous shorebird studies from the coasts of The Netherlands and Germany. They found that, when disturbed, entire flocks of nonterritorial shorebirds departed feeding sites and moved to other feeding sites. They also found that one person or a group of people could cause most or all territorial shorebirds (e.g., redshanks, oystercatchers, and curlews) to abandon a preferred feeding site until the disturbance ceased and then often a smaller number of these birds returned. Finally, they noted that their review argued for keeping visitors to nature reserves at sufficient distance from high-tide roosts. These studies suggest that disturbance response varies considerably among foraging shorebirds and perhaps among feeding sites. It would appear that in some situations, certain shorebird species are somewhat more tolerant of modest levels of human disturbance than some other bird species and that such disturbance may not affect the birds' ability to satisfy nutritional requirements or their populations if the areal extent of quality foraging habitats is adequate.

Wildlife disturbance can be a special concern if school groups engage in wildlife observation and photography (Cline et al., 2007; DeLong, 2002; Knight and Cole, 1995). Observers and photographers often want to enhance their view or photograph by encroaching closer and closer to their subject. This can cause increased stress in wildlife and eventually lead to flushing. If a bird is nesting or brood-rearing, disturbance can cause temporary or permanent nest desertion. Even if only temporary, eggs and nestlings can face survival challenges associated with temperature extremes and predation.

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife are often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Holmes et al. 2007; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993). Lafferty et al. (2006) studied the effects of erecting educational signing, employing docents, and placing a rope barrier that directed recreationists away from a western snowy plover (*Charadrius alexandrinus nivosus*) nesting area on a California beach. Despite the fact pedestrians were easily seen and continued to routinely pass by the nesting area, human-related disturbance was reduced by more than half, plover numbers increased within the barrier area, and plover reproductive success was enhanced. Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

Participants in environmental education programs could also cause trampling of native plants, erosion, and introduction or spread of exotic species, including invertebrates, plants, and invasive species. All of these impacts could adversely affect native fish, wildlife, plants, and their habitats. The degree of actual effects upon important life history parameters such as foraging, predator avoidance, reproduction, and survival of individuals, and diversity and abundance of native species (community health) would depend on specific circumstances.

Currently, the primary area of the Refuge used for environmental education is the Sandpiper Trail; a boardwalk that is built on piers and rises above the underlying brackish and salt marsh along the southern boundary of the Refuge. Generally, for an onsite environmental education activity a school bus drops the children off on a blacktop area next to the trail; however, walking along a blacktop road to the trail is also an access method. Confining visitors to this trail and associated access route avoids potential impacts associated with trampling of vegetation and erosion of soils. Additionally, although students are provided an avenue through the forest and across the marsh to the edge of the mudflats, they are not allowed to venture onto the mudflats themselves, thus keeping this critical foraging area free from direct disturbance. It is possible that large groups of students moving quickly and noisily along the trail could disturb shorebirds feeding on the mudflats. Specific behavioral stipulations proposed for this use are intended to minimize these potential adverse effects. The proposed new facilities on the Refuge's south side (two observation decks/platforms and associated trails/boardwalks, the Red Knot Trail addition, new interpretive panels and signage, and improvements to the parking strip) would be sited in this same area and share the same design features as the current facilities. It is expected that these new facilities and associated public uses would have the same effects on wildlife and their habitat as those at present. Anecdotal observations from the decades since the Sandpiper Trail has been opened to the public reveal that that use of this facility by school groups does not appear to disturb shorebirds foraging on the mudflats. There are perch sites in trees on three sides of the Refuge allowing raptors to move to other locations should they be disturbed by school groups on the Sandpiper Trail.

To preserve views of the Refuge mudflats at various overlook points along the Sandpiper Trail, volunteers and staff would continue to remove a modest amount of native and nonnative vegetation. Maintenance of some vegetation growth is not expected to, nor has it had an effect on the overall health of the forest or marsh habitats.

Buses transporting students and teachers to the Sandpiper Trail pass through the port gate and travel along the blacktop-paved road (on Port of Grays Harbor property) to the trailhead. Some participants in environmental education activities may park their vehicles at the existing small parking area (that is partially paved and partially graveled) near the port gate and adjacent to Airport Way. It is proposed that this narrow parking area be repaved to improve the existing parking surface, which would reduce vehicle-related erosion potential from this area.

The proposed nature center and parking lot would be built on upland fill adjacent to Paulson Road. The proposed boardwalk and observation deck/platform would be designed and constructed similar to the Sandpiper Trail. The trails would be elevated above the marsh, but would not approach the mudflats as closely as the Sandpiper Trail, thereby reducing potential effects upon foraging shorebirds. When school groups use the trail and observation deck/platform, raptors might be discouraged from perching in adjacent trees. Because upland forest occupies a much larger area at this location that would remain closed to visitor access, these birds should have acceptable alternative perching sites.

Due to the denseness of vegetation and insubstantial nature of sediments, almost all other areas of the Refuge are, at best, difficult for visitors to access, and free-roaming would not be allowed. Visitors would be required to stay on trails or blacktop roads, thus reducing the potential for impacts upon native fish, wildlife, and their habitats.

Public Use

Not including research, the only other general public uses allowed (and proposed for authorization) on the Refuge are wildlife observation, photography, and interpretation. These uses occur year round, but the peak use period is in the spring, at the same time school groups visit the Refuge. A large group of students using the trail shared by wildlife observers/photographers could reduce wildlife sightings near the Sandpiper Trail and possibly cause shorebirds or other wildlife using the mudflats or open water to move farther afield. For the period the students were on the trail, this could diminish the quality of the experience for some other visitors. The same could occur with use of the proposed new nature center and associated facilities. Specific behavioral stipulations proposed for this use are intended to minimize these potential adverse effects. Additionally, the Sandpiper Trail is lengthy and it is proposed that it be extended (Red Knot Trail), so, if necessary, other visitors could move away from the students to acquire better opportunities to observe and photograph wildlife during the time the school groups were on the trail. The same could occur with the facilities at the proposed new nature center.

Cultural Resources and Values

There are no recorded prehistoric or historic sites on the Refuge and, to date, the Service has not conducted or authorized any other party to conduct cultural resource surveys on the Refuge.

Development, including construction of the proposed visitor facilities described above, can impact cultural resources. However, because Refuge facilities would be built in areas that were formerly mudflats, and later filled in with dredge spoils, it is unlikely that there exist cultural resources at these sites. Nonetheless, prior to construction of any new facilities, the Service would undertake appropriate surveys and engage in consultations consistent with requirements of the National Historic Preservation Act (16 U.S.C. 470). This process would result in avoiding, minimizing, and/or mitigating any potential effects.

As noted earlier, all existing and proposed environmental education activities occur or would occur on hardened surfaces (i.e., gravel, pavement, or boardwalk). This further reduces the potential that these public uses would adversely affect cultural resources at the Refuge.

Public Review and Comment:

Public availability of this CD has been widely announced together with announcement of the availability of the Refuge's draft CCP. The review and comment period has also been the same as for the draft CCP/EA.

Determination: (check one below)

___ Use is Not Compatible

_**X**_ Use is Compatible with following Stipulations

Stipulations Necessary to Ensure Compatibility:

General

In addition to the stipulations listed here, students would be required to comply with Refuge System-related and other applicable laws, regulations, and policies including "Prohibited Acts" listed in the Code of Federal Regulations (50 C.F.R. 27).

1. Prior to visiting the Refuge, student groups would be educated regarding appropriate conduct in such a natural area. This includes moving slowly and quietly so as not to disturb wildlife; not damaging or removing any animals, plants, Refuge facilities, or other objects; and not littering or otherwise leaving food or other items on the Refuge. Teachers, Refuge staff, interns, and trained volunteers would help ensure these behavioral requirements were observed.

2. Teachers, interns, and trained volunteers would be informed of rules to help ensure public safety and minimize adverse effects upon native fish, wildlife, plants, and their habitats while education program participants were on the Refuge. Such rules would also be posted on the port gate sign and enforced by Refuge staff.

3. Group size for school groups and guided education walks would be limited to help ensure a quality visitor experience and minimize potential effects on wildlife from large groups. To ensure that students and other visitors are provided high quality orientation, information, interpretation, and education, the Refuge would continue to provide regular training to volunteers assisting with the environmental education program.

4. Vehicles used to access the Refuge for environmental education would park in designated parking areas or on port property on blacktop surfaces (with port permission). Those participating in education activities would be required to stay on hardened surfaces, including designated roads, trails, and boardwalks.

5. Individuals participating in environmental education activities would be prohibited from using attractants such as food or recorded audio playback devices (e.g., those used to attract birds and other wildlife). This includes tape and digital recorders, portable computers (e.g., laptops, notebooks, and tablets), and smart phones. Also, photography through use of kites, remote-controlled aircraft, drones, or extended poles (anything taller than a standard photographic tripod or monopod) would not be allowed.

6. In order to avoid harassment, disease, and/or death of native wildlife, or transport of exotic or invasive plant parts, insects, or other undesirable species, individuals participating in environmental education activities would be prohibited from bringing dogs or other pets with them onto the Refuge. The exceptions would be certified service animals.

7. Cutting of vegetation to maintain views to the mudflats would be limited to that necessary and conducted by staff or Refuge volunteers only.

8. Periodic monitoring and evaluation of facilities, programs, habitats, and wildlife would be conducted by staff to assess if program objectives are being met with little or no additional or unexpected impacts to resources (budgetary, staffing, wildlife, facilities, etc.).

9. No changes could be made to any of these stipulations without specific, prior written approval of the refuge manager (for the purpose of these stipulations, the refuge manager would be the project leader of Nisqually National Wildlife Refuge Complex).

Justification:

Environmental education is a popular, valuable, and proven program at Grays Harbor NWR. Service policy states that environmental education programs can, "…promote understanding and appreciation of natural and cultural resources and their management on all lands and waters in the Refuge System" (USFWS 2006). Service policy strongly encourages refuge managers to provide quality, compatible environmental education programs. At Grays Harbor NWR, it is expected that students and teachers would also enjoy some wildlife observation and photography and environmental interpretation ancillary to their environmental education experiences. These are also wildlife-dependent public uses that are to be given special consideration in refuge planning and management.

Service policy and Federal law require that wildlife-dependent public uses (including environmental education) be given special consideration in refuge planning and management, and opportunities to allow these uses are to be considered in each refuge CCP (USFWS 2000 and NWRS Administration Act). When determined compatible on a refuge-specific basis, a wildlife-dependent use becomes a priority public use for that refuge and is to be facilitated and strongly encouraged. Safe and compatible opportunities for families, including children, to participate in wildlife-dependent uses are to be provided across the Refuge System.

Potentially, environmental education could cause some wildlife disturbance. However, this program has been provided on the Refuge for decades and existing facilities and program management have appropriately minimized public safety concerns and effects upon native wildlife, plants, and their habitats, and cultural resources. The stipulations included herein continue the positive efforts of the past and provide additional protection to biological and cultural resources, and the public.

<u>Compatibility Standard</u>.

As noted earlier, purposes of Grays Harbor NWR include providing opportunities for wildlife-oriented education, consistent with the conservation of fish and wildlife and their habitats, and fulfilling associated international treaty obligations. Providing opportunities for environmental education is directly supportive of these congressionally established Refuge purposes.

The several stipulations associated with these uses have been designed to greatly reduce the likelihood and magnitude of potential biological effects. Potential impacts associated with environmental education are greatly limited because visitors would access and use key facilities via a paved road, and hardened and raised boardwalks and viewing decks/platforms.

The Refuge would monitor wildlife and habitat disturbance, and other potential impacts to determine if these stipulations were resulting in expected and desirable outcomes. The Refuge would apply adaptive management principles to modify stipulations or adjust objectives, as necessary, to achieve desirable results (see USDI 2008 and Williams et al. 2009).

The Refuge would reserve the right to add to or otherwise modify the stipulations listed herein in order to ensure the continued compatibility of this use. New or modified stipulations could be instituted as a result of new information generated by ongoing or new studies; new legal, regulatory, or policy requirements; significant changes to the Refuge environment or status of native fish, wildlife, plants, or their habitats; or for other legitimate reasons. Teachers, interns, and volunteers would be appropriately advised of any such changes.

The Refuge would also reserve the right to terminate permission for this use if individuals were violating Refuge rules or regulations; if unacceptable impacts were occurring to native fish, wildlife, plants, or their habitats, cultural resources or Refuge facilities, or other Refuge visitors; or for other legitimate reasons.

In order to be allowed on the Refuge, environmental education would need to be determined compatible. By allowing this use to occur under the stipulations described above, it is anticipated that wildlife which were disturbed would find sufficient food resources and resting places so their abundance and use would not be measurably lessened on the Refuge. Additionally, it is anticipated that monitoring, as needed, would prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats; other public uses; and cultural resources. For the several reasons stated above and consistent with the stipulations described herein, this use would not materially interfere with or detract from maintenance of the Refuge's biological integrity, diversity, and environmental health; fulfillment of Grays Harbor NWR's purposes; or the Refuge System's mission.

Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for "allowed" uses only)

_____ 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

This compatibility determination has been developed and issued concurrent with the CCP and EA for Grays Harbor NWR and the Black River Unit.

Compatibility Determination for Environmental Education at Grays Harbor NWR:

Uses are compatible with stipulations.

Refuge Determination

Prepared by: _____
(Signature) (Date)

Approved by Project Leader, Nisqually National Wildlife Refuge Complex: _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____
(Signature) (Date)

Regional Chief, National Wildlife Refuge System, Pacific Region: _____
(Signature) (Date)

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Compatibility Determination

Use: Research, Surveys, and Scientific Collections.

Refuge: Grays Harbor National Wildlife Refuge, Grays Harbor County, Washington

Establishing and Acquisition Authorities:

Act to Establish the Grays Harbor National Wildlife Refuge (Pub L. 100-406, 102 STAT. 1041)

Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742m)

Refuge Purposes:

> . . . (1) to conserve fish and wildlife populations and their habitats, including but not limited to those of western sandpiper, dunlin, red knot, long-billed dowitcher, short-billed dowitcher, other shorebirds, and other migratory birds, including birds of prey; (2) to fulfill international treaty obligations of the United States with regard to fish and wildlife and their habitats; (3) to conserve those species known to be threatened with extinction; and (4) to provide an opportunity, consistent with the purposes set forth in paragraphs (1), (2), and (3), for wildlife-oriented recreation, education, and research (Pub L. 100-406, 102 STAT. 1041).
>
> . . . 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)).

National Wildlife Refuge System (Refuge System or NWRS) 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).

Description of Uses:

This use involves research, surveys, and scientific collections conducted by non-Refuge System parties on Grays Harbor National Wildlife Refuge (NWR or Refuge).

Research refers to a planned, organized, and systematic investigation of a scientific nature. Such studies are designed to determine the cause(s) of observed biotic or abiotic phenomenon over a finite time period, where cause and effect relationships usually can be inferred through statistical analyses.

Survey activities include scientific inventories and monitoring of fish, wildlife and plants, public use, and abiotic refuge resources (e.g., soils, water).

Scientific collecting involves gathering of refuge natural resources or cultural artifacts for scientific purposes. Examples include collection of vegetation, small mammals, and soils; contaminant sampling; adult and larval mosquito trapping/monitoring; and collection and curation of cultural resources.

As noted above, one of the purposes of Grays Harbor National Wildlife Refuge (NWR or Refuge) is to provide opportunities for wildlife-oriented research, consistent with the conservation of fish and wildlife and their habitats, and fulfilling associated international treaty obligations. Relevant treaties include those with Japan, Russia, and Western Hemisphere nations which call for the exchange of fish-, wildlife-, and habitat-related scientific, technical, and research information, and the protection of regions and natural objects of scientific value (25 U.S.T. 3329, T.I.A.S. 7990; 23 U.S.T. 845, T.I.A.S. 7345; 56 Stat. 1354, T.S. 981).

Refuge staff periodically receive requests from outside parties (e.g., universities, state agencies, other Federal agencies, and nongovernmental organizations) to conduct research, surveys, and scientific collecting 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 Refuge lands and waters to larger landscapes (e.g., ecoregion, region, flyway, national, and international), issues, and trends.

The Service's Research and Management Studies (USFWS 1982) and Appropriate Refuge Uses (USFWS 2006) policies indicate priority consideration 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 management goals and objectives, where applicable, would be given a higher priority over other requests. Attached to this compatibility determination (CD) are examples of high-priority research, survey, and scientific collection topics for Grays Harbor NWR.

Research, surveys, and scientific collections on the Refuge would generally be authorized through individual special use permits (SUPs) consistent with Service policy (USFWS 1986). Before being allowed on the Refuge, this use would need to be found appropriate (see Appropriate Refuge Uses) and then be determined compatible (USFWS 2000).

Projects that represent public or private economic use of the natural resources of the Refuge (e.g., bioprospecting) would need to comply with relevant Federal regulations for such uses (see May we allow economic uses on national wildlife refuges?, 50 C.F.R. 29.1). In such cases, the Refuge would need to first determine that the use contributed to the achievement of Refuge purposes or the Refuge System mission prior to making a determination regarding the project's compatibility.

This CD has been developed and made publicly available concurrent with the comprehensive conservation plan (CCP) and associated environmental assessment (EA) for Grays Harbor NWR and the Black River Unit of Nisqually NWR. Much of the information and some of the analyses

contained in this CD are addressed in greater detail in the CCP and EA. The CCP and EA are incorporated through reference herein.

Availability of Resources:

Refuge responsibilities for research, surveys, and scientific collections by non-Refuge System entities are primarily limited to the following: review of proposals, preparation of an SUP(s) and other appropriate compliance documents (pursuant to the National Environmental Policy Act, Endangered Species Act, National Historic Preservation Act, etc.), and monitoring project implementation to ensure that impacts and conflicts remain within acceptable levels (compatible) over time. Additional administrative, logistical, and operational support could also be provided depending on each specific request. Estimated costs for one-time and annually recurring tasks by Refuge staff are determined on a project-by-project basis. Sufficient funding in the Refuge's general operating budget would need to 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 would be clearly stated in the SUP(s).

The Refuge has the following staffing and funding to administratively support and monitor research, surveys, and scientific collections that are currently taking place on Grays Harbor NWR (see table below). Any substantial increase in the number of projects would create a need for additional resources to satisfy administrative and monitoring needs to ensure the projects were implemented in a compatible manner. Any substantial additional costs above those itemized below could result in determining a project not compatible unless expenses were offset by the investigator, sponsoring organization, or other party.

Monies raised during the Grays Harbor Shorebird Festival (a few thousand dollars each year) may be used to help fund efforts at the Refuge, including research.

Table B.5. Costs to Administer and Manage Research, Surveys, and Scientific Collections under the Preferred Alternative

Category	One-time Expense ($)	Recurring Expense ($/year)
Administration and Management	0	2,000
Monitoring	0	3,500
Maintenance	0	500
Total Costs	0	6,000

Anticipated Impacts of the Uses:

Refuge Goals and NWRS Mission

Use of the Refuge to conduct research, surveys, or scientific collecting would generally provide information of benefit to native fish, wildlife, plants, and their habitats or cultural resources. Scientific findings gained through these projects could provide important information regarding life-history needs of species and species groups as well as identify or refine management actions to achieve natural or cultural resource management objectives. Reducing uncertainty regarding wildlife and habitat responses to refuge management actions undertaken in order to achieve desired outcomes

(objectives) is essential for adaptive management (see Adaptive Management, USDI 2008 and Williams et al. 2009).

Potentially, some project's methods could impact or conflict with Refuge-specific natural or cultural resources, priority wildlife-dependent public uses, other high-priority research, or Refuge management programs. In such cases, in order for the project to be determined compatible, it would need to be clearly demonstrated that the project's scientific findings would contribute to Refuge management and that the project could not be conducted off-Refuge. The investigator(s) would need to identify methods/strategies in advance to minimize or eliminate potential impacts and conflicts. If unacceptable impacts, including long-term and cumulative impacts, could not be avoided, then the project could not be determined compatible.

Research 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 would be project- and site-specific, where they would vary depending upon nature and scope of the field work. Data collection techniques would generally have minimal animal mortality or disturbance, habitat destruction, no introduction of contaminants, or no introduction of nonindigenous species. In contrast, projects involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection would have short-term impacts. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) would be collected for identification and/or experimentation and statistical analysis. Where possible, researchers would 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 would also ensure minimal impacts to fish, wildlife, plants, and their habitats. If, after incorporating the above strategies, a project would still result in long-term or cumulative effects, it would not be found 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) would be required for activities that may affect a federally listed species and/or critical habitat. Only projects which have no effect or would result in not likely to adversely affect determinations would 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 would 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 would 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 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) would usually be localized and temporary in nature. Where long-term or cumulative unacceptable effects cannot be avoidable, the project would not be found compatible. Project proposals would 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.

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 would 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 would form the primary basis for allowing or denying a specific project. Projects which result in unacceptable refuge impacts would not be found compatible. If allowed and found compatible after approval, all projects would be assessed during implementation to ensure impacts and conflicts remain within acceptable levels.

If the proposal is approved, then the refuge manager would issue an 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) would 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 would 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 (inventories, monitoring, and research) necessary to support adaptive management decisions]) would require additional NEPA documentation.

The management direction of Grays Harbor NWR is guided by the protection of biological diversity and enhancement and management of a valuable estuary ecosystem for the benefit of migratory shorebirds, other migratory birds, including birds of prey, fish, and other dependent wildlife (USFWS, 1988).

The Refuge has developed the following seven draft goals as part of its comprehensive conservation planning process.

1. Protect, maintain, and restore estuarine habitats representative of the Grays Harbor ecosystem for the benefit of shorebirds, other migratory birds, fish, and a diverse assemblage of other native species.
2. Protect and maintain upland habitat representative of the Grays Harbor ecosystem for the benefit of migratory passerines and other wildlife.
3. Contribute to the protection and long-term environmental health of the Refuge and greater Grays Harbor estuary and ecosystem.

4. Collect scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.
5. Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance their understanding and appreciation of the Refuge's natural resources and foster a connection with nature.
6. Provide environmental education opportunities that initiate a sense of wonder and foster a connection with nature and the Refuge for students both on and off the Refuge.
7. Support and strengthen an active volunteer workforce and Friends Groups to assist in providing quality visitor services programs and outreach.

High priority research, survey, and scientific collection projects would directly support draft Refuge goal number 4. It is likely that most proposed research, survey, or scientific collection projects would also support one or more of the other draft Refuge goal numbers 1, 2, 3, 5, and 6; but each would need to be evaluated separately. Projects that were determined supportive of draft Refuge goals and the Refuge System mission would have a greater chance of being found appropriate, determined compatible, and authorized for implementation.

Fish, Wildlife, Plants, and Their Habitats

Impacts would be project- and site-specific, and would vary depending upon the nature and scope of the field work. Data collection techniques would generally have minimal animal mortality or disturbance, habitat destruction, no introduction of contaminants, and no introduction of nonindigenous species. In contrast, projects involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection would at least have short-term, localized impacts.

As noted earlier, the purposes of Grays Harbor NWR include conservation of fish and wildlife populations and their habitats, with emphasis upon shorebirds, other migratory birds, birds of prey, and species threatened with extinction. Refuge purposes also include fulfilling international treaty obligations of the United States with regard to fish and wildlife and their habitats. Examples of such treaties include the Ramsar Convention and treaties between the U.S. and Canada, Japan, Mexico, Russia, the Soviet Union, and Western Hemisphere nations. These treaties address the conservation and protection of migratory birds and species in danger of extinction, protection of wetlands, and establishment and management of nature preserves (I.L.M. 11:963-976; 39 Stat. 1702, T.S. 628; 25 U.S.T. 3329, T.I.A.S. 7990; 50 Stat. 1311, T.S. 912; 23 U.S.T. 845, T.I.A.S. 7345; T.I.A.S. 9073, 92 Stat. 3110; and 56 Stat. 1354, T.S. 981).

Wildlife species of special management concern at the Refuge include shorebirds such as western sandpiper (*Calidris mauri*), dunlin (*Calidris alpina*), semi-palmated plover (Charadrius semipalmatus), black-bellied plover (*Pluvialis squatarola*), red knot (*Calidris canutus roselaari*), long-billed dowitcher (*Limnodromus scolopaceus*), short-billed dowitcher (*Limnodromus griseus*), and greater yellowlegs (*Tringa melanoleuca*); birds of prey such as bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Cirus cyaneus*), merlin (*Falco columbarius*), and peregrine falcon (*Falco peregrinus*); waterfowl, other waterbirds, and other migratory birds including ducks and geese, gulls, terns, mergansers, common loon (*Gavia immer*), brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*) and other waterbirds; and neotropical songbirds. Management also focuses on species threatened with extinction which, when the Refuge was established, included the

peregrine falcon, bald eagle, and brown pelican. All these species have since been removed from the Federal endangered species list and are considered recovered in this area of the U.S. Shorebirds and other fauna at the Refuge provide prey for these raptors, so the Refuge will continue to ensure that management decisions support continued recovery of these birds. It's possible that the following three fishes listed as threatened under the Federal Endangered Species Act (16 U.S.C. 1531-1544) occur on the Refuge: green sturgeon (*Acipenser medirostris*), bull trout (*Salvelinus confluentus*), and eulachon (*Thaleichtys pacificus*, aka smelt).

Refuge management focuses on providing quality intertidal mudflat roosting and foraging habitat for migrating shorebirds. This is especially important during the spring (late April through May) when hundreds of thousands of these birds use the entire Harbor estuary as a refueling stop on their northern migration from wintering areas in South America. While at Grays Harbor, the birds enhance fat reserves for the nonstop flight to their Arctic breeding grounds. Grays Harbor is one of four major North American staging areas for shorebirds and hosts one of the largest concentrations of these birds on the west coast south of Alaska. In 1995, in recognition of its high value to over 500,000 shorebirds annually, Grays Harbor Estuary was designated a site of hemispheric importance (the highest ranking) by the Western Hemisphere Shorebird Reserve Network (http://www.whsrn.org/site-profile/grays-harbor-estuary). Bowerman Basin (within the Refuge) has been designated a Globally Important Bird Area and is listed as priority wintering habitat for peregrine falcons by the Washington Department of Fish and Wildlife (Audubon Washington Jun 2001). Although shorebird numbers are especially high in the spring, a diversity of wildlife use Refuge habitats throughout the year. For example, shorebirds also visit and feed in the estuary from June through October, during their southward migration, and dunlin and black-bellied plover winter at the Refuge.

Refuge habitats of special management concern include open water, intertidal mudflats, tidal salt and brackish marsh, and forest. Native plants of special concern include native eelgrass (*Zostera marina*) and sweetgrass (*Schoenoplectus pungens*). Because Refuge mudflats are some of the last in the estuary to flood during twice-daily high tides, they are especially valuable for foraging shorebirds. The Refuge's mudflat habitat is dense with nutrient-rich, invertebrate bird foods, such as polychaete worms, tubeworms, and the shrimp-like Corophium amphipod (*Corophium spp.*). Red alder (*Alnus rubra*) dominates the forest that provides roost sites for raptors, and cover and forage for passerines. Invasive species of actual or potential concern include common reed (*Phragmites australis*), three different species of Spartina (*Spartina spp.*), a few knotweed species (*Polygonum spp.*), Asian or Japanese eelgrass (*Zostera japonica*), yellow flag iris (*Iris pseudacorus*), Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), Canada and bull thistle (*Cirsium arvense* and *Cirsium vulgare*, respectively), Griffins isopod (*Orthione griffenis*), green crab (*Carcinus maenas*), and invasive mussels and snails.

Disturbance would likely be one of the most common wildlife effects caused by research, surveys, and scientific collections. Human disturbance has differential effects on wildlife and is dependent upon, among other variables, the species involved and its age; the time of year; the breeding cycle stage (if applicable); the surrounding environment; whether the activity involves vehicles; the intensity, speed, noise, nature, and frequency of the disturbing activity; and the directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Holmes et al. 2005; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole 1995a; Knight and Cole 1995b; Lafferty 2001a). Disturbance can cause animals stress and alter their normal behavior; cause them to stop feeding; cause abandonment of nests and young; and allow predators access to nests and young, reduce parental attention to young, and otherwise impact survival of individual birds, eggs, nestlings,

or broods (Burger and Gochfeld, 1991; Haysmith and Hunt, 1995; Lafferty, 2001b). The effects of disturbance on individual animals are likely additive.

The distances of researchers from wildlife subjects and the numbers of researchers involved are important disturbance variables. Holmes et al. (2007) found that vigilance behavior of Gentoo penguins (*Pygoscelis papua*) increased as the numbers of observers increased. Additional studies in penguin colonies revealed that a slow approach that ended with a visitor sitting quietly and closely observing a bird had little effect on the bird's heart rate, yet a rapid approach that ended with a visitor remaining standing and closely observing a bird resulted in an elevated heart rate (Nimon et al., Mar 1995). A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan, 2004). Breeding birds are especially sensitive to human disturbance (Trulio, 2005; Hammitt and Cole, 1998).

A variety of factors affect flushing and flushing distances among waterbirds, including the species involved; the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed); whether the species is hunted; and the type, size, speed, and noise of disturbance (e.g., dogs versus humans, cycling versus walking, or approaching birds by walking versus in a motorized boat) (Goss-Custard and Verboven 1993; Lafferty 2001b; Rodgers and Smith 1997; Rodgers 1991; Smit and Visser 1993). Flushing of birds or even raising their alert levels (which usually occurs at a greater distance than that for flushing) creates stress and requires animals to expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing.

In a study of the effects of disturbance on feeding shorebirds in a British estuary, Goss-Custard and Verboven (1993) found that flushed birds normally flew just a short distance and quickly resumed feeding. They noted that although disturbance (by walkers, observers, anglers, dog-walkers, and shell fisherman) had increased over a 15-year period, populations of oystercatchers had not diminished because there were ample areas away from disturbance for the birds to move and continue feeding; birds could feed at other hours of the day and night when people were not present; feeding intensity could be increased somewhat to compensate for lost feeding time; some of the best feeding areas, the mudflats, were areas not usually accessed by humans; and the birds might habituate to certain types of disturbance. Importantly, if enough people were present in some of the smaller habitats, all of the feeding shorebirds were displaced and as the density of feeding shorebirds increased elsewhere, older birds stole more food from subordinate birds.

In another study of the effects of disturbance on British shorebirds, Gill et al. (2001) found that there was a strong relationship between the density of desirable prey species and the numbers of godwits using a site, and that human disturbance had no effect on the numbers of godwits supported at preferred forage sites. In a study of the effects of trail users (walkers, joggers, bicyclists, and in-line skaters) on shorebirds in San Francisco Bay, Trulio and Sokale (2008) found there was no difference in shorebird use between sites without trail use and those sites with low numbers of trail users. However, after a certain point on high use days, increasing numbers of trail users resulted in reduced numbers of foraging shorebirds. Similar to the situation at Grays Harbor, these trails were elevated and aligned parallel to the adjacent mudflats.

In a study of sanderlings (*Calidris alba*) on a California beach, Thomas (5-2000) found that the number, proximity, and activity of recreationists all affected foraging time by the birds. The presence of dogs off-leash was especially disturbing. Smit and Visser (1993) reviewed numerous shorebird studies from the coasts of The Netherlands and Germany. They found that, when disturbed, entire flocks of nonterritorial shorebirds departed feeding sites and moved to other feeding sites. They also found that one person or a group of people could cause most or all territorial shorebirds (e.g., redshanks, oystercatchers, and curlews) to abandon a preferred feeding site until the disturbance ceased and then often a smaller number of these birds returned. Finally, they noted that their review argued for keeping visitors to nature reserves at sufficient distance from high-tide roosts. These studies suggest that disturbance response varies considerably among foraging shorebirds and perhaps among feeding sites. It would appear that in some situations, certain shorebird species are somewhat more tolerant of modest levels of human disturbance than some other bird species and that such disturbance may not affect the birds' ability to satisfy nutritional requirements or their populations if the areal extent of quality foraging habitats is adequate.

Trulio (May 2005) reviewed numerous studies of the effects of recreational and other human uses on wildlife, especially waterbirds. Reviewed studies found that similar to the effects of recreationists, researchers can often have a number of adverse effects on wildlife and can contribute to nest abandonment, increased depredation, reduction of nests near disturbed areas, lower productivity, and increased flight. These effects may vary based on the species studied, the stage in the breeding cycle when disturbance occurs, the presence of predators in the area, and other factors. In a near-shore study with Xantus's murrelets (*Synthliboramphus hypoleucus*), Newman et al. (2005) found that biochemical and cellular indicators of stress were adversely affected by research activities, including capture, handling, and radio-marking. Wright et al. (2007) found that land-based researchers flushed large numbers of California brown pelicans (*Pelecanus occidentalis*) in studies at a seabird colony on the lower Columbia River. A study of the effects of varying frequencies of research activities within black skimmer (*Rynchops niger*) nesting subcolonies by Safina and Burger (1983) found that pre-laying adults left disturbed subcolonies; some nesting pairs deserted nests early in incubation; and nest density, late nesting, hatching success, and fledgling success were all adversely affected by this disturbance. Robert and Ralph (1975) assessed biological effects of researchers entering a nesting colony of western gulls (*Larus occidentalis*) and found that hatching failure was positively correlated with the frequency of disturbance and that effects were greater during the early stage of the breeding cycle. Colwell et al. (1988) studied the effects of blood sampling of shorebirds on breeding grounds in Minnesota, Manitoba, and Saskatchewan. They found that blood sampling had no effect on return of birds the following year; that it had varying effects on clutch desertion (based on when in the reproductive cycle the birds were captured, whether both parents were sampled, and whether the species was biparental or uniparental); and that a small percentage of birds (0-3 percent) died or sustained debilitating injuries.

Wildlife disturbance can be a special concern with wildlife observation and photography (Cline et al. 2007; DeLong 2002; Knight and Cole 1995), and can include research or biologist activities. Observers and photographers often want to enhance their view or photograph by encroaching closer and closer to their subject. This can cause increased stress in wildlife and eventually lead to flushing. If a bird is nesting or brood-rearing, disturbance can cause temporary or permanent nest desertion. Even if only temporary, eggs and nestlings can face survival challenges associated with temperature extremes and predation.

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife are often less disturbed by routine human activities that repeatedly occur along

defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Holmes et al. 2007; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993). Lafferty et al. (2006) studied the effects of erecting educational signing, employing docents, and placing a rope barrier that directed recreationists away from a western snowy plover (*Charadrius alexandrinus nivosus*) nesting area on a California beach. Despite the fact pedestrians were easily seen and continued to routinely pass by the nesting area, human-related disturbance was reduced by more than half, plover numbers increased within the barrier area, and plover reproductive success was enhanced. In the aforementioned study of researchers entering a nesting colony of western gulls, Robert and Ralph (1975) found that chick survival was higher in the more frequently disturbed plots compared with those that were disturbed less frequently. It appeared that chicks in the more frequently disturbed plots may have habituated to some extent to the researchers. When researchers approached chicks in the less frequently disturbed plots, the chicks flushed a greater distance and were exposed to attacks by adult birds. Chick survival on the control (undisturbed plot) was higher than on the disturbed plots. Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

In addition to travel by foot or vehicle, field research can involve transport of project infrastructure, equipment, and supplies, such as permanent transects or plot markers, and exclosure devices. Access to and work at study sites could result in localized and temporary effects including trampling of native plants, erosion, collecting of soil and plant samples, and trapping and handling of fish and wildlife. Longer-term effects could potentially be caused by introduction or spread of exotic species, including invertebrates, plants, and invasive species, or pathogens. All of these impacts could adversely affect native fish, wildlife, plants, and their habitats. The degree of actual effects upon important life history parameters such as foraging, predator avoidance, reproduction, and survival of individuals; and on diversity and abundance of native species (community health) would depend on specific circumstances. These potential effects could be minimized or eliminated by requiring proper cleaning of investigator equipment and clothing as well as quarantine methods and possibly restoration or mitigation plans, where appropriate (see attached).

It is possible that some research could be conducted from the Sandpiper and Red Knot Spur trails: boardwalks that are built on piers and rise above the underlying brackish and salt marsh along the southern boundary of the Refuge. Access to these trails is on the hardened blacktop road. Use of these trails and associated access route would avoid potential problems associated with trampling of vegetation and erosion of soils. Additionally, although researchers would be provided an avenue through the forest and across the marsh to the edge of the mudflats, they might or might not venture onto the mudflats themselves. If they did not, the critical foraging area would remain disturbance-free. Anecdotal observations from the decades since the Sandpiper Trail has been opened to the public reveal that visitor use of this facility does not disturb shorebirds foraging on the mudflats. If researchers did venture onto the mudflats, SUP conditions would limit their stay there to the minimum necessary. Shorebirds and other wildlife could be flushed, but such temporary and infrequent disturbance would not be expected to be significant. There are perch sites on three sides of the Refuge allowing raptors to move to other locations should they be disturbed by visitors on the Sandpiper Trail.

The existing small Refuge parking area is partially paved and partially graveled. To the extent that researchers parked there, it would minimize erosion potential. It is proposed that this narrow parking area be repaved to improve the existing parking surface, which would reduce vehicle-related erosion potential from this area.

Public Use

Almost all visitations at the Refuge occur on the Sandpiper Trail. This area is relatively small and crowding can occur, especially during special Refuge events. If research was conducted from the trail during the spring (especially late April through early May), it could result in crowding on the Trail and it could reduce the quality of viewing and photography by other Refuge visitors. If field research was conducted on or near the mudflats or marshlands during this same time period, it could result in flushing of shorebirds and other wildlife, and thereby reduce viewing and photography opportunities. General and project-specific stipulations and conditions regarding the locations and scheduling of research would be used to greatly minimize the likelihood that such activities would impair other approved public uses, including wildlife observation and photography, and environmental education and interpretation.

The exception could be research and surveys specifically focused on public use. In such cases, approved study protocols would help ensure that such projects would not significantly reduce the quality of wildlife-dependent public uses.

Cultural Resources and Values

There are no recorded prehistoric or historic sites on the Refuge and, to date, the Service has not conducted or authorized any other party to conduct cultural resource surveys on the Refuge. It is unlikely that research at the Refuge would affect cultural resources. However, if such projects involved construction of new facilities, the Service would undertake appropriate surveys and engage in consultations consistent with requirements of the National Historic Preservation Act (16 U.S.C. 470) prior to project approval. Additionally, if the research, surveys, or scientific collections specifically focused on cultural resources, such projects could require additional permits and approvals, potentially including a permit under the Archaeological Resources Protection Act (16 U.S.C. 470aa-470mm). Stipulations and conditions associated with Refuge SUPs or ARPA permits would help ensure that research-related adverse effects upon cultural resources were avoided, minimized, and/or mitigated, as appropriate.

Public Review and Comment:

Public availability of this CD has been widely announced together with announcement of the availability of the Refuge's draft CCP. The review and comment period has also been the same as for the draft CCP.

Determination: (check one below)

__ Use is Not Compatible

_X_ Use is Compatible with following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. Investigator(s), researchers, and support staff would follow all Refuge-specific regulations that specify access and travel on the Refuge.

2. Projects would adhere to scientifically defensible protocols for data collection, where available and applicable

3. Permission to use the Refuge for research, surveys, or scientific collections would be officially authorized through issuance of a special use permit (SUP).

4. To acquire an SUP, at least 3 months before initiation of field work, a researcher(s) would be required to submit a detailed project proposal (see attached format) and request an SUP. Among other things, proposals would need to adhere to scientifically defensible protocols for data collection, where available and applicable.

5. Project proposals would be reviewed by Refuge staff and others, as needed. This review would assess relative to Refuge management issues and understanding of natural systems the potential impacts (short-term, long-term, and cumulative) relative to the benefits of the investigation. This assessment would form the primary basis for determining whether or not the project could be approved.

6. All SUPs would have a definite termination date in accordance with 5 RM 17.11. Annual or other short-term SUPs are preferred, however, some permits may be allowed for a longer period, if needed, to allow completion of the project.

7. SUP renewals would be subject to refuge manager review and approval based timely submission of and content in progress reports, compliance with SUP stipulations, and required permits. Continuation of existing projects would require approval by the refuge manager.

8. SUPs would cover use by a specified individual or organization and could not be assigned or sub-permitted to others.

9. Researchers must possess all required local, State, and Federal permits and approvals for collections and other activities of their proposed projects.

10. SUPs would include maps clearly depicting the areas researchers would be authorized to access and use, including the Refuge entry point(s). Permittees would be prohibited from straying outside the project areas depicted on maps.

11. The Refuge would supply researchers with information about the Refuge; its purposes and goals; natural and cultural resources of concern; open and closed areas, dates, and times; rules and regulations; and any hazardous conditions. Researchers would be responsible for reviewing and understanding this information and ensuring that their colleagues also received, reviewed, and understood this information.

12. A section 7 consultation under the Endangered Species Act would be required for all projects and activities that may affect a federally listed species and/or critical habitat. Projects which would have "no effect" or would result in a "not likely to adversely affect" determination would be considered for potential approval.

13. Researchers would be required to secure approval from the Service prior to use of any pesticide (including uses of herbicides, fungicides, and insecticides) on the Refuge. This would involve researchers submitting to the refuge manager a completed Pesticide Use Proposal (PUP) for each proposed pesticide use. Any researcher-applicator would be required to have a current state pesticide application license and endorsement for the applicable habitat. These PUPs would need to be submitted at least 90 days prior to proposed use of the pesticide to allow adequate time for evaluation and processing.

14. To minimize the introduction and/or spread of exotic plants or animals, diseases, or other pests, sampling equipment as well as researcher's clothing and vehicles (e.g., ATVs, boats) would need to be thoroughly cleaned (free of dirt, seeds, and other plant material) before being used on the Refuge.
    a. Researchers/investigators would be required to disinfect waders by following specific protocols provided by the Refuge. Disinfection is required prior to entry into any Refuge wetland and when crossing between wetlands.

15. Researchers would be prohibited from constructing new or maintaining existing structures, creating new or expanding exiting trails, or removing vegetation to facilitate travel on the Refuge without specific, prior written approval of the refuge manager (for the purpose of these stipulations, the refuge manager would be the project leader of the Nisqually National Wildlife Refuge Complex).

16. Any flagging used would need to be biodegradable.

17. Consistent with Service policy regarding management of nonhazardous solid waste on refuges (USFWS 2001), permittees would be prohibited from littering, dumping refuse, abandoning equipment or materials, or otherwise discarding any items on the Refuge.

18. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates, and artifacts) would be collected for identification and/or experimentation and statistical analysis.
    a. Where possible, researchers would be required to coordinate and share collections. This could reduce sampling needed for multiple projects and any associated mortality and disturbance. For example, if one investigator collected fish for a diet study and another researcher was examining otoliths, then it could be possible to accomplish sampling for both projects with one collection effort.

19. Researchers and their colleagues would be prohibited from collecting, removing, disturbing or otherwise adversely impacting any prehistoric/archaeological or historic artifacts, cultural resources, abiotic or biological specimens or samples, or mementos from the Refuge unless stated in the SUP.
    a. In the event such resources were inadvertently disturbed in the course of conducting otherwise permitted activities, the disturbing activity would need to be immediately discontinued and the refuge manager would need to be notified within 24 hours.

20. 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 ongoing project already permitted by SUP(s) on the Refuge.

21. Upon completion of the project or annually (at the discretion of the refuge manager), researchers would be required to remove all equipment and physical markers (unless required for long-term projects) and restore sites to the refuge manager's satisfaction. SUPs would specify conditions for removal and clean up.

22. At any time, Refuge staff may accompany investigator(s) in the field.

23. Progress reports are required at least annually for multiple-year projects. The minimum required elements for a progress report would be provided to investigator(s) (see Attachment 2).

24. Final project reports would be due 1 year after completion of the project.
    a. Researchers would be required to provide Refuge staff with the following:
        i. An early opportunity(ies) to review and comment on draft manuscripts well before their submittal to a scientific journal for consideration for publication;
        ii. Copies (reprints) of all publications resulting from a project permitted on the Refuge; and
        iii. At the conclusion of the project, raw data in a format negotiated with Refuge staff.

25. 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 would 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 would be necessary (see Attachment 3).

26. In all written and oral presentations resulting from projects on the Refuge, researchers would be required to appropriately cite and acknowledge the U.S. Fish and Wildlife Service National Wildlife Refuge System, Nisqually National Wildlife Refuge Complex, and Refuge staff and other Service personnel who supported or contributed to the project.

27. The Refuge would monitor compliance with the stipulations and SUP conditions, habitat quantity and quality, wildlife use and productivity, water quality, cultural resources, Refuge facilities, other Refuge public uses, and other relevant endpoints to determine if stipulations associated with research, surveys, and scientific collections were resulting in expected and desirable outcomes. In consultation with researchers, the Refuge would apply adaptive management principles to modify stipulations or adjust objectives, as necessary, to achieve desirable results. In the event that modified stipulations or adjusted objectives did not adequately address the situation, the refuge manager could temporarily or permanently withdraw official permission to continue research, surveys, or scientific collections on the Refuge. Permission could also be withdrawn for other legitimate reasons. Permits could be revoked with 30 days or less written notice.

28. The Refuge would reserve the right to add to or otherwise modify the stipulations listed herein in order to ensure the continued compatibility of this use. New or modified stipulations would be instituted as a result of ongoing or new studies; new legal, regulatory, or policy requirements; significant changes to the Refuge environment or status of native fish, wildlife, plants, or their habitats; as a result of mutual agreement with researchers; or for other legitimate reasons. Researchers would be advised of new or significantly modified stipulations at least 90 days prior to their becoming effective.

Justification:

Almost all research, surveys, and scientific collections on refuges are inherently valuable to the Service because they expand scientific information available for resource management decisions about fish, wildlife, plants, and their habitats, cultural resources, and/or public use.

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 would 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, research would not occur and less scientific information would be available to aid the Service in managing and conserving Refuge resources.

Compatibility Standard.

As noted above, one of the purposes of Grays Harbor NWR is to provide opportunities for wildlife-oriented research, consistent with the conservation of fish and wildlife and their habitats, and fulfilling associated international treaty obligations. Relevant treaties include those with Japan, Russia, and Western Hemisphere nations which call for the exchange of fish-, wildlife-, and habitat-related scientific, technical, and research information, and the protection of regions and natural objects of scientific value. Providing opportunities for research, surveys, and scientific collections is directly supportive of Refuge purposes.

By allowing the use to occur under the stipulations described above, it is anticipated that wildlife which were disturbed by this use would find sufficient food resources and resting places elsewhere on the Refuge or, if needed, elsewhere in Grays Harbor. Their abundance on and use of the Refuge on a longer-term basis should not be measurably lessened. Additionally, it is anticipated that monitoring, as needed, would prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats, cultural resources, and public use. Where this was not the case, the proposed project would likely not be compatible and would not be authorized for implementation. As a result, potential research, surveys, and scientific collections, consistent with the stipulations described herein, would not materially interfere with or detract from maintenance of the Refuge's biological integrity, diversity, and environmental health; fulfillment of Grays Harbor NWR's purposes; or the Refuge System's mission.

Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for "allowed" uses only)

_____ 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

This compatibility determination has being developed and issued concurrent with the CCP and EA for Grays Harbor NWR and the Black River Unit.

Compatibility Determination for Research, Surveys, and Scientific Collections at Grays Harbor NWR:

Uses are compatible with stipulations.

Refuge Determination

Prepared by: _____
(Signature) (Date)

Approved by Project Leader, Nisqually National Wildlife Refuge Complex: _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____
(Signature) (Date)

Regional Chief, National Wildlife Refuge System, Pacific Region: _____
(Signature) (Date)

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 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; and*
- *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(s).

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.

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:

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. 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 Not mortgage, pledge, assign, repatriate, transfer, exchange, give, sublet, discard or part

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

High-Priority Research, Surveys, and Scientific Collections

Following are examples of high-priority research, survey, and scientific collection topics for Grays Harbor NWR. They are not listed in priority order.

- Survey shorebirds and their use of the Refuge as part of a comprehensive survey of Grays Harbor.
- Assess the nature of sediment buildup in Bowerman Basin (e.g., its rate, areal extent, causes) and its effects on vegetation changes (e.g., encroachment of marsh onto mudflats) and shorebird foraging and roosting habitat.
- Design and implement an appropriate climate change monitoring program for the Refuge. Assess effects of climate change on sea level and resultant effects on Refuge habitats and wildlife. Assess whether sedimentation of mudflats could offset sea level rise.
- Inventory primary shorebird prey species in the Refuge's mudflats and salt marsh habitats.
- Assess effects of public use of the Sandpiper Trail on shorebird foraging, avian predation, and other wildlife use of the Refuge. Develop appropriate mitigation measures.
- Inventory use of Refuge habitats by fish.
- Inventory, map, and assess status, areal extent, and effects of exotic, especially invasive species, and determine the most effective methods to remove or otherwise manage such species.
- In light of the commercial and industrial uses surrounding the Refuge and elsewhere in Grays Harbor, analyze water, sediments, vegetation, key prey species, and fish and wildlife in the Refuge for potential contaminants.
- Develop baseline inventory of animal groups on Refuge, including small mammals, reptiles, amphibians, and pollinators.
- Develop baseline inventory of native and nonnative eelgrass beds on Refuge.
- Monitor and map the health and abundance of sweetgrass on the Refuge.
- Assess use of the Refuge by avian shorebird predators and their interaction with prey species.
- Monitor the brackish and salt marsh following proposed berm removal.
- Assess rate of change in areal extent of upland forest, its use by raptors and other wildlife, and current and future effects on foraging shorebirds.

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Convention between the United States of America and the United Mexican States for the Protection of Migratory Birds and Game Mammals (50 Stat. 1311, T.S. 912).

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Compatibility Determination

Use: Sweetgrass Gathering

Refuge: Grays Harbor National Wildlife Refuge, Grays Harbor County, Washington

Establishing and Acquisition Authorities:

Act to Establish the Grays Harbor National Wildlife Refuge (Pub L. 100-406, 102 STAT. 1041)

Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742m)

Refuge Purposes:

> . . . (1) to conserve fish and wildlife populations and their habitats, including but not limited to those of western sandpiper, dunlin, red knot, long-billed dowitcher, short-billed dowitcher, other shorebirds, and other migratory birds, including birds of prey; (2) to fulfill international treaty obligations of the United States with regard to fish and wildlife and their habitats; (3) to conserve those species known to be threatened with extinction; and (4) to provide an opportunity, consistent with the purposes set forth in paragraphs (1), (2), and (3), for wildlife-oriented recreation, education, and research (Pub L. 100-406, 102 STAT. 1041).
>
> . . . 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)).

National Wildlife Refuge System Mission:

> "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.668ddet seq.).

U.S. Fish and Wildlife Service Native American Policy

The Service will work directly with Native American governments and observe legislative mandates, trust responsibilities, and respect Native American cultural values when planning and implementing programs.

The Service has developed and adopted this policy to help accomplish its mission and to participate in fulfilling the Federal Government's and the Department of the Interior's trust responsibilities to assist Native Americans in protecting, conserving, and utilizing their reserved, treaty-guaranteed, or

statutorily identified trust assets. This policy is consistent with Federal policy supporting Native American government self-determination.

Secretarial Order 3206, Sec. 4. Background

The unique and distinctive political relationship between the United States and Indian Tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements, and differentiates tribes from other entities that deal with, or are affected by, the Federal government. This relationship has given rise to a special Federal trust responsibility, involving the legal responsibilities and obligations of the United States toward Indian tribes and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights.

Description of Use:

In 1995, the Refuge received approximately 30 to 35 requests for gathering sweetgrass *(Schoenoplectus pungens, formerly Scirpus americanus)* from the salt and brackish marsh habitat on the north side of the Refuge. Prior to Service acquisition of this parcel, gathering of sweetgrass (used for basket weaving materials) had been occurring annually each summer. Additionally, Native Americans have traditionally gathered these plant materials within the greater Grays Harbor estuary for use in weaving baskets.

Requests were largely for personal use and the amount typically desired was estimated at 25 to 50 pounds of material wet weight per person. The primary requested collecting period is from mid-July through early August, when the plants were mature. Harvesting involved foot traffic through the salt marsh to access appropriate gathering sites for sweetgrass and utilizing traditional harvest methods by pulling the mature culms from the base of the rhizome.

Gathering Methods:

Gathering methods have included pulling individual culms from the rhizome and/or cutting above the rhizome. Mature culms ready for harvesting will pull out easily from the sheath, helping to minimize damage to the rhizome. However, a faster method of harvesting the plant material is cutting the culms above the rhizome. This method is considered more damaging to the plant, as culms that are not ready to be harvested are taken from the plant prematurely, thereby reducing the amount of energy returned and stored in the rhizome for the next season's growth and production. Cutting plants may result in wasted plant materials, as inferior culms would most likely be taken in the process. Pulling has been described as the traditional harvesting method by Native American gatherers (Shebitz and Crandell, in press). Pulling is more selective since it focuses on desirable stems for weaving and does not remove all of the plants in a collecting area.

Availability of Resources:

The Refuge currently has the following staff and funding to administratively permit and support monitoring of sweetgrass gathering currently taking place. Any substantial increase in the number of permit requests would create a need for additional resources to satisfy administrative permitting and monitoring needs in order to verify that activities are implemented in a compatible manner.

Table B.5. Estimated annual costs to administer Sweetgrass Gathering on the Refuge

Category	One-time Expense ($)	Recurring Expense ($/year)
Administration and management	0	2,500
Monitoring	0	1,000
Total Costs	0	3,500

Anticipated Impacts of the Use:

Fish, Wildlife, Plants, and Their Habitats

As noted earlier, purposes of Grays Harbor NWR include conservation of fish and wildlife populations and their habitats, with emphasis upon shorebirds, other migratory birds, birds of prey, and species threatened with extinction. Refuge purposes also include fulfilling international treaty obligations of the United States with regard to fish and wildlife and their habitats. Examples of such treaties include the Ramsar Convention and treaties between the U.S. and Canada, Japan, Mexico, Russia, the Soviet Union, and Western Hemisphere nations. These treaties address the conservation and protection of migratory birds and species in danger of extinction, protection of wetlands, and establishment and management of nature preserves (I.L.M. 11:963-976; 39 Stat. 1702, T.S. 628; 25 U.S.T. 3329, T.I.A.S. 7990; 50 Stat. 1311, T.S. 912; 23 U.S.T. 845, T.I.A.S. 7345; T.I.A.S. 9073, 92 Stat. 3110; and 56 Stat. 1354, T.S. 981).

Wildlife species of special management concern at the Refuge include shorebirds such as western sandpiper (*Calidris mauri*), dunlin (*Calidris alpina*), semi-palmated plover (Charadrius semipalmatus), black-bellied plover (*Pluvialis squatarola*), red knot (*Calidris canutus roselaari*), long-billed dowitcher (*Limnodromus scolopaceus*), short-billed dowitcher (*Limnodromus griseus*), and greater yellowlegs (*Tringa melanoleuca*); birds of prey such as bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Cirus cyaneus*), merlin (*Falco columbarius*), and peregrine falcon (*Falco peregrinus*); waterfowl, other waterbirds, and other migratory birds including ducks and geese, gulls, terns, mergansers, common loon (*Gavia immer*), brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*) and other waterbirds; and neotropical songbirds.

Management also focuses on species threatened with extinction which, when the Refuge was established, included the peregrine falcon, bald eagle, and brown pelican. All these species have since been removed from the Federal endangered species list and are considered recovered in this area of the U.S. Shorebirds and other fauna at the Refuge provide prey for these raptors, so the Refuge will continue to ensure that management decisions support continued recovery of these birds. It's possible that the following three fishes listed as threatened under the Federal Endangered Species Act (16 U.S.C. 1531–1544) occur on the Refuge: green sturgeon (*Acipenser medirostris*), bull trout (*Salvelinus confluentus*), and eulachon (*Thaleichtys pacificus*, aka smelt).

Refuge management focuses on providing quality intertidal mudflat roosting and foraging habitat for migrating shorebirds. This is especially important during the spring (late April through May) when hundreds of thousands of these birds use the entire Harbor estuary as a refueling stop on their northern migration from wintering areas in South America. While at Grays Harbor, the birds enhance fat reserves for the non-stop flight to their Arctic breeding grounds. Grays Harbor is one of four major North American staging areas for shorebirds and hosts one of the largest concentrations of

these birds on the West Coast south of Alaska. In 1995, in recognition of its high value to over 500,000 shorebirds annually, Grays Harbor Estuary was designated a site of hemispheric importance (the highest ranking) by the Western Hemisphere Shorebird Reserve Network. Bowerman Basin (within the Refuge) has been designated a Globally Important Bird Area and is listed as priority wintering habitat for peregrine falcons by the Washington Department of Fish and Wildlife (Audubon Washington, Jun 2001). Although shorebird numbers are especially high in the spring, a diversity of wildlife use Refuge habitats throughout the year. For example, shorebirds also visit and feed in the estuary from June through October, during their southward migration, and dunlin and black-bellied plover winter at the Refuge.

Refuge habitats of special management concern include open water, intertidal mudflats, tidal salt and brackish marsh, and forest. Native plants of special concern include native eelgrass (*Zostera marina*) and sweetgrass (*Schoenoplectus pungens*). Because Refuge mudflats are some of the last in the estuary to flood during twice-daily high tides, they are especially valuable for foraging shorebirds. The Refuge's mudflat habitat is dense with nutrient-rich, invertebrate bird foods, such as polychaete worms, tubeworms, and the shrimp-like Corophium amphipod (*Corophium spp.*). Red alder (*Alnus rubra*) dominates the forest that provides roost sites for raptors, and cover and forage for passerines. Invasive species of actual or potential concern include common reed (*Phragmites australis* three different species of Spartina (*Spartina spp.*), a few knotweed species (Polygonum*spp.*), Asian or Japanese eelgrass (*Zostera japonica*), yellow flag iris (*Iris pseudacorus*), Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), Canada and bull thistle (*Cirsium arvense* and *Cirsium vulgare*, respectively), Griffins isopod (*Orthione griffenis*), green crab (*Carcinus maenas*), and invasive mussels and snails.

It is expected that the greatest effects on wildlife from sweet grass collection would likely be associated with disturbance. Human disturbance has differential effects on wildlife and is dependent upon, among other variables, the species involved and its age; the time of year; the breeding cycle stage (if applicable); the surrounding environment; whether the activity involves vehicles; the intensity, speed, noise, nature, and frequency of the disturbing activity; and the directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Holmes et al. 2005; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole 1995a; Knight and Cole 1995b; Lafferty 2001a). Disturbance can cause animals stress and alter their normal behavior; cause them to stop feeding; cause abandonment of nests and young; and allow predators access to nests/young, reduce parental attention to young, and otherwise impact survival of individual birds, eggs, nestlings, or broods (Burger and Gochfeld, 1991; Haysmith and Hunt, 1995; Lafferty, 2001b). The effects of disturbance on individual animals are likely additive.

Distance of observers/photographers from wildlife subjects and the numbers of observers/ photographers involved are important disturbance variables. Holmes et al. (2007) found that vigilance behavior of Gentoo penguins (*Pygoscelis papua*) increased as the numbers of observers increased. A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004).

A variety of factors affect flushing and flushing distances among waterbirds, including the species involved; the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed);

whether the species is hunted; and the type, size, speed, and noise of disturbance (e.g., dogs versus humans, cycling versus walking, or approaching birds by walking versus in a motorized boat) (Goss-Custard and Verboven 1993; Lafferty 2001b; Rodgers and Smith 1997; Rodgers 1991; Smit and Visser 1993). Flushing of birds or even raising their alert levels (which usually occurs at a greater distance than that for flushing) creates stress and requires animals to expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing.

In a study of the effects of disturbance on feeding shorebirds in a British estuary, Goss-Custard and Verboven (1993) found that flushed birds normally flew just a short distance and quickly resumed In a study of the effects of disturbance on feeding shorebirds in a British estuary, Goss-Custard and Verboven (1993) found that flushed birds normally flew just a short distance and quickly resumed feeding. They noted that although disturbance (by walkers, observers, anglers, dog-walkers, and shell fisherman) had increased over a 15-year period, populations of oystercatchers had not diminished because there were ample areas away from disturbance for the birds to move and continue feeding; birds could feed at other hours of the day and night when people were not present; feeding intensity could be increased somewhat to compensate for lost feeding time; some of the best feeding areas, the mudflats, were areas not usually accessed by humans; and the birds might habituate to certain types of disturbance. Importantly, if enough people were present in some of the smaller habitats, all of the feeding shorebirds were displaced and as the density of feeding shorebirds increased elsewhere, older birds stole more food from subordinate birds.

In another study of the effects of disturbance on British shorebirds, Gill et al. (2001) found that there was a strong relationship between the density of desirable prey species and the numbers of godwits using a site, and that human disturbance had no effect on the numbers of godwits supported at preferred forage sites. In a study of the effects of trail users (walkers, joggers, bicyclists, and in-line skaters) on shorebirds in San Francisco Bay, Trulio and Sokale (2008) found there was no difference in shorebird use between sites without trail use and those sites with low numbers of trail users. However, after a certain point on high use days, increasing numbers of trail users resulted in reduced numbers of foraging shorebirds. Similar to the situation at Grays Harbor, these trails were elevated and aligned parallel to the adjacent mudflats.

In a study of sanderlings (*Calidris alba*) on a California beach, Thomas (5-2000) found that the number, proximity, and activity of recreationists all affected foraging time by the birds. The presence of dogs off-leash was especially disturbing. Smit and Visser (1993) reviewed numerous shorebird studies from the coasts of The Netherlands and Germany. They found that, when disturbed, entire flocks of nonterritorial shorebirds departed feeding sites and moved to other feeding sites. They also found that one person or a group of people could cause most or all territorial shorebirds (e.g., redshanks, oystercatchers, and curlews) to abandon a preferred feeding site until the disturbance ceased and then often a smaller number of these birds returned. Finally, they noted that their review argued for keeping visitors to nature reserves at sufficient distance from high-tide roosts. These studies suggest that disturbance response varies considerably among foraging shorebirds and perhaps among feeding sites. It would appear that in some situations, certain shorebird species are somewhat more tolerant of modest levels of human disturbance than some other bird species and that such disturbance may not affect the birds' ability to satisfy nutritional requirements or their populations if the areal extent of quality foraging habitats is adequate.

Wildlife disturbance can be a special concern with wildlife observation and photography (Cline et al. 2007; DeLong 2002; Knight and Cole 1995). Sweetgrass gathering could be compared to disturbance levels similar or greater to observation and photography. Observers and photographers often want to enhance their view or photograph by encroaching closer and closer to their subject. This can cause increased stress in wildlife and eventually lead to flushing. If a bird is nesting or brood-rearing, disturbance can cause temporary or permanent nest desertion. Even if only temporary, eggs and nestlings can face survival challenges associated with temperature extremes and predation.

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife are often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Holmes et al. 2007; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993). Lafferty et al. (2006) studied the effects of erecting educational signing, employing docents, and placing a rope barrier that directed recreationists away from a western snowy plover (*Charadrius alexandrinus nivosus*) nesting area on a California beach. Despite the fact pedestrians were easily seen and continued to routinely pass by the nesting area, human-related disturbance was reduced by more than half, plover numbers increased within the barrier area, and plover reproductive success was enhanced. Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

Observers, photographers, or participants in interpretation programs could also cause trampling of native plants, erosion, and introduction or spread of exotic species, including invertebrates, plants, and invasive species. All of these impacts could adversely affect native fish, wildlife, plants, and their habitats. The degree of actual effects upon important life history parameters such as foraging, predator avoidance, reproduction, and survival of individuals and on diversity and abundance of native species (community health) would depend on specific circumstances.

The primary area of the Refuge officially open to public use is the Sandpiper Trail that consists of a boardwalk trail built on piers, which rises above the underlying brackish and salt marsh along the southern boundary of the Refuge. Access to this trail is on the hardened black top road. Confining visitors to this trail and the associated access route avoids potential problems associated with trampling of vegetation and erosion of soils. Visitors are provided an avenue through the forest and across the marsh to the edge of the mudflats; the mudflats themselves are closed to trespass, thus keeping this critical foraging area disturbance-free. The proposed new facilities on the Refuge's south side include two new observation decks/platforms, new Red Knot Trail (approximate 250 feet long), new interpretive panels/signage, and improvements to the parking strip. As funding allows these future improvements would be sited in this same area and share the same design features as the current facilities. It is expected that these new facilities and associated public uses would have the same effects on wildlife and their habitat as those at present. Anecdotal observations over the decades since the Sandpiper Trail has been opened to the public reveal that visitor use of this facility does not disturb shorebirds foraging on the mudflats. There are perch sites in trees on three sides of the Refuge allowing raptors to move to other locations should they be disturbed by visitors on the Sandpiper Trail.

General Impacts Expected:

Impacts from the gathering of sweetgrass would be site-specific and would vary depending upon the number of annual special use permits allotted. Authorized gathering techniques (pulling method) would generally have minimal plant/animal mortality or disturbance, habitat destruction, no introduction of contaminants, and no introduction of non-indigenous species. Gathering of mature culms utilizing the pulling method would have short-term, localized impacts on the overall plant community.

Impacts to Listed Species:

No direct impact to listed species is anticipated to occur as a result of sweetgrass gathering. No listed species occur directly in the habitat where sweetgrass harvest occurs and use is limited both spatially and temporally. Any unanticipated future impacts would be reduced by ensuring that the activity avoids areas hosting rare species.

Sweetgrass Gathering Specific Impacts:

Description of Sweetgrass: *S. pungens,* commonly referred to as "sweetgrass" by many basket-makers, a perennial sedge also known as "American bulrush" or "American three square" due to its triangular culm with flat sides. Sweetgrass is generally not found in large stands, but is found forming fringes along the edge of ponds, lakes, and streams. Sweetgrass seems to prefer coarser substrates and is associated where there is a presence of freshwater influence (Pojar and MacKinnon, 1994).

Impacts from the gathering of sweetgrass would be site-specific and would vary depending upon the number of people actually gathering under the annual allotted SUPs. Not all permitees gather each year. Authorized gathering techniques would generally have minimal animal mortality or disturbance, habitat destruction, no introduction of contaminants, and no introduction of nonindigenous species. Plant gathering would have short-term, localized impacts on the overall plant community.

<u>Status of Sweetgrass Habitat:</u>

The site where sweetgrass is typically collected is located on the north side of the Refuge in an area closed to the public. The area remains closed to provide undisturbed habitat for wildlife and to protect the native salt marsh and mudflats. Described as a low salt/brackish marsh, the sweetgrass stands in Grays Harbor are small, narrow, and somewhat disjunct. Sweetgrass is one of the most widespread flowering plants occurring on several continents. However, the occurrence of sweetgrass marsh is limited in western Washington and accessibility to stands for harvesting is further limiting (Shebitz and Crandell in press).

Surveys conducted in 1996 had indicated there may be a total of roughly 25 acres of sweetgrass at Grays Harbor NWR. However, more complete surveys conducted in the early 2000s produced an estimate of approximately 10 acres of sweetgrass on Grays Harbor NWR (Crandell, 2004). These small stands comprise one of only three locations in coastal Washington where viable stands remain (Linda Kunze, pers comm). Sweetgrass is an important component of the native salt marsh at the Refuge, representing roughly 10 acres of the total estimated 156 acres of brackish and salt marsh on the Refuge.

Current and historical information on the status of sweetgrass in Washington and on the Refuge is limited. Harvesting locations on the Olympic Peninsula in more recent times have included the Skokomish River delta in Hood Canal and multiple shoreline locations in Grays Harbor. Habitat and land use changes and overharvesting apparently have contributed to declines and reduced accessibility (Lamberson 1996, Nordquist and Nordquist 1983, Shebitz and Crandell, in press). Today, sweetgrass stands at Grays Harbor NWR are considered the only site in Grays Harbor that is accessible for harvesting by Native Americans (Shebitz and Crandell in press) and sufficient stands for harvesting do not currently occur in the Skokomish estuary.

Concern about the status and health of sweetgrass on the Refuge has been ongoing for the Refuge staff and also for Native American gatherers. Lamberson (1996) indicated a consensus among gatherers and weavers that there is a general increase in numbers of basket-makers but a decrease in the quality and amount of sweetgrass habitat. A basket-weaver from the area who had traditionally harvested sweetgrass in Washington stated that because of marked declines, she began to harvest sweetgrass in Oregon instead. One longtime harvester who has been collecting at Bowerman Basin (now Grays Harbor NWR) for 20 years indicated that the reeds had become shorter. Others have reported that they believe it has declined in extent and quality. The sweetgrass stands on the Refuge represent a significant proportion of what remains in western Washington. Considering the limited occurrence and size of stands in Washington, sweetgrass stands on the Refuge should be treated as sensitive, likely declining habitats.

This native coastal marsh is an important part of the diversity and richness of the Grays Harbor estuary and Grays Harbor NWR. This narrow strand provides a transition zone between the extensive mudflats of the estuary habitats of the Refuge and the adjacent uplands. Salt marshes in general play an important role in nutrient cycling, sediment trapping, contaminant filtering, and nurseries for fish and shellfish, and water recharge. The sweetgrass stands on the Refuge also provide food for waterfowl and waterbirds and potential nesting habitat for small numbers of birds (marsh wrens, song sparrows, etc.), as well as contribute to the health and function of the adjoining mudflats where shorebirds concentrate during migration and wintering periods. Grays Harbor marshes are threatened by the encroachment of invasive, exotic plant species, including Phragmites, Spartina, knotweed species, and nonnative eelgrass. The protection and enhancement of native marshes is essential in order to sustain the integrity and diversity of the Grays Harbor estuary.

Results of 1995 Sweetgrass Gathering and Current Use:

The lands where sweetgrass gathering has occurred were acquired as part of the Refuge in 1995. Limited sweetgrass gathering was allowed by SUP on a trial basis during July and August 1995. Thirty-one individuals (both Native American and non-Native American) were issued permits; one commercial request was denied. A detailed set of permit stipulations were designed to try to minimize impacts to wildlife and habitat. Amount, dates, duration (one day only within a prescribed period), and collecting method were all prescribed, based on resource protection needs and input from collectors. Only those collectors who had been gathering sweetgrass for many years were given permits; no new applicants were granted permits. Only personal use was allowed; permit conditions prohibited commercial uses. Management of this program was extremely labor intensive to try to ensure that each applicant met permit criteria and understood the special conditions. All permittees were informed that this was an experimental year, to allow a more thorough evaluation of the effects of sweetgrass gathering at Grays Harbor NWR. Permittees were cooperative and appeared sensitive

to habitat and wildlife considerations, but wanted to continue their practice of collecting sweetgrass for use in making baskets.

The effects of the summer 1995 harvesting activity were readily apparent during a site visit on September 14, 1995. There were many trails throughout much of the Sweetgrass stands, associated trampling of the plants and soils, and larger areas of impact where pulling or cutting had occurred. In areas where foot traffic was highest, trampling had exposed bare, muddy soils. Although permittees were required to only pull by hand, there were areas where sweetgrass had obviously been cut, which is much more harmful to the plants. Sweetgrass collecting and the foot traffic in the marsh necessary for collecting had caused visual impacts including creating trails in the salt marsh and sweetgrass stands, vegetation damage, compacting wetland soils, and reducing vegetative cover. Impacts to sweetgrass caused by cutting and harvest raised concerns, though detailed studies were not available at that time to quantify effects.

The effects of sweetgrass gathering, despite being limited by an SUP with many conditions, appeared to have potential cumulative effects on habitat. Preliminary results from 1996 sampling as part of an independent survey indicated a potential negative correlation between sweetgrass harvesting and plant density: sweetgrass plant density was twice as high in stands on the south side of Bowerman Basin (including Grays Harbor NWR) where harvesting does not occur, compared to stands on the north side where harvesting occurs. Although it was difficult to conclude what the relative effects of harvesting and foot traffic were in comparison to environmental conditions in each area, the direct and indirect effects of sweetgrass harvest raised concerns of cumulative, long-term effects to sweetgrass, salt marsh plants, soils, and the health of plant communities.

As a result, to reduce impacts to sweetgrass and the salt marsh on the Refuge and maintain compatibility, sweetgrass harvesting for non-Native American gatherers was discontinued in 1996 to reduce effects on sweetgrass. However gathering continued to be permitted for Native American gatherers under SUPs, to continue to support a traditional cultural use. A range of 20 to 194 permits have been issued annually from 1997 onward to tribal members from as many as 13 tribes through their tribal representatives. Numbers of permits more typically range from 40 to 100 each year. It should be noted that each member who is issued a permit may not necessarily choose to collect in a given year and that not all tribes or members may obtain permits each year.

The Refuge also encouraged and provided partial funding to support research on the health and status of sweetgrass at Grays Harbor NWR and the effects of harvesting to provide needed information to guide future management decisions. Although analysis is still ongoing, preliminary results of part of a PhD dissertation have been provided (Crandell 2004; pers. comm). Sweetgrass harvesting was conducted experimentally in test plots to evaluate the effects of harvesting on sweetgrass plants and also the trampling associated with access in the salt marsh. Preliminary results looked at above ground biomass, stem height, and stem density and showed some negative effects caused by harvesting using cutting and to a lesser degree by trampling, but further analysis is needed. To address those preliminary impacts, mitigating measures and stipulations were designed to protect and sustain sweetgrass and native salt marsh habitats, and maintain compatibility while supporting a traditional cultural use by local tribes.

Impacts to Other Priority Public Uses:

Permitted sweetgrass gathering generally results in little disturbance to other Refuge visitors, since it occurs within a closed area that is distant from open public areas. The activity of gathering

sweetgrass may inadvertently flush birds or mammals, but the likelihood is limited, so effects on wildlife observation are not anticipated. The collecting area is visible from the Sandpiper Trail, but is located more than 0.5 miles away. No significant effects to trails, trail users, or other education or interpretation programs are foreseen at this time.

Mitigating Measures:

Although personal gathering for non-Native American gatherers cannot be sustained on the Refuge, the Refuge continues to support a traditional cultural activity that is important to many local tribes. In addition, as a measure to increase sweetgrass resources in the local western Washington area and provide new areas for harvesting, the Refuge has provided permission to gather seeds or seedlings for out-planting in other areas as part of restoration or reestablishment projects. For example, the Refuge worked closely with the Skokomish Tribe in the late 1990s to allow the gathering of a limited number of individual sweetgrass plants from Grays Harbor NWR to be used to restore sweetgrass in the Skokomish River estuary where sweetgrass was extirpated. Successful reestablishment or introduction in other nearby locations would help to perpetuate sweetgrass in western Washington, provide a new gathering site, potentially reduce harvesting pressure on the Refuge, and support an important cultural use by local tribes.

Plant gatherings for reestablishment and out-plant purposes were allowed by an SUP on a limited basis in spring 1996, accompanied by an extensive monitoring program to provide important new information on the status of sweetgrass at Grays Harbor NWR and to ensure that no adverse impacts were caused. This cooperative effort with the Skokomish Tribe is an example of ways that the Refuge can create partnerships and further assist local Tribes in sustaining sweetgrass and this traditional use. The Refuge also offered to provide seeds or seedlings to another Tribe more recently in a restoration project on the Olympic Peninsula, although they later decided to use nursery stock for out-planting to ensure greater success. The Refuge will continue to consider future requests from others for similar out-planting purposes on a case-by-case basis, to perpetuate sweetgrass marshes for traditional use while insuring compatibility.

Public Review and Comment:

Open-house style public meetings were held and verbal and written comments were solicited from the public during public scoping for the CCP/EA for the Refuge. Appendix J of the draft CCP/EA gives further details of public involvement undertaken during development of the CCP. Additional public review and comment will be solicited during the draft CCP/EA comment period.

Note that the SUPs were developed and improved over time with input from gatherers and local tribes to reflect traditional practices and cultural needs while maintaining compatibility and supporting this cultural use.

Determination: (check one below)

_____ Use is Not Compatible

_X___ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. In order to minimize impacts to sweetgrass stands and the native salt marsh, sweetgrass harvesting will be limited to Native Americans by permit to support a cultural need while protecting and sustaining sweetgrass and other Refuge resources.

2. Any new data or research relevant to sweetgrass plant communities or harvesting will be evaluated and considered as it becomes available. Additional conditions or restrictions will be considered if needed to sustain sweetgrass stands and the salt marsh and maintain compatibility.

3. Permits will be issued annually to Native American gatherers through Tribal representatives with appropriate special conditions to support long-term sustainability of salt marshes, sweetgrass stands, and harvesting that is compatible with Refuge purposes and also supports cultural needs.

4. Sweetgrass harvest will be permitted between July 1 and September 15 (by permit as described) to allow sweetgrass to be harvested during optimum periods while limiting access into salt marsh habitats during other times of the year.

5. Permits will include special conditions designed to support a cultural need for Native American gatherers, but also to minimize effects on sweetgrass and the salt marsh caused by foot traffic, trampling, plant harvesting, and presence in this sensitive habitat.

6. Periodic monitoring and evaluation of facilities, programs, habitats, and wildlife would be conducted by staff to assess whether program objectives are being met with little or no additional or unexpected impacts to resources (budgetary, staffing, wildlife, facilities, etc.)

The following SUP stipulations will be included in each permit to help ensure resource protection and sustainability of this shared resource:

a. Permit is nontransferable and valid only for the specific named permittee. Only the individual permittee is allowed on the Refuge for harvesting. The permittee may bring an assistant (that is a tribal member), if needed, to gather sweetgrass.
b. Permittee must sign permit. The signed permit must accompany permittee when harvesting sweetgrass *Schoenoplectus pungens* (formerly *Scirpus americanus*) on Refuge.

c. Gathering may only occur during daylight hours.

d. Permit is for gathering of sweetgrass (*Schoenoplectus pungens)* only. No other activities (i.e., picnicking) are allowed.

e. In order to reduce the introduction of exotic species into the marsh, only clean, new bags will be used to transport collected material. Before entering the gathering area, boots or footwear must be clean of vegetation, debris, and mud that may contain seeds from other areas.

f. Permittee will remove all litter upon completion of harvesting materials.

g. To minimize disturbance to the plants, the only gathering method allowed for sweetgrass (*Schoenoplectus pungens)* will be by pulling mature, individual plant stems from the plant base (culms from the rhizome).

h. Permittee may only collect enough material that will fill one 30-gallon garbage bag, or one armful load (limited to one bag per permittee).

i. Permit is valid only one day during the designated gathering period from July 1 to September 15.

j. By September 30th, each Tribal representative is responsible for and will notify the Refuge in writing of the dates of all harvesting activities and amounts collected.

k. No pets are allowed on Refuge.

l. Violation of permit conditions will result in revocation of permit and may affect future gathering of sweetgrass (*Schoenoplectus pungens)*.

Justification:

The associated disturbance to wildlife from gathering activities is expected to be negligible to minor. Sweetgrass gathering tends to be focused in limited areas within the salt marsh where sweetgrass stands occur and is typically of limited duration. Much of the salt marsh is not accessed since sweetgrass does not occur in the majority of salt marsh habitat. In addition, the most accessible sweetgrass stands closest to roads are usually the areas where harvest occurs, further limiting spatial effects to the salt marsh.

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 these activities to occur. The relatively limited number of individual animals expected to be adversely affected will not cause animal populations to materially decline, the physiological condition and production of refuge 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.

The effects to sweetgrass and native plant communities will be greatly reduced by continuing to limit collecting only to Native American collectors by permit. Permits will include multiple permit conditions designed to protect sweetgrass stands in the long-term as well as native salt marsh plant communities. Harvest effects and sweetgrass will continue to be evaluated and if future conditions or restrictions are needed to protect natural resources and ensure compatibility, they can be designed and implemented. Because most collecting typically occurs in the more easily accessible areas near roads, much of the salt marsh and some of the sweetgrass stands receive little to no impacts. The limited areas where sweetgrass harvesting is concentrated receive more foot traffic and harvesting effects are greater on sweetgrass plants, however large portions of the Refuge and salt marsh do not receive direct effects.
The Refuge would monitor compliance with the stipulations enumerated herein.

The Refuge would monitor wildlife and habitat disturbance, and other potential impacts to determine if these stipulations were resulting in expected and desirable outcomes.

The Refuge would apply adaptive management principles to modify stipulations or adjust objectives, as necessary, to achieve desirable results (see 522 DM 1).

Any new data or research relevant to sweetgrass plant communities or harvesting will be evaluated and considered as it becomes available. Additional conditions or restrictions will be considered if needed to sustain sweetgrass stands and the salt marsh and maintain compatibility.

Thus, allowing sweetgrass gathering for cultural purposes under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge system mission. Sweetgrass gathering provides an opportunity for tribal members to continue to gather sweetgrass and to support a traditional cultural use practiced over many years, and as such, help fulfill the mission of the National Wildlife Refuge System.

Compatibility Standard

Providing opportunities for sweetgrass collecting is directly supportive of the Service's Native American Tribal policy. It supports and respects the traditional cultural uses of the sustainable resources on the Refuge. The stipulations associated with this use are specifically designed to greatly reduce the likelihood and magnitude of potential biological effects. Potential impacts associated with sweetgrass gathering are greatly limited because permits are required to harvest the sweetgrass and staff would closely monitor use and impacts to the resource.

In order to be allowed on the Refuge, sweetgrass gathering would need to be determined compatible. By allowing this use to occur under the stipulations described above, it is anticipated that wildlife that were disturbed would find sufficient food resources and resting places so their abundance and use would not be measurably lessened on the Refuge. Additionally, it is anticipated that monitoring, as needed, would prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats. For the several reasons stated above and consistent with the stipulations described herein, this use would not materially interfere with or detract from maintenance of the Refuge's biological integrity, diversity, and environmental health; fulfillment of the Refuge purposes; or the Refuge System's mission.

Mandatory 10- or 15-Year Re-evaluation Date:

_____ 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

This compatibility determination has been developed and issued concurrent with the CCP and EA for Grays Harbor NWR and the Black River Refuge.

Compatibility Determination for Sweetgrass Gathering at Grays Harbor NWR:

Uses are compatible with stipulations.

Refuge Determination

Prepared by: _____
(Signature) (Date)

Approved by Project Leader, Nisqually National Wildlife Refuge Complex: _____
(Signature) (Date)

Concurrence

Refuge Supervisor: _____
(Signature) (Date)

Regional Chief, National Wildlife Refuge System, Pacific Region: _____
(Signature) (Date)

References and Citations:

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Compatibility Determination

Use: Wildlife Observation, Photography, and Interpretation.

Unit Name: Black River Unit of Billy Frank Jr. Nisqually National Wildlife Unit, Thurston County, Washington

Establishing and Acquisition Authorities:

Migratory Bird Conservation Act of 1929, as amended (16 U.S.C. 715-715r)

Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742m)

Unit Purposes:

> . . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds (16 U.S.C. 715-715r).
>
> . . . 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)).

National Wildlife Refuge System (Refuge System or NWRS) Mission:

> "The mission of the [National Wildlife Unit] 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).

Description of Use:

Interpretation is the communication of information and explanation of the nature, origin, and purpose of historical, natural, or cultural resources, objects, sites, and phenomena using personal or nonpersonal methods. The National Association for Interpretation defines interpretation to be, "a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in the resource." For national wildlife refuges, the purposes of interpretation are to convey an understanding and appreciation for refuge resources, the issues that affect them, and the conservation techniques and programs pursued in their management (USFWS 2006b). For purposes of this compatibility determination (CD), interpretation addresses environmental and cultural resources and values.

Wildlife observation, photography, and interpretation are often enhanced with the provision of brochures, wildlife and plant lists, interpretive signs and displays, trails, auto tour routes and vehicle pullouts, viewing platforms or towers, viewing equipment, photography or viewing blinds,

interpretive presentations and tours, visitor stations or centers, and bookstores or similar retail outlets. Many of these facilities and information sources serve all three activities. In addition, refuge visitors often enjoy all three activities together. Information can be conveyed in person, in writing, with images, with sound, and, increasingly, through a diversity of electronic media and devices.

For purposes of this CD, observation and photography include viewing and capturing images of wild plants and animals, wildlife habitats, wildlands, waters, landscapes, cultural resources, and cultural activities; noncommercial recording of all types (e.g., filming, videography, audiography, writing, and drawing or painting); and general nature study and appreciation. This CD does not address recording of images and audio for commercial purposes. Nor does it address observation, photography, and interpretation opportunities offered by commercial tours, sometimes referred to as ecotourism.

At present, the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Unit (Unit) is not officially open for general public use. However, public roads define some boundaries and cut through portions of the Unit so individuals have always been able to access portions of the Black River Unit via boat. There are two undeveloped boat launch sites within the Unit boundary. Individuals traveling local roads or boating on the river currently have undeveloped opportunities to observe and photograph wildlife on the Unit.

Comments received during the CCP process reveal a desire of the public for interpretive signs, off-road parking and viewing areas, opportunities to view elk, trails, viewing blinds, a visitor center and information kiosks, and barrier-free facilities on the Unit. In the CCP, it is proposed that portions of the Unit be officially opened for wildlife observation, photography, and interpretation, and that associated infrastructure and management programs be developed to facilitate these public uses. Specifically, it is proposed that two observation, photography, and interpretation sites be developed near the southern end of the Unit, on either side of Endicott Road, between 118th and 123rd Avenues. The east side site would focus on wetland, riparian forest, and riverine habitats, and include a parking area near a viewing deck. The west side site would focus on upland forest bounding an open grassland where wintering elk are commonly seen, have a viewing deck, and accommodate bus parking. Both sites would include parking areas for automobiles, some interpretive and regulatory signs or panels, and opportunities for wildlife viewing and photography, and would be fully accessible for those with limited mobility. Following establishment of the Thurston County Gate-Bellmore Trail, the Service would also explore potential spur trails into the Unit to provide additional opportunities for observation, photography, and interpretation. It is proposed that these areas of the Unit be open for visitation every day of the year, from sunrise to sunset.

In addition, it is proposed that a boat launch site and parking area be developed where 123rd Avenue crosses Black River. Boating on the river would provide additional opportunities for Unit visitors to enjoy wildlife observation and photography.

Observation, photography, and interpretation are priority, wildlife-dependent public uses and are to be given special consideration in refuge planning and management. When determined compatible on a refuge-specific basis, a wildlife-dependent use becomes a priority public use for that refuge and is to be facilitated and encouraged (see National Wildlife Refuge System Administration Act, 16 U.S.C. 668dd-668ee).

This CD has been developed and made publicly available concurrent with the comprehensive conservation plan (CCP) and associated environmental assessment (EA) for Grays Harbor NWR and

the Black River Unit. Much of the information and some of the analyses contained in this CD are addressed in greater detail in the CCP and EA.

Availability of Resources:

Following is an estimate of one-time costs associated with the Unit's proposed wildlife observation, photography, and interpretive facilities.

Table B-8. Costs to Administer and Manage Wildlife Observation and Photography and Interpretation under the Preferred Alternative.

Category	One-time Expenses ($)	Recurring Expense ($/year)
New parking and viewing area on east side of Endicott Road	110,000	1,000
New parking and viewing area on west side of Endicott Road	90,000	1,000
New boat launch, parking, and kiosk at 123rd Avenue	130,000	2,000
Monitoring and administration	5,000	12,000
Maintenance	5,000	21,000
Law Enforcement	5,000	13,000
Total Costs	345,000	50,000

Funding and/or in-kind support would be sought to develop the new facilities. The proposed Unit annual operations budget will support the annual costs (staff) associated with the proposed wildlife observation and photography and interpretive program on the Unit.

Anticipated Impacts of the Use(s):

Unit Goals and NWRS Mission

The management direction of the Black River Unit is guided by the protection of biological diversity, and enhancement and management of a valuable wetland ecosystem for the benefit of anadromous salmonid production, migratory birds, and other wetland-dependent wildlife (USFWS 1996). The Unit has developed the following six draft goals as part of its comprehensive conservation planning process.

1. Protect, maintain, and enhance aquatic habitats characteristic of the upper Black River Watershed while maintaining historical characteristics of the north Puget Trough Lowlands for the benefit of native fish, amphibians, migratory birds, and a diverse assemblage of other native species.
2. Protect and maintain upland habitats characteristic of the upper Black River watershed.
3. Contribute to the protection and long-term environmental health of the greater Black River watershed and ecosystem.
4. Gather scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.
5. Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance their understanding and appreciation of the Unit's natural resources and foster a connection with nature.

6. Support and develop an active volunteer program and partnerships to assist in providing quality visitor services programs and outreach.

Observation, photography, and interpretation activities would directly support draft Unit goal number 5. It is expected that these uses would enhance the public's understanding of and appreciation for the importance of conservation and for the Unit's management programs; therefore, they would also indirectly support the Refuge System mission and draft goals 1, 2, and 3.

Fish, Wildlife, Plants, and Their Habitats

The Black River is a tributary to the Chehalis River, which drains to the Pacific Ocean through Grays Harbor. Slow-moving Black River and surrounding wetlands form the most intact lowland river system remaining in western Washington. The Unit includes upland forest, riparian forest, grassland, various wetland types, including shrub swamp and rare sphagnum bog, and aquatic systems.

The Black River, tributaries, wetlands, grasslands, shrub swamps, and forests support a diversity of resident and migratory wildlife species. Wildlife species of special management concern at the Unit include salmonids such as steelhead trout (*Oncorhynchus mykiss*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), coho salmon (*Oncorhynchus kisutch*), and Chinook salmon (*Oncorhynchus tshawytscha*), which use the Black River and its tributaries for migration, spawning, and rearing. Many species of frogs, salmanders, and newts are found in the mosaic of wetlands. River otter (*Lutra canadensis*), mink (*Mustela vison*), muskrat *(Ondatra zibethicus),* and beaver *(Castor canadensis)* can be seen in the Black River; a herd of Roosevelt elk (*Cervus elaphus roosevelti)* graze in Unit grasslands. Ducks, geese, and grebes; rails, bitterns, herons; raptors; and neotropical songbirds occur throughout the Unit.

Unit management focuses on protecting, restoring, and maintaining quality habitats—especially freshwater streams, bogs and emergent marshes, and upland grasslands—for a diversity of native wildlife and plant species, including those that are rare and declining. The Unit provides valuable habitat for an endemic, State-sensitive species, the Olympic mud minnow (*Novumbra hubbsi*), and the State-endangered and federally threatened species Oregon spotted frog (*Rana pretiosa*). The frog is known to occur in three subbasins in the State and in two locations on the Unit. It is suspected that the Unit may support rare bog-adapted insects, federally endangered water howellia (*Howellia aquatilis*) and possibly the streaked horned lark (*Eremophila alpestris*), proposed for listing under the Federal Endangered Species Act (16 U.S.C. 1531-1544).

Invasive species of actual or potential concern include reed canarygrass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), knotweed species (*Polygonum spp.*), yellow flag iris *(Iris pseudacorus),* Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), holly (*Ilex spp.),* New Zealand mudsnail (*Potamopyrgus antipodarum*), feral cat (*Felis catus*), bullfrog (*Rana catesbeiana*), and various warm water fish species.

It is expected that the greatest effects upon wildlife of visitors engaging in wildlife observation, photography, and interpretation would likely be associated with disturbance. Human disturbance has differential effects on wildlife and is dependent upon, among other variables, the species involved and its age; the time of year; the breeding cycle stage (if applicable); the surrounding environment; whether the activity involves vehicles; the intensity, speed, noise, nature, and frequency of the disturbing activity; and the directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Holmes et al. 2005; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole

1995a; Knight and Cole 1995b; Lafferty 2001a). Disturbance can cause animals stress and alter their normal behavior, cause them to stop feeding, cause abandonment of nests and young, and allow predators access to nests/young, reduce parental attention to young, and otherwise impact survival of individual birds, eggs, nestlings, or broods (Burger and Gochfeld 1991; Haysmith and Hunt 1995; Lafferty 2001b). The effects of disturbance on individual animals are likely additive.

Naylor et al. (2009) examined the effects of four types of off-road recreational disturbance (all-terrain vehicle riding, mountain biking, hiking, and horseback riding) on North American elk (*Cervus elaphus*) in northeast Oregon. They found that all types of disturbance studied affected elk behavior. Hiking generally caused an increase in the time elk traveled, especially in the morning; resulted in a decrease in resting time; and had no effect on time spent feeding. Ciuti et al. (2012) studied the effects of various human disturbances (e.g., hiking, biking, horseback riding, hunting, fishing, riding all-terrain vehicles, general vehicle traffic, and roads) in various landscapes with different management programs in southwest Alberta. They also found that hiking caused elk travel time to increase and that an increase in the number of hikers caused an increase in travel behavior in elk. Behavioral responses of tule elk (*Cervus elaphus nannodes*) to off-trail hikers and off-shore boats were investigated by Becker et al. (2012) at Point Reyes National Seashore, California. They learned that elk exhibiting rutting behavior and those in the presence of off-trail hikers displayed the most disturbance behaviors (i.e., head up, stand, move off, run, or alarm cry). Elk were more sensitive to human disturbance when herd sizes were smaller (<15 animals).

The distances of observers or photographers to wildlife subjects and the numbers of observers or photographers involved are important disturbance variables. Holmes et al. (2007) found that vigilance behavior of Gentoo penguins (*Pygoscelis papua*) increased as the numbers of observers increased. A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004). Breeding birds are especially sensitive to human disturbance (Trulio 2005; Hammitt and Cole 1998). In a study of the effects of trail users (walkers, joggers, bicyclists, and in-line skaters) on shorebirds in San Francisco Bay, Trulio and Sokale (2008) found there was no difference in shorebird use between sites without trail use and those sites with low numbers of trail users. However, after a certain point on high-use days, increasing numbers of trail users resulted in reduced numbers of foraging shorebirds. In a study of sanderlings (*Calidris alba*) on a California beach, Thomas (5-2000) found that the number, proximity, and activity of recreationists all affected foraging time by the birds. The presence of off-leash dogs was especially disturbing.

A variety of factors affect flushing and flushing distances among waterbirds, including the species involved; the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed); whether the species is hunted; and the type, size, speed, and noise of disturbance (e.g., dogs versus humans, cycling versus walking, or approaching birds by walking versus in a motorized boat) (Goss-Custard and Verboven 1993; Lafferty 2001b; Rodgers and Smith 1997; Rodgers 1991; Smit and Visser 1993). Flushing of birds or even raising their alert levels (which usually occurs at a greater distance than that for flushing) creates stress and requires animals to expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing.

Wildlife disturbance can be a special concern with wildlife observation and photography (Cline et al. 2007; DeLong 2002; Knight and Cole 1995). Observers and photographers often want to enhance

their view or photograph by encroaching closer and closer to their subject. This can cause increased stress in wildlife and eventually lead to flushing. If a bird is nesting or brood-rearing, disturbance can cause temporary or permanent nest desertion. Even if only temporary, eggs and nestlings can face survival challenges associated with temperature extremes and predation.

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife is often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Holmes et al. 2007; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993). In an elk study in southwestern Alberta, Ciuti et al. (2012) found that, where hunting is not allowed, elk can exhibit habituation (e.g., reduced vigilance behavior) to some types or levels of human disturbance. Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

Observers, photographers, or participants in interpretation programs could also cause trampling of native plants, erosion, and introduction or spread of exotic species, including invertebrates, plants, and invasive species. All of these impacts could adversely affect native fish, wildlife, plants, and their habitats. The degree of actual effects upon important life history parameters such as foraging, predator avoidance, reproduction, survival of individuals, and diversity and abundance of native species (community health) would depend on specific circumstances.

The proposed public use facilities described above would invite visitors into the Unit to enjoy observation, photography, and interpretation and, at the same time, bring them closer to wildlife and their habitats. However, it is expected that wildlife disturbance and other potential impacts would be greatly limited because participating visitors would enjoy these uses within the bounds of new facilities that are adjacent to a public road and within a large block of Service-owned land, they would follow Principles of Ethical Field Practices, developed by North American Nature Photography Association, and open-field travel would be prohibited.

The highest potential for wildlife disturbance might involve boaters on the Black River who were observing or photographing wildlife. For much of its reach through the Unit, the Black River is fairly narrow and not very deep. Wildlife approached by a boat would not likely have adequate space to move aside or dive under water and allow a boat to pass. Instead, such species might head to shrub cover along the shore, or swim or fly up or down the river away from the approaching craft. Boat use of the river is not expected to be high, so such disturbances would be infrequent, and there would be ample, undisturbed areas of the river for displaced wildlife to relocate.

In addition, the presence of wildlife observers or photographers, or those enjoying interpretation at the new facilities on either side of Endicott Road, would have some effects on habitat use and movement by elk. The elk currently use the entire area, readily crossing the road and grazing or resting in much of the area. It is expected that elk would avoid the immediate footprint of the public facilities when in use by people, although the footprint is a relatively small part of the overall block of habitat available there, so effects would be fairly localized.

Public Use

Because the Unit is closed to general public use, observation, photography, and interpretation would have no effects on other visitors. However, subject to evaluations for compatibility, it is proposed in the CCP that portions the Unit also be opened for fishing, boating, research, grazing, haying, and mowing.

It is possible that visitors participating in wildlife observation, photography, and interpretation could meet up with a school group on an environmental education field trip at one of the proposed new visitor facilities. It is unlikely that a handful of visitors enjoying observation, photography, or interpretation would adversely affect those participating in environmental education or any of the other new uses listed above.

Visitors would be expected to not disturb or otherwise interfere with animal behaviors by using telephoto lenses to photograph animals and adhering to local regulatory requirements. Other practices that can reduce wildlife disturbance when observing or photographing include use of observation or photo blinds and use of binoculars or spotting scopes to enable good viewing while maintaining a respectable distance from individuals or colonies.

Social, Cultural, and Other Values

To date, few cultural resource surveys have been conducted on the Unit. There are no recorded archaeological sites, but some local farms and associated structures are of historic value. Prior to construction of any new facilities, the Service would undertake appropriate surveys and engage in consultations consistent with requirements of the National Historic Preservation Act (16 U.S.C. 470). This process would result in avoiding, minimizing, and/or mitigating any potential effects.

Comments received during the CCP process reveal a concern by some members of the public that increased visitation on the Unit could result in vandalism (e.g., of old houses or other buildings on the Unit) or impacts to adjacent private property, such as trespass or illegal dumping. Substantial private property remains within the approved Unit boundary and public versus private property boundaries are not always well marked. Drawing additional visitors to the Unit could result in trespass or damage to private property. The sites proposed for the new visitor facilities lay along a public road and well within a large area of Service-owned property. That, along with improved signing, possibly maps and other visitor information, and the presence of other visitors, should reduce the likelihood of trespass or vandalism.

Public Review and Comment:

Public availability of this CD has been widely announced together with announcement of the availability of the Unit's draft CCP. The review and comment period has also been the same as for the draft CCP.

Determination: (check one below)

____Use is Not Compatible

_X_Use is Compatible with following Stipulations

Stipulations Necessary to Ensure Compatibility:

General

1. In addition to the stipulations listed here, visitors would be required to comply with Refuge System-related and other applicable laws, regulations, and policies including "Prohibited Acts" listed in the Code of Federal Regulations (50 C.F.R. 27).

2. Portions of the Unit would be open for public use daily, year-round, from sunrise to sunset, pending authorization. Visitation would not be authorized until the procedural and substantive requirements described earlier had been satisfied. The Service would also develop appropriate digital and hardcopy visitor information in support of wildlife observation, photography, and interpretation, including rules and requirements and State consumption advisories.

3. Members of the public accessing the new visitor facilities would be required to park their vehicles in the Unit-designated parking areas and stay on designated walkways or trails and the observation and photography decks. Open-field travel would be prohibited.

4. Rules to help ensure public safety and minimize adverse effects upon native fish, wildlife, plants, their habitats, and private property would be posted on Unit sign boards and enforced by Unit staff.

5. Interpretive materials would be used to inform visitors of desired behaviors when viewing and photographing wildlife. Examples include Principles of Ethical Field Practices developed by the North American Nature Photography Association. The Unit would provide signs, pamphlets, and verbal instructions from Unit staff and volunteers, as well as promote appropriate use of trails, blinds, and platforms to minimize wildlife and habitat disturbance. These materials will clearly state pertinent Unit-specific regulations.

   Among others, these principles include not disturbing or otherwise interfering with animal behaviors, using telephoto lenses to photograph animals, and adhering to local regulatory requirements. Other practices that can reduce wildlife disturbance when observing or photographing include use of observation or photo blinds, and use of binoculars or spotting scopes to enable good viewing while maintaining a respectable distance from individuals or colonies.

6. Observers and photographers would be prohibited from using feed, manual elk calls, or recorded audio playback devices (e.g., those used to attract birds and other wildlife). This includes tape and digital recorders, portable computers (e.g., laptops, tablets, notebooks, etc.), and smart phones. Also, photography through use of kites, remote-controlled aircraft, drones, or extended poles (anything taller than a standard photographic tripod or monopod) would not be allowed.

7. In order to avoid harassment, disease, and/or death of native wildlife, or transport of exotic or invasive plant parts, insects, or other undesirable species, individuals participating in observation, photography, and interpretation would be prohibited from bringing dogs or other pets with them onto the Unit. The exceptions would be legitimate, leashed guide animals.

8. No changes could be made to any of these stipulations without specific, prior written approval of the refuge manager (for the purpose of these stipulations, the refuge manager would be the project leader of Nisqually National Wildlife Refuge Complex).

9. The Unit would establish a program to monitor compliance with the stipulations enumerated herein.

Justification:

Service policy states that, "Viewing and photographing wildlife in natural or managed environments should foster a connection between visitors and natural resources" (USFWS 2006a). Policy also advises that wildlife observation and photography can promote understanding and appreciation of natural resources and their management across the Refuge System (USFWS 2006c and USFWS 2006d). Participation in Unit interpretive and informational programs can instill a sense of wonder, cultivate a connection with nature, foster a life-long relationship with a Unit and the Refuge System, encourage a conservation ethic, enhance the public's understanding and appreciation for fish, wildlife, plants, their habitats, cultural resources, and Unit management programs to conserve these valuable resources.

Service policy and Federal law require that wildlife-dependent public uses identified in the Improvement Act (including wildlife observation, photography, and interpretation) be given special consideration in refuge planning and management, and opportunities to allow these uses are to be considered in each CCP (USFWS 2000 and NWRS Administration Act). When determined compatible on a refuge-specific basis, those wildlife-dependent uses becomes priority public uses for that refuge and are to be facilitated, and strongly encouraged. Safe and compatible opportunities for families, including children, to participate in wildlife-dependent uses are to be provided across the Refuge System.

The Unit would monitor wildlife and habitat disturbance, and other potential impacts to determine if these stipulations were resulting in expected and desirable outcomes. The Unit would apply adaptive management principles to modify stipulations or adjust objectives, as necessary, to achieve desirable results (USDI 2008 and Williams et al. 2009).

The Unit would reserve the right to add to or otherwise modify the stipulations listed herein in order to ensure the continued compatibility of these uses. New or modified stipulations could be instituted as a result of new information generated by ongoing or new studies; new legal, regulatory, or policy requirements; significant changes to the Unit environment or status of native fish, wildlife, plants, or their habitats; or for other legitimate reasons. Visitors would be appropriately advised of any such changes.

The Unit would also reserve the right to terminate permission for these uses if individuals were violating Unit rules or regulations; if unacceptable impacts were occurring to native fish, wildlife, plants, or their habitats, cultural resources or Unit facilities, or other Unit visitors; or for other legitimate reasons.

Compatibility Standard.

Providing opportunities for wildlife observation, photography, and interpretation is directly supportive of one of the Unit's draft goals, but could cause some wildlife disturbance and other effects. Carefully designed and constructed facilities, proper program management, and the stipulations included herein would greatly reduce this potential. This is primarily the case because Unit visitors would enjoy these uses within the bounds of new facilities that are adjacent to a public road and within a large block of Service-owned land, and open-field travel would be prohibited.

In order to be allowed on the Unit, observation, photography, and interpretation would need to be determined compatible. By allowing these uses to occur under the stipulations described above, it is anticipated that wildlife which wase disturbed would find sufficient food resources and resting places so their abundance and use would not be measurably lessened on the Unit. Additionally, it is anticipated that monitoring, as needed, would prevent unacceptable or irreversible impacts to fish, wildlife, plants, their habitats, other public uses, cultural resources, Unit facilities, and private lands. For the several reasons stated above and consistent with the stipulations described herein, this use would not materially interfere with or detract from maintenance of the Unit's biological integrity, diversity, and environmental health; fulfillment of the Black River Unit's purposes; or the Refuge System's mission.

Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for "allowed" uses only)

_____ 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 Unit 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

This compatibility determination has being developed and issued concurrent with the CCP and EA for Grays Harbor NWR and the Black River Unit.

Compatibility Determination for Wildlife Observation, Photography, and Interpretation at Black River Unit:

Uses are compatible with stipulations.

Unit Determination

Prepared by: _____
(Signature) (Date)

Approved by Project Leader, Nisqually National Wildlife Unit Complex: _____
(Signature) (Date)

Concurrence

Unit Supervisor: _____
(Signature) (Date)

Regional Chief, National Wildlife Refuge System, Pacific Region: _____
(Signature) (Date)

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Compatibility Determination

Use: Research, Surveys, and Scientific Collection.

Unit Name: Black River Unit of Billy Frank Jr. Nisqually National Wildlife Unit, Thurston County, Washington

Establishing and Acquisition Authorities:

Migratory Bird Conservation Act of 1929, as amended (16 U.S.C. 715-715r)

Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742m)

Unit Purposes:

> . . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds (16 U.S.C. 715-715r).
>
> . . . 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)).

National Wildlife Refuge System (Refuge System or NWRS) Mission:

> "The mission of the [National Wildlife Unit] 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 1977 (Public Law 105-57).

Description of Use(s):

This use involves research, surveys, and scientific collections conducted by non-Refuge System parties on the Black River Unit of Billy Frank Jr. Nisqually National Wildlife (Unit).

Research refers to a planned, organized, and systematic investigation of a scientific nature. Such studies are designed to determine the cause(s) of observed biotic or abiotic phenomenon over a finite time period, where cause and effect relationships usually can be inferred through statistical analyses.

Survey activities include scientific inventories and monitoring of fish, wildlife, plants, public use, and abiotic refuge resources (e.g., soils, water).

Scientific collecting involves gathering of refuge natural resources or cultural artifacts for scientific purposes. Examples include collection of vegetation, small mammals, and soils; contaminant

sampling; adult and larval mosquito trapping/monitoring; and collection and curation of cultural resources.

Unit staff periodically receive requests from outside parties (e.g., universities, state agencies, other Federal agencies, and nongovernmental organizations) to conduct research, surveys, and scientific collecting on Unit 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, Unit-specific, or evaluate the relative contribution of Unit lands and waters to larger landscapes (e.g., ecoregion, region, flyway, national, and international), issues, and trends.

The Service's Research and Management Studies (4 RM 6, USFWS 1982) and Appropriate Unit Uses (603 FW1.10D(4), USFWS 2006) 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 management goals and objectives, where applicable, would be given a higher priority over other requests. Attached to this compatibility determination (CD) are examples of high-priority research, survey, and scientific collection topics for the Black River Unit.

It is proposed that an approximately 300-acre research natural area (RNA) be established at the northern end of the Unit. This area would include a reach of the Black River, adjacent shrub swamp, and a large portion of the known bog habitat. The RNA would help further protect natural ecological processes surrounding these rare bogs and would facilitate long-term research and monitoring of these unusual habitats.

Research, surveys, and scientific collections on the Unit would generally be authorized through individual special use permits (SUPs) consistent with Service policy (USFWS 1986). Before being allowed on the Unit, this use would need to be found appropriate (see Appropriate Unit Uses) and then be determined compatible (USFWS 2000).

This CD has been developed and made publicly available concurrent with the comprehensive conservation plan (CCP) and associated environmental assessment (EA) for Grays Harbor NWR and the Black River Unit. Much of the information and some of the analyses contained in this CD are addressed in greater detail in the CCP and EA. The CCP and EA are incorporated through reference herein.

Availability of Resources:

Unit responsibilities for research, surveys, and scientific collections by non-Refuge System entities would be primarily limited to the following: review of proposals, preparation of an SUP(s) and other appropriate compliance documents (pursuant to the National Environmental Policy Act [42 U.S.C. 4321-4347], Endangered Species Act [16 U.S.C. 1531-1544], National Historic Preservation Act [16 U.S.C. 470], etc.), and monitoring project implementation to ensure that impacts and conflicts remain within acceptable levels (compatible) over time. Additional administrative, logistical, and operational

support could also be provided depending on each specific request. Estimated costs for one-time and annually re-occurring tasks by Unit staff are determined on a project-by-project basis. Sufficient funding in the Unit's general operating budget would need to be available to cover expenses for these projects. The terms and conditions for funding and staff support necessary to administer each project on the Unit would be clearly stated in the SUP(s).

The Unit has the following staffing and funding to administratively support and monitor research, surveys, and scientific collections that are currently taking place on the Black River Unit (see table below). Any substantial increase in the number of projects would create a need for additional resources to satisfy administrative and monitoring of the investigators and their projects and to ensure the projects were implemented in a compatible manner. Any substantial additional costs above those itemized below could result in finding a project not compatible unless expenses were offset by the investigator, sponsoring organization, or other party.

Table B-9. Costs to Administer and Manage Research, Surveys, and Scientific Collections under the Preferred Alternative

Category	One-time Expense ($)	Recurring Expense ($/year)
Administration and Management		3,500
Total Costs		3,500

Anticipated Impacts of the Use(s):

Unit Goals and NWRS Mission

Use of the Unit to conduct research, surveys, or scientific collecting would generally provide information of benefit to native fish, wildlife, plants, and their habitats or cultural resources. Scientific findings gained through these projects could provide important information regarding life-history needs of species and species groups as well as identify or refine management actions to achieve natural or cultural resource management objectives in refuge management plans (especially CCPs). Reducing uncertainty regarding wildlife and habitat responses to refuge management actions undertaken in order to achieve desired outcomes (objectives) is essential for adaptive management in accordance with 522 DM 1 (see Adaptive Management USDI 2008 and Williams et al. 2009).

Potentially, some project's methods could impact or conflict with Unit-specific natural or cultural resources, priority, wildlife-dependent public uses, other high-priority research, or Unit management programs. In such cases, in order for the project to be determined compatible, it would need to be clearly demonstrated that the project's scientific findings would contribute to Unit management and that the project could not be conducted off-Unit. The investigator(s) would need to identify methods/strategies in advance to minimize or eliminate potential impacts and conflicts. If unacceptable impacts, including long-term and cumulative impacts, could not be avoided, then the project would not be determined compatible. Research 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 would be project- and site-specific, where they would vary depending upon nature and scope of the field work. Data collection techniques would generally have minimal animal mortality or disturbance, habitat destruction, no introduction of contaminants, or no introduction of nonindigenous species. In contrast, projects involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection would have short-term impacts. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) would be collected for identification and/or experimentation and statistical analysis. Where possible, researchers would 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 would also ensure minimal impacts to fish, wildlife, plants, and their habitats. If, after incorporating the above strategies, a project would still result in long-term or cumulative effects, it would not be found 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) would be required for activities that may affect a federally listed species and/or critical habitat. Only projects which have no effect or would result in not likely to adversely affect determinations would 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 would 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 would 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 project (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) would usually be localized and temporary in nature. Where long-term or cumulative unacceptable effects cannot be avoided, the project would not be found compatible. Project proposals would be reviewed by Unit staff and others, as needed, to assess the potential impacts (short-term, long-term, and cumulative) relative to benefits of the investigation to Unit management issues and understanding of natural systems.

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 would be reviewed by Unit staff and others, as needed, to assess the potential impacts (short-term, long-term, and cumulative) relative to benefits of the investigation to Unit management issues and understanding of natural systems. This assessment would form the primary basis for allowing or denying a specific project. Projects which result in unacceptable Unit impacts would not be found compatible. If allowed and found compatible after approval, all projects also would be assessed during implementation to ensure impacts and conflicts remain within acceptable levels.

If the proposal is approved, then the Unit manager would issue an SUP(s) with required stipulations (terms and conditions) of the project to avoid and/or minimize potential impacts to Unit resources as well as conflicts with other public-use activities and Unit 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) would ensure that proposed projects contribute to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the Unit. As a result, these projects would help fulfill Unit purpose(s), contribute to the mission of the Refuge System, and maintain the biological integrity, diversity, and environmental health of the Unit.

Projects which are not covered by the CCP (objectives under Goal 4 [Gather scientific information (inventories, monitoring, and research) but are necessary to support adaptive management decisions]) would require additional NEPA documentation.

The management direction of the Black River Unit is guided by the protection of biological diversity and enhancement and management of a valuable wetland ecosystem for the benefit of anadromous salmonid production, migratory birds, and other wetland-dependent wildlife (USFWS 1996). The Unit has developed the following six draft goals as part of its comprehensive conservation planning process.

1. Protect, maintain, and enhance aquatic habitats characteristic of the upper Black River Watershed while maintaining historical characteristics of the north Puget Trough Lowlands for the benefit of native fish, amphibians, migratory birds, and a diverse assemblage of other native species.
2. Protect and maintain upland habitats characteristic of the upper Black River watershed.
3. Contribute to the protection and long-term environmental health of the greater Black River watershed and ecosystem.
4. Gather scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.
5. Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance their understanding and appreciation of the Unit's natural resources and foster a connection with nature.
6. Support and develop an active volunteer program and partnerships to assist in providing quality visitor services programs and outreach.

High priority research, survey, and scientific collection projects would directly support draft Unit goal number 4. It is likely that most proposed research, survey, or scientific collection projects would also support one or more of the other draft Unit goal numbers 1, 2, 3, and 5, but each would need to be evaluated separately. Projects that were determined supportive of draft Unit goals and the Refuge System mission would have a greater chance of being found appropriate, determined compatible, and authorized for implementation.

Fish, Wildlife, Plants, and Their Habitats

Impacts would be project- and site-specific, and would vary depending upon the nature and scope of the field work. Data collection techniques would generally have minimal animal mortality or disturbance, habitat destruction, no introduction of contaminants, and no introduction of

nonindigenous species. In contrast, projects involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection would at least have short-term, localized impacts.

The Black River is a tributary to the Chehalis River which drains to the Pacific Ocean through Grays Harbor. Slow-moving Black River and surrounding wetlands form the most intact lowland river system remaining in western Washington. The Unit includes upland forest, riparian forest, grassland, various wetland types, including shrub swamp and rare sphagnum bog, and aquatic systems.

The river, tributaries, wetlands, grasslands, shrub swamps, and forests support a diversity of resident and migratory wildlife species. Wildlife species of special management concern at the Unit include salmonids such as steelhead trout (*Oncorhynchus mykiss*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), coho salmon (*Oncorhynchus kisutch*), and Chinook salmon (*Oncorhynchus tshawytscha*), which use Black River and its tributaries for migration, spawning, and rearing. Many species of frogs, salmanders, and newts are found in the mosaic of wetlands. River otter (*Lutra canadensis*), mink (*Mustela vison*), muskrat *(Ondatra zibethicus)*, and beaver *(Castor canadensis)* can be seen in Black River; a herd of Roosevelt elk (*Cervus elaphus roosevelti)* graze in Unit grasslands. Ducks, geese, and grebes; rails, bitterns, herons; raptors; and neotropical songbirds occur throughout the Unit.

Unit management focuses on protecting, restoring, and maintaining quality habitats—especially freshwater streams, bogs and emergent marshes, and upland grasslands—for a diversity of native wildlife and plant species, including those that are rare and declining. The Unit provides valuable habitat for an endemic, State-sensitive species, the Olympic mud minnow (*Novumbra hubbsi*) and the State-endangered and federally threatened species Oregon spotted frog (*Rana pretiosa*). The frog is known to occur in three subbasins in the State, and in two locations on the Unit. It is suspected that the Unit may support rare bog-adapted insects, federally endangered water howellia (*Howellia aquatilis*) and possibly the streaked horned lark (*Eremophila alpestris*), proposed for listing under the Federal Endangered Species Act (16 U.S.C. 1531-1544).

Invasive species of actual or potential concern include reed canarygrass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), knotweed (*Polygonum species*), yellow flag iris *(Iris pseudacorus),* Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), holly (*Ilex spp.),* New Zealand mudsnail (*Potamopyrgus antipodarum*), feral cat (*Felis catus*), bullfrog (*Rana catesbeiana*), and various warm water fish species.

Disturbance would likely be one of the most common wildlife effects caused by research, surveys, and scientific collections. Human disturbance has differential effects on wildlife and is dependent upon, among other variables, the species involved and its age; the time of year; the breeding cycle stage (if applicable); the surrounding environment; whether the activity involves vehicles; the intensity, speed, noise, nature, and frequency of the disturbing activity; and the directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Holmes et al. 2005; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole 1995a; Knight and Cole 1995b; Lafferty 2001a). Disturbance can cause animals stress and alter their normal behavior; cause them to stop feeding; cause abandonment of nests and young; and allow predators access to nests/young, reduce parental attention to young, and otherwise impact survival of individual birds, eggs, nestlings, or broods (Burger and Gochfeld 1991; Haysmith and Hunt 1995; Lafferty 2001b). The effects of disturbance on individual animals are likely additive.

Naylor et al. (2009) examined the effects of four types of off-road recreational disturbance (all-terrain vehicle riding, mountain biking, hiking, and horseback riding) on North American elk (*Cervus elaphus*) in northeast Oregon. They found that all types of disturbance studied affected elk behavior. Hiking generally caused an increase in the time elk traveled, especially in the morning; resulted in a decrease in resting time; and had no effect on time spent feeding. Ciuti et al. (2012) studied the effects of various human disturbances (e.g., hiking, biking, horseback riding, hunting, fishing, riding all-terrain vehicles, general vehicle traffic, and roads) in various landscapes with different management programs in southwest Alberta. They also found that hiking caused elk travel time to increase and that an increase in the number of hikers caused an increase in travel behavior in elk. They noted that, where hunting is not allowed, elk can exhibit habituation (e.g., reduced vigilance behavior) to some types or levels of human disturbance. Behavioral responses of tule elk (*Cervus elaphus nannodes*) to off-trail hikers and off-shore boats were investigated by Becker et al. (2012) at Point Reyes National Seashore, California. They learned that elk exhibiting rutting behavior and those in the presence of off-trail hikers displayed the most disturbance behaviors (i.e., head up, stand, move off, run, or alarm cry). Elk were more sensitive to human disturbance when herd sizes were smaller (<15 animals).

The distances of researchers from wildlife subjects and the numbers of researchers involved are important disturbance variables. Holmes et al. (2007) found that vigilance behavior of Gentoo penguins (*Pygoscelis papua*) increased as the numbers of observers increased. A study of visitors to a colony of kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*) revealed that nesting success was influenced by the distance observers were from the birds (positively correlated) and the number of observers involved (negatively correlated) (Beale and Monaghan 2004). Breeding birds are especially sensitive to human disturbance (Trulio 2005; Hammitt and Cole 1998). In a study of the effects of trail users (walkers, joggers, bicyclists, and in-line skaters) on shorebirds in San Francisco Bay, Trulio and Sokale (2008) found there was no difference in shorebird use between sites without trail use and those sites with low numbers of trail users. However, after a certain point on high use days, increasing numbers of trail users resulted in reduced numbers of foraging shorebirds. In a study of sanderlings (*Calidris alba*) on a California beach, Thomas (5-2000) found that the number, proximity, and activity of recreationists all affected foraging time by the birds. The presence of off-leash dogs was especially disturbing.

A variety of factors affect flushing and flushing distances among waterbirds, including the species involved; the activity in which the birds are engaged (e.g., foraging versus nesting); prey density and nutritional requirements for feeding birds; flock size (large flocks may be more easily disturbed); whether the species is hunted; and the type, size, speed, and noise of disturbance (e.g., dogs versus humans, cycling versus walking, or approaching birds by walking versus in a motorized boat) (Goss-Custard and Verboven 1993; Lafferty 2001b; Rodgers and Smith 1997; Rodgers 1991; Smit and Visser 1993). Flushing of birds or even raising their alert levels (which usually occurs at a greater distance than that for flushing) creates stress and requires animals to expend energy that otherwise would be invested in essential life history activities such as foraging, migration, predator avoidance, mating, nesting, and brood-rearing.

Trulio (May 2005) reviewed numerous studies of the effects of recreational and other human uses on wildlife, especially waterbirds. Reviewed studies found that similar to the effects of recreationists, researchers can often have a number of adverse effects on wildlife and can contribute to nest abandonment, increased depredation, reduction of nests near disturbed areas, lower productivity, and increased flight. These effects may vary based on the species studied, the stage in the breeding cycle when disturbance occurs, the presence of predators in the area, and other factors. Tremblay and

Ellison (1979) studied the effects on reproductive success of researchers entering black-crowned night heron (*Nycticorax nycticorax*) colonies in the St. Lawrence Estuary, Canada. They found that effects varied significantly based on when in the breeding cycle researchers entered colonies. Entering just prior to or during laying of eggs caused inhibition of laying, abandonment of nests, and predation or abandonment of eggs. Entry into the colonies following egg laying had much less impact. More frequent researcher disturbance had greater effects on reproductive success than less frequent visits. In some situations, researchers' actions caused mortality of young birds. In studies of tricolored herons (*Egretta tricolor*), Frederick and Collopy (1989) found that when researchers visited the nesting colonies after courtship and early egg laying, there were no differences in reproductive success between sites visited frequently versus those visited infrequently. Parsons and Burger (1982) examined the effects of research handling on behavior of black-crowned night heron (*Nycticorax nycticorax*) nestlings in Massachusetts. Nestlings that were not handled exhibited escape behavior when disturbed. Nestlings that were regularly handled displayed increasingly defensive behavior, did not move from their nests, and appeared to have habituated somewhat to the disturbance. Handling did not affect growth of the nestlings. All adult birds flew away when researchers entered the colonies.

In a near-shore study with Xantus's murrelets (*Synthliboramphus hypoleucus*), Newman et al. (2005) found that biochemical and cellular indicators of stress were adversely affected by research activities, including capture, handling, and radio-marking. Wright et al. (2007) found that land-based researchers flushed large numbers of California brown pelicans (*Pelecanus occidentalis*) in studies at a seabird colony on the lower Columbia River. A study of the effects of varying frequencies of research activities within black skimmer (*Rynchops niger*) nesting subcolonies by Safina and Burger (1983) found that pre-laying adults left disturbed subcolonies; some nesting pairs deserted nests early in incubation; and nest density, late nesting, hatching success, and fledgling success were all adversely affected by this disturbance. Robert and Ralph (1975) assessed biological effects of researchers entering a nesting colony of western gulls (*Larus occidentalis*) and found that hatching failure was positively correlated with the frequency of disturbance and that effects were greater during the early stage of the breeding cycle. Colwell et al. (1988) studied the effects of blood sampling of shorebirds on breeding grounds in Minnesota, Manitoba, and Saskatchewan. They found that blood sampling had no effect on return of birds the following year, that it had varying effects on clutch desertion (based on when in the reproductive cycle the birds were captured, whether both parents were sampled, and whether the species was biparental or uniparental), and that a small percentage of birds (0-3 percent) died or sustained debilitating injuries.

Wildlife disturbance can be a special concern with wildlife observation and photography (Cline et al. 2007; DeLong 2002; Knight and Cole 1995). Observers and photographers often want to enhance their view or photograph by encroaching closer and closer to their subject. This can cause increased stress in wildlife and eventually lead to flushing. If a bird is nesting or brood rearing, disturbance can cause temporary or permanent nest desertion. Even if only temporary, eggs and nestlings can face survival challenges associated with temperature extremes and predation.

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife are often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Holmes et al. 2007; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser

1993). In an elk study in southwestern Alberta, Ciuti et al. (2012) found that, where hunting is not allowed, elk can exhibit habituation (e.g., reduced vigilance behavior) to some types or levels of human disturbance. Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

In addition to travel by foot or vehicle, field research can involve transport of project infrastructure, equipment, and supplies, such as permanent transects or plot markers, and exclosure devices. Access to and work at study sites could result in localized and temporary effects including trampling of native plants, erosion, collecting of soil and plant samples, and trapping and handling of fish and wildlife. Longer-term effects could potentially be caused by introduction or spread of exotic species, including invertebrates, plants, and invasive species, or pathogens. All of these impacts could adversely affect native fish, wildlife, plants, and their habitats. The degree of actual effects upon important life history parameters such as foraging, predator avoidance, reproduction, and survival of individuals, and on diversity and abundance of native species (community health), would depend on specific circumstances. These potential effects could be minimized or eliminated by requiring proper cleaning of investigator equipment and clothing and possibly restoration or mitigation plans, where appropriate (see attached). The general stipulations attached hereto, project-specific stipulations, and permit conditions would be expected to greatly reduce the potential impacts of research, surveys, and scientific collections on Unit fish, wildlife, plants, and their habitats.

Public Use

Because the Unit is closed to general public use, research, surveys, and scientific collections would have no effects on other visitors at this time. However, subject to evaluations for compatibility, it is proposed that the Unit also be opened for wildlife observation, photography, interpretation, fishing, boating, and grazing, haying, and mowing.

If research was conducted at one of the proposed new visitor facilities, it is possible that it could result in some crowding, especially with school groups. If field research was conducted in Unit habitats near one of these new facilities, it could result in flushing of birds and other wildlife, or cause some animals to move farther afield. This would reduce the quality of experience for observers and photographers. Such conflicts would be expected to be infrequent and temporary.

General and project-specific stipulations and permit conditions regarding the locations and scheduling of research would be used to greatly minimize the likelihood that such activities would impair wildlife-dependent uses. The exception could be research and surveys specifically focused on public use. In such cases, approved study protocols would help ensure that such projects would not significantly reduce the quality of wildlife-dependent public uses.

Cultural Resources and Values

To date, few cultural resource surveys have been conducted on the Unit. There are no recorded archaeological sites, but some buildings and associated structures are of historic value. It is unlikely that research at the Unit would affect cultural resources. However, if such projects involved construction of new facilities, the Service would undertake appropriate surveys and engage in consultations consistent with requirements of the National Historic Preservation Act (16 U.S.C. 470) prior to project approval. Additionally, if the research, surveys, or scientific collections specifically

focused on cultural resources, such projects could require additional permits and approvals, potentially including a permit under the Archaeological Resources Protection Act (ARPA, 16 U.S.C. 470aa-470mm). Stipulations and conditions associated with Unit SUPs or ARPA permits would help ensure that research-related adverse effects upon cultural resources were avoided, minimized, and/or mitigated, as appropriate.

Public Review and Comment:

Public availability of this CD has been widely announced together with announcement of the availability of the Unit's draft CCP. The review and comment period has also been the same as for the draft CCP.

Determination: (check one below)

___ Use is Not Compatible

_X_ Use is Compatible with following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. Investigator(s), researchers, and support staff will follow all Unit-specific regulations that specify access and travel on the Unit.

2. Projects will adhere to scientifically defensible protocols for data collection, where available and applicable

3. Permission to use the Unit for research, surveys, or scientific collections would be officially authorized through issuance of an SUP.

4. To acquire an SUP, at least 6 months before initiation of field work, a researcher(s) would be required to submit a detailed project proposal (see attached format) and request an SUP. Among other things, proposals would need to adhere to scientifically defensible protocols for data collection, where available and applicable.

5. Project proposals would be reviewed by Unit staff and others, as needed. This review would assess relative to Unit management issues and understanding of natural systems the potential impacts (short-term, long-term, and cumulative) relative to the benefits of the investigation. This assessment would form the primary basis for determining whether or not the project could be approved.

6. All SUPs will have a definite termination date in accordance with 5 RM 17.11. Annual or other short-term SUPs are preferred, however, some permits may be allowed for a longer period, if needed, to allow completion of the project.

7. SUP renewals will be subject to refuge manager review and approval based on timely submission of and content in progress reports, compliance with SUP stipulations, and required permits. Continuation of existing projects will require approval by the refuge manager.

8. SUPs would cover use by a specified individual or organization and could not be assigned or sub-permitted to others.

9. Researchers must possess all required local, State, and Federal permits and approvals for collections and other activities of their proposed projects.

10. SUPs would include maps clearly depicting the areas researchers would be authorized to access and use, including the Unit entry point(s). Permittees would be prohibited from straying outside the project areas depicted on maps.

11. A section 7 consultation under the Endangered Species Act would be required for all projects and activities that may affect a federally listed species and/or critical habitat. Projects which would have "no effect" or would result in a "not likely to adversely affect" determination would be considered for potential approval.

12. Researchers would be required to secure approval from the Service prior to use of any pesticide (including uses of herbicides, fungicides, and insecticides) on the Unit. This would involve researchers submitting to the refuge manager a completed FWS Pesticide Use Proposal (PUP) for each proposed pesticide use. Any researcher-applicator will be required to have a current State pesticide application license and endorsement for the applicable habitat. These PUPs would need to be submitted at least 90 days prior to proposed use of the pesticide to allow adequate time for evaluation and processing.

13. To minimize the introduction and/or spread of exotic plants or animals, diseases, or other pests, sampling equipment as well as researchers' clothing and vehicles (e.g., ATVs, boats) would need to be thoroughly cleaned (free of dirt, seeds, and other plant material) before being used on the Unit.
    a. Researchers/investigators will be required to disinfect waders by following specific protocols provided by the refuge. Disinfection is required prior to entry into any Unit wetland and when crossing between wetlands.

14. Researchers would be prohibited from constructing new or maintaining existing structures, creating new or expanding exiting trails, or removing vegetation to facilitate travel on the Unit without specific, prior written approval of the refuge manager (for the purpose of these stipulations, the refuge manager would be the project leader of the Billy Frank Jr. Nisqually National Wildlife Unit Complex).

15. Any flagging used would need to be biodegradable.

16. Consistent with Service policy regarding management of nonhazardous solid waste on refuges (USFWS 2001), permittees would be prohibited from littering, dumping refuse, abandoning equipment or materials, or otherwise discarding any items on the Unit.

17. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates, and artifacts) would be collected for identification and/or experimentation and statistical analysis.
    a. Where possible, researchers would be required to coordinate and share collections. This could reduce sampling needed for multiple projects and any associated mortality and disturbance. For example, if one investigator collected fish for a diet study and

another researcher was examining otoliths, then it could be possible to accomplish sampling for both projects with one collection effort.

18. Researchers and their colleagues would be prohibited from collecting, removing, disturbing, or otherwise adversely impacting any prehistoric/archaeological or historic artifacts, cultural resources, abiotic or biological specimens or samples, or mementos from the Unit unless stated in the Special Use Permit.
    a. In the event such resources were inadvertently disturbed in the course of conducting otherwise permitted activities, the disturbing activity would need to be immediately discontinued and the refuge manager would need to be notified within 24 hours.

19. If unacceptable impacts to natural resources or conflicts arise or are documented by the Unit staff, then the refuge manager can suspend, modify conditions of, or terminate an ongoing project already permitted by SUP(s) on the Unit.

20. Upon completion of the project or annually (at the discretion of the refuge manager), researchers would be required to remove all equipment and physical markers (unless required for long-term projects) and restore sites to the refuge manager's satisfaction. SUPs would specify conditions for removal and clean up.

21. At any time, Unit staff may accompany investigator(s) in the field.

22. 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).

23. Final project reports would be due 1 year after completion of the project.
    a. Researchers would be required to provide Unit staff with the following:
        i. An early opportunity(ies) to review and comment on draft manuscripts well before their submittal to a scientific journal for consideration for publication;
        ii. Copies (reprints) of all publications resulting from a project permitted on the Unit; and
        iii. At the conclusion of the project, raw data in a format negotiated with Unit staff.

24. All samples collected on Unit 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).

25. In all written and oral presentations resulting from projects on the Unit, researchers would be required to appropriately cite and acknowledge the U.S. Fish and Wildlife Service National Wildlife Refuge System, Billy Frank Jr. Nisqually National Wildlife Unit, and Unit staff and other Service personnel who supported or contributed to the project.

26. The Unit would monitor compliance with the stipulations and SUP conditions, habitat quantity and quality, wildlife use and productivity, water quality, cultural resources, Unit facilities, other Unit public uses, and other relevant endpoints to determine if stipulations

associated with research, surveys, and scientific collections were resulting in expected and desirable outcomes. In consultation with researchers, the Unit would apply adaptive management principles to modify stipulations or adjust objectives, as necessary, to achieve desirable results. In the event that modified stipulations or adjusted objectives did not adequately address the situation, the refuge manager could temporarily or permanently withdraw official permission to continue research, surveys, or scientific collections on the Unit. Permission could also be withdrawn for other legitimate reasons. Permits could be revoked with 30 days or less written notice.

27. The Unit would reserve the right to add to or otherwise modify the stipulations listed herein in order to ensure the continued compatibility of this use. New or modified stipulations would be instituted as a result of ongoing or new studies; new legal, regulatory, or policy requirements; significant changes to the Unit environment or status of native fish, wildlife, plants, or their habitats; as a result of mutual agreement with researchers; or for other legitimate reason. Researchers would be advised of new or significantly modified stipulations at least 90 days prior to their becoming effective.

Justification:

Almost all research, scientific collecting, and surveys on refuge lands are inherently valuable to the Service because they would expand scientific information available for resource management decisions about fish, wildlife, plants, their habitats, cultural resources, and/or public use.

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 would be authorized on Unit lands. In many cases, if it were not for the Unit staff providing access to Unit lands and waters along with some support, the project would not occur and less scientific information would be available to the Service to aid in managing and conserving the Unit 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 would find sufficient food resources and resting places so their abundance and use would not be measurably lessened on the Unit. Additionally, it is anticipated that monitoring, as needed, would prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats. As a result, these projects would not materially interfere with or detract from fulfilling Unit purpose(s) (including wilderness); contributing to the mission of the NWRS; and maintaining the biological integrity, diversity, and environmental health of the Unit.

Compatibility Standard

Authorizing research, surveys, and scientific collections is directly supportive of one of the Unit's draft goals, but these activities could cause some wildlife disturbance and other effects. In order to be allowed on the Unit, these uses would need to be determined compatible. By allowing these uses to occur under the stipulations described above, it is anticipated that wildlife which were disturbed would find sufficient food resources and resting places so their abundance and use would not be measurably lessened on the Unit. Additionally, it is anticipated that monitoring, as needed, would prevent unacceptable or irreversible impacts to fish, wildlife, plants, their habitats, cultural resources, and public use. For the several reasons stated above and consistent with the stipulations described herein, this use would not materially interfere with or detract from maintenance of the Unit's biological integrity, diversity, and environmental health; fulfillment of the Black River Unit's purposes; or the Refuge System's mission.

Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for "allowed" uses only)

_____ 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 Unit 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

This compatibility determination has being developed and issued concurrent with the CCP and EA for Grays Harbor NWR and the Black River Unit.

Compatibility Determination for Research, Surveys, and Scientific Collections at Black River Unit:

Unit Determination

Prepared by: _____
(Signature) (Date)

Approved by Project Leader, Billy Frank Jr. Nisqually National Wildlife Unit Complex: _____
(Signature) (Date)

Concurrence

Unit Supervisor: _____
(Signature) (Date)

Regional Chief, National Wildlife Refuge System, Pacific Region: _____
(Signature) (Date)

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High-Priority Research, Surveys, and Scientific Projects

Following are examples of high-priority research, survey, and scientific project topics for the Black River Unit. They are not listed in priority order.

- Enhance understanding of Oregon spotted frogs, including habitat use, movements, breeding and rearing locations and requirements, and breeding success. Establish baseline inventory and mapping of oviposition sites and monitor annually.
- Inventory, map, and assess health of bogs and associated biota, including plants and insects.
- Enhance understanding of ecology of bogs and other abiotic and biotic systems within proposed research natural area.
- Enhance understanding of hydrology of Black River and its tributaries, including effects of water control at Black Lake, and the effects of reduced magnitude and frequency of high-flow events.
- Assess water quality and quality in Black River and its tributaries. Identify surface and groundwater withdrawals, impacts from sedimentation, sources and volumes/concentrations of nutrient inputs and effects of these nutrients on water quality; aquatic, marsh, and riparian plant growth (including invasive species); and amphibians.
- Inventory, map, and assess status, areal extent, and effects of exotic, especially invasive species, and determine the most effective methods to remove or otherwise manage such species, including in a riverine environment (including reed canarygrass and bullfrogs).
- Enhance understanding of the habitat and wildlife effects of various management practices, including grazing, haying, and mowing.
- Develop baseline inventory of plant and animal groups on Unit, including small mammals; fish; reptiles and amphibians; insects and pollinators; wetland plants; submerged aquatics; and rare, declining, listed, and Federal and State priority species or species groups.
- Inventory and assess use of Black River and its tributaries by fish, including anadromous and exotic species.
- Design and implement an appropriate climate change monitoring program for the Unit. Assess effects of climate change on Unit habitats and wildlife.

Compatibility Determination

Use: Grazing, Haying, and Mowing.

Unit Name: Black River Unit of Billy Frank Jr. Nisqually National Wildlife Unit, Thurston County, Washington

Establishing and Acquisition Authorities:

Migratory Bird Conservation Act of 1929, as amended (16 U.S.C. 715-715r)

Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742m)

Unit Purposes:

> . . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds (16 U.S.C. 715-715r).
>
> . . . 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)).

National Wildlife Refuge System (Refuge System or NWRS) Mission:

> "The mission of the [National Wildlife Unit] 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).

Description of Use(s):

This compatibility determination (CD) addresses grazing, haying, and mowing in the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Unit (Unit). As used herein, grazing involves domestic livestock feeding on native or nonnative vegetation. Grazing can include trailing and watering of livestock. Species of livestock potentially used for grazing on the Unit include cattle (*Bos primigenius*) and goats (*Capra aegagrus hircus*) or horses (*Equus ferus caballus*).

On multiple-use public lands (e.g., those managed by the U.S. Forest Service or U.S. Bureau of Land Management), grazing is one of several management purposes. However, on almost all national wildlife refuges, including this Unit, grazing is not a purpose and would instead be used as a management tool to achieve conservation purposes, such as enhancement of wildlife habitat values or control of invasive plants.

Haying involves the cutting or mowing, bailing, and curing of vegetation for livestock fodder. Mowing involves open field cutting, but not removal of vegetation. Haying and mowing on the Unit would also be for purposes like those just mentioned. Grazing, haying, and mowing occurred on a number of parcels prior to these lands becoming the Unit to provide for livestock, to keep open areas of grass, and to control invasive plant species.

There have been grazing, haying, and mowing programs on the Black River Unit-owned parcels since 2001 At present, one or more of these habitat management practices occur on approximately 165 acres of either upland dry, nonnative grasslands, seasonally flooded, nonnative grasslands, and some emergent wetlands. These practices are conducted consistent with cooperative land management agreements (CLMAs) which are authorized under Federal regulations (50 C.F.R. 29.2).

It is anticipated that the program would initially include approximately165 acres, but the total number of acres treated could increase or decrease seasonally, annually, or otherwise depending on Unit habitat management needs and the addition of new lands to the Unit. If all the currently owned upland dry, nonnative grasslands; seasonally flooded, nonnative grasslands; and emergent marshes were treated using these management techniques, it would be nearly 300 acres.

Grazing and mowing are proposed for more than 82 acres of the Unit's seasonally flooded, nonnative grasslands. Additional acres may be included as parcels are added to the Unit. This habitat supports migratory and marsh birds, many amphibian species, Oregon spotted frog (OSF, *Rana pretiosa*), and other wildlife species. Management is especially challenged by the widespread presence of invasive reed canarygrass (*Phalaris arundinacea*).

Grazing, haying, and mowing are also proposed for more than 35 acres of emergent marshes. This habitat supports migratory and marsh birds, amphibians, other wildlife species, and potentially supports water howellia (*Howellia aquatilis*). Emergent marsh is very important for the Oregon spotted frog. Its management is challenged by the widespread presence of invasive reed canarygrass.

Grazing, haying, and mowing are also proposed for more than 163 acres of upland dry, nonnative grasslands. It is possible some of these grasslands may have been maintained through prescribed burning by Native Americans. The purposes of employing grazing, haying, and mowing practices would be to maintain and enhance a mosaic of open and short, early successional grasslands and forbs (2 to 12 inches in height), an occasional large, cavity-producing tree (e.g., big leaf maple [*Acer macrophyllum*] or Garry oak [*Quercus garryana*]), and borders of native shrubs. This habitat supports Roosevelt elk (*Cervus elaphus roosevelti*); black-tailed deer (*Odocoileus hemionus columbianus*); bats; small mammals; western meadowlark (*Sturnella neglecta*) and killdeer plover (*Charadruis vociferus*); raptors such as American kestrel (*Falco sparverius*), hawks, and owls; American wigeon (*Anas americana*) and geese; cavity-nesting birds; pollinators such as hummingbirds, butterflies, and moths; and possibly streaked horned lark (*Eremophila alpestris strigata*, proposed for listing as a threatened species under the Endangered Species Act, 16 U.S.C. 1531-1544). Invasive plants of concern in upland grasslands include Himalayan and evergreen blackberries (*Rubus armeniacus* and *Rubus acinatus*), Scotch broom (*Cytisus scoparius*), common burdock (*Arctium minus*), common teasel (*Dipsacus fullonum*), and Canada and bull thistle (*Cirsium arvense* and *Cirsium vulgare*).

Haying or mowing would be conducted seasonally, generally from late April or early May through October. Grazing, as a tool, could be used year-round as needed to control invasive plants and

provide appropriate habitat structure for wildlife, especially for Oregon spotted frog. The herbivores could be temporarily removed or rotated out of specific areas as needed. These practices would often be implemented along with an array of other habitat management techniques, such as placement of barrier cloth, hand cutting, fertilizing, prescribed fire, herbicide treatment, planting, seeding, and water control.

These activities are considered specialized uses under U.S. Fish and Wildlife Service (Service) policy (USFWS 1986). Federal regulations consider grazing and haying to be economic uses (see May we allow economic uses on national wildlife refuges? 50 C.F.R. 29.1). Grazing, haying, and mowing on the Unit would be authorized through special use permits (SUPs), cooperative farming agreements, CLMAs, contracts, or similar agreements. Before being allowed on the Unit, these uses would first need to be found appropriate (USFWS 2006) and then be determined compatible (USFWS 2000).

This CD has been developed and made publicly available concurrent with the comprehensive conservation plan (CCP) and associated environmental assessment (EA) for Grays Harbor NWR and the Black River Unit. Much of the information and some of the analyses contained in this CD are addressed in greater detail in the CCP and EA. The CCP and EA are incorporated through reference herein.

Availability of Resources:

The Service seeks to recover its costs associated with administration of specialized uses and/or charge a fee equal to the fair market value of the benefit received by the user (see 5 RM 17).

Applicable administrative costs include both direct and indirect costs, such as:

- Costs associated with construction, repair, operation, and maintenance of associated facilities;
- Salaries and associated employee expenses related to evaluation of the proposed use (including appropriateness finding, compatibility determination, and compliance with applicable laws, regulations, and policies such as the National Environmental Policy Act [42 U.S.C. 4321-4347], Endangered Species Act [16 U.S.C. 1531-1544], and National Historic Preservation Act[16 U.S.C. 470]) and development of the grazing permit or agreement;
- Salaries and associated employee expenses related to monitoring of this use to ensure that permit/agreement requirements are followed and that the use remains compatible. This includes evaluation of the effects of grazing, haying, and mowing on the Unit's natural and cultural resources, and compatible, especially wildlife-dependent, public use;
- Use-related supplies, equipment, and travel; and
- An applicable portion of Unit overhead costs.

At the discretion of the Service, grazing permittees could be required to install temporary or construct permanent grazing-related facilities. Grazing fees and/or CLMA in-kind requirements would be adjusted accordingly. Following is an estimate of one-time costs associated with implementation of proposed grazing program.

Table B-9. Costs to Administer and Manage Grazing, Haying, and Mowing under the Preferred Alternative

Projects	One-time Costs	Recurring Costs per/year
Administration and oversight of grazing, haying, and mowing		5,000
Monitoring		1,000
Maintenance		3,000
Total Costs		9,000

Fee revenues collected would not be retained by the Unit. Instead, these monies would be deposited into the U.S. Treasury Department's National Wildlife Refuge Fund. Monies from this fund are used for redistribution to refuges to help offset the costs of administering specialized uses (Expenses for Sales) and for payments in lieu of taxes to counties or other local governments (under the Unit Revenue Sharing Act [16. U.S.C. 715s]).

Alternately, instead of charging a permittee a fee for grazing, haying, or mowing on the Unit, the Service and permittee could enter into a CLMA. This would allow the permittee to provide share-in-kind services to the Unit that, depending on their value, could reduce or eliminate their grazing, hazing, or mowing fee. Because mowing would not generate a marketable commodity for the permittee, the Service could either contract for this work or include mowing as one of the share-in-kind services to be provided by the permittee as part of a grazing and/or haying CLMA. Repair or maintenance of fences or gates or other similar work could also be included in a CLMA.

The proposed Unit annual operations budget will support the annual costs (staff) associated with the proposed grazing, haying, and mowing program on the Unit.

Anticipated Impacts of the Use(s):

Unit Goals and NWRS Mission

The management direction of the Black River Unit is guided by the protection of biological diversity and enhancement and management of a valuable wetland ecosystem for the benefit of anadromous salmonid production, migratory birds, and other wetland-dependent wildlife (USFWS 1996). The Unit has developed the following six draft goals as part of its comprehensive conservation planning process.

1. Protect, maintain, and enhance aquatic habitats characteristic of the upper Black River Watershed while maintaining historical characteristics of the north Puget Trough Lowlands for the benefit of native fish, amphibians, migratory birds, and a diverse assemblage of other native species.
2. Protect and maintain upland habitats characteristic of the upper Black River watershed.
3. Contribute to the protection and long-term environmental health of the greater Black River watershed and ecosystem.
4. Gather scientific information (inventories, monitoring, and research) necessary to support adaptive management decisions.
5. Provide quality opportunities for visitors to observe and photograph a diversity of wildlife and habitats to enhance their understanding and appreciation of the Unit's natural resources and foster a connection with nature.

6. Support and develop an active volunteer program and partnerships to assist in providing quality visitor services programs and outreach.

Properly managed grazing, haying, and mowing would directly support draft Unit goal numbers 1, 2, 3, and 4.

Fish, Wildlife, Plants, and Their Habitats

The Black River is a tributary to the Chehalis River which drains to the Pacific Ocean through Grays Harbor. Slow-moving Black River and surrounding wetlands form the most intact lowland river system remaining in western Washington. The Unit includes upland forest, riparian forest, grassland, various wetland types, including shrub swamp and rare sphagnum bog, and aquatic systems.

The river, tributaries, wetlands, grasslands, shrub swamps, and forests support a diversity of resident and migratory wildlife species. Wildlife species of special management concern at the Unit include salmonids such as steelhead trout (*Oncorhynchus mykiss*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), coho salmon (*Oncorhynchus kisutch*), and Chinook salmon (*Oncorhynchus tshawytscha*), which use Black River and its tributaries for migration, spawning, and rearing. Many species of frogs, salmanders, and newts are found in the mosaic of wetlands. River otter (*Lutra canadensis*), mink (*Mustela vison*), muskrat *(Ondatra zibethicus)*, and beaver *(Castor canadensis)* can be seen in Black River; a herd of Roosevelt elk (*Cervus elaphus roosevelti)* graze in Unit grasslands. Ducks, geese, and grebes; rails, bitterns, herons; raptors; and neotropical songbirds occur throughout the Unit.

Unit management focuses on protecting, restoring, and maintaining quality habitats—especially freshwater streams, bogs and emergent marshes, and upland grasslands—for a diversity of native wildlife and plant species, including those that are rare and declining. The Unit provides valuable habitat for an endemic, state sensitive species, the Olympic mud minnow (*Novumbra hubbsi*) and the State-endangered and federally threatened species Oregon spotted frog (*Rana pretiosa*). The frog is known to occur in three subbasins in the State, and in two locations on the Unit. It is suspected that the Unit may support rare bog-adapted insects, federally endangered water howellia (*Howellia aquatilis*) and possibly the streaked horned lark (*Eremophila alpestris*), proposed for listing under the Federal Endangered Species Act (16 U.S.C. 1531-1544).

Invasive species of actual or potential concern include reed canarygrass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), knotweed (*Polygonum species*), yellow-flag iris *(Iris pseudacorus),* Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), holly (*Ilex spp.),* New Zealand mudsnail (*Potamopyrgus antipodarum*), feral cat (*Felis catus*), bullfrog (*Rana catesbeiana*), and various warm water fish species.

Livestock grazing, haying, and mowing can be valuable techniques to manage grassland and marsh habitats. In the absence of livestock grazing, haying, mowing, or fire, or with insufficient grazing and browsing by wild herbivores, pasture and marsh grasses can grow tall and rank, and can accumulate substantial thatch. This reduces the values of these habitats for grazing and browsing animals, small animal movements and escape, ground-nesting birds, amphibian breeding and egg placement, juvenile movement, and can create a competitive advantage for invasive plants. Properly managed livestock grazing can diversify grassland habitats (e.g., by reducing vegetation height, removing standing herbage to increase the availability of succulent forbs, and increasing the diversity of insect

prey) to benefit certain ground-nesting songbirds, waterfowl, gallinaceous birds, rodents, and rabbits. It can increase the use of grasslands by foraging and loafing cranes and geese and can increase the palatability of forage on elk winter ranges. It can reduce the density and extent of invasive weeds and potentially allow a more diverse and palatable assemblage of native species to thrive and provide forage and cover for wildlife. It can help create the plant successional stage appropriate for target wildlife species (Drawe et al. 2006; Fenster 2006; Johnson-Nistler and Knight 2006; Krausman et al. 2009; Mini and LeValley 2006; Stoneberg 2006). Grazing and haying can remove thatch, and grazing, haying, and mowing can all increase native plant vigor, stimulate new native plant growth, improve habitat and vegetation structure for native amphibians, reduce encroachment of woody plants, and help reduce the presence of invasive plant species.

However, unless properly managed, these habitat management practices can cause a variety of undesirable effects. Kirby et al. (1992), Krausman et al. (2009), and the U.S. Environmental Protection Agency (USEPA 1994) reviewed numerous studies that evaluated the environmental effects, including the effects upon fish, wildlife, plants, and their habitats, of grazing. When stocking rates are too high or rotation among pastures is not frequent enough, livestock can overgraze pastures causing long-term damage to vegetation and soils. When grazing increases, vegetation diversity decreases, and heavy, long-term, continuous grazing is detrimental to almost all wildlife populations. Livestock can also graze pastures unevenly, can create less-dense vegetation in some areas, increasing the exposure of ground-nesting breeding birds and their eggs to predation, and can graze down and reduce recruitment of desirable riparian shrubs and trees, adversely affecting wildlife use of these valuable habitat components. Livestock (in drier areas than western Washington) are drawn to water and grazing in adjacent riparian and wetland areas can cause vegetation trampling, soil compaction, erosion, and an increase in stream temperature due to loss of plant cover and shading. Areas surrounding water troughs and salt blocks, corrals, and loading ramps can be denuded by trampling and experience soil compaction. Heavy livestock grazing or grazing on wet or unstable soils or in streams can lead to stream bank damage, siltation from erosion of shorelines or through stirring up stream bottom sediments, and nutrient loading due to livestock defecating or urinating into the water or on adjacent lands where it is washed into the water. These effects would all impact water quality and could adversely affect fish and amphibians. They can also cause down-cutting of stream channels and lowering of water tables. Livestock can also facilitate introduction of alien, including invasive, species (e.g., through seeds carried in hair, on vehicles and farm machinery, and in feces) and disease (e.g., brucellosis). Livestock fencing can hinder movements by some wildlife species.

Cattle grazing can also affect deer and elk though competition for forage. Cattle primarily graze grass, a preferred elk food, until mid to late summer when grass can become scarcer, and then cattle may increase their intake of browse, a preferred food of deer that is especially important during the winter. Whether to avoid forage competition or for other reasons, some studies have found that deer and elk avoid grazing cattle and grazed range in some situations, although other studies suggest possible habituation in other situations (Chaikina 2006; Drawe et al. 2006).

Haying or mowing can also impact wildlife and their habitats. If haying or mowing occurs during the nesting season (primarily April 1 to July 15), the nests, eggs, and young of ground-nesting birds can be injured or lost. Haying removes vegetation and nutrients from managed fields and long-term haying can require the application of fertilizer to compensate for lost nutrients. If grass is mowed when it is too high or too thick, the result can be an undesirably thick layer of long clippings lying on top of the cut grass.

Grazing, haying, and mowing-related activities (e.g., transporting livestock or haying/mowing equipment, moving water and salt, fence and gate maintenance and repair, monitoring) would be potential sources of wildlife disturbance. Human disturbance has differential effects on wildlife and is dependent upon, among other variables, the species involved and its age; the time of year; the breeding cycle stage (if applicable); the surrounding environment; whether the activity involves vehicles; the intensity, speed, noise, nature, and frequency of the disturbing activity; and the directness of approach to an animal (Blanc et al. 2006; Goss-Custard and Verboven 1993; Holmes et al. 2005; Hammitt and Cole 1998; Kirby et al. 1993; Knight and Cole 1995a; Knight and Cole, 1995b; Lafferty 2001a). Disturbance can cause animals stress and alter their normal behavior; cause them to stop feeding; cause abandonment of nests and young; and allow predators access to nests and young, reduce parental attention to young, and otherwise impact survival of individual birds, eggs, nestlings, or broods (Burger and Gochfeld, 1991; Haysmith and Hunt, 1995; Lafferty, 2001b). The effects of disturbance on individual animals are likely additive.

Naylor et al. (2009) examined the effects of four types of off-road recreational disturbance (all-terrain vehicle riding, mountain biking, hiking, and horseback riding) on North American elk (*Cervus elaphus*) in northeast Oregon. They found that all types of disturbance studied affected elk behavior. Hiking generally caused an increase in the time elk traveled, especially in the morning; resulted in a decrease in resting time; and had no effect on time spent feeding. Ciuti et al. (2012) studied the effects of various human disturbances (e.g., hiking, biking, horseback riding, hunting, fishing, riding all-terrain vehicles, general vehicle traffic, and roads) in various landscapes with different management programs in southwest Alberta. They also found that hiking caused elk travel time to increase and that an increase in the number of hikers caused an increase in travel behavior in elk. Behavioral responses of tule elk (*Cervus elaphus nannodes*) to off-trail hikers and off-shore boats were investigated by Becker et al. (2012) at Point Reyes National Seashore, California. They learned that elk exhibiting rutting behavior and those in the presence of off-trail hikers displayed the most disturbance behaviors (i.e., head up, stand, move off, run, or alarm cry). Elk were more sensitive to human disturbance when herd sizes were smaller (<15 animals).

Studies have had mixed results regarding potential habituation of birds and some other taxa to human disturbance. Wildlife are often less disturbed by routine human activities that repeatedly occur along defined routes (e.g., trails, roads, or water channels), especially frequent disturbance that does not involve direct contact or other threat, compared with those activities that occur irregularly and outside predictable paths/channels (Blanc et al. 2006; Burger 1998; Holmes et al. 2007; Knight and Cole 1995b; Smit and Visser 1993). Some species can habituate to the presence of humans who stay in the same general location and remain relatively still (Goss-Custard and Verboven 1993; Smit and Visser 1993). Habituation to some types and levels (intensity and frequency) of human disturbance appears to vary among species, within species, between resident and migratory populations, and potentially between inexperienced and experienced breeders. This makes it difficult to forecast habituation in actual field situations.

Disturbance levels would be expected to be highest when the livestock program was initially established, when turn-outs or round-ups occurred, and when haying and mowing were conducted. These potential disturbances would be infrequent and short-lived. In the absence of human and other activity, wildlife might acclimate to the presence of grazing livestock. There could be differential effects to ground-nesting birds. Livestock could destroy nests or eggs, or injure or kill young birds by stepping on them. It is unclear whether such birds would appropriately alter their nesting habits in the presence of livestock or how great of a problem this could be. This would be addressed through the monitoring program.

Properly managed grazing, haying, and mowing would be expected to increase the value of Unit grasslands and marshes for grazing and ground-nesting species of wildlife. When combined with other management techniques (e.g., planting, seeding, prescribed fire, and herbicides) careful use of prescribed grazing, haying, and mowing would help set back succession and enhance the mix of native versus nonnative species in the Unit's savannah-like habitats. Because they lack the proper soils, these grasslands are not prairies. However, proper management of these savannah-like areas could create habitats to support a diversity of native wildlife, including prairie-species such as Roosevelt elk; black-tailed deer; bats; small mammals; western meadowlark and killdeer plover; raptors such as American kestrel and owls; American wigeon and geese; cavity-nesting birds; pollinators such as hummingbirds, butterflies, and moths; and possibly streaked horned lark. These management practices could also be used to increase the interspersion of water and plants in overgrown wetlands or those choked with invasive species. An example would be the grazing or mowing of dense stands of reed canarygrass to reduce their height and density and open up areas to re-create habitat that allows for animal movement into and out of breeding and egg laying habitats, rearing habitats, foraging areas, and much improved sanctuary sites for Oregon spotted frogs. Other benefitting species would include other amphibans, small aquatic mammals, migratory and resident waterfowl and marsh birds, and potentially water howellia.

The Service would implement management practices to reduce the adverse and encourage the beneficial effects of grazing. These include slow movement of heavy equipment, possibly using single-wire electric fencing, cross fencing, pasture rotations, seasonal grazing and other rotational grazing systems, desired animal unit months (grazing intensity), and in-pasture placement of salt blocks and water troughs to deter livestock from riparian areas and to spread out and target grazing pressure. Because of different physical and biological characteristics, different vegetation responses to these proposed habitat management techniques, and different management objectives, it is probable that the grazing, haying, and mowing programs in the grasslands will differ from those employed in the marshes.

Public Use

The Unit is closed to general public use, so grazing, haying, and mowing would have no effects on other visitors. However, subject to evaluations for compatibility, it is proposed that the Unit also be opened for wildlife observation, photography, interpretation, and research.

The presence of grazing livestock, fencing, corrals, loading ramps, and perhaps dung and associated insects could adversely affect the quality of experience for some who visited the Unit for wildlife observation, photography, or interpretation. Workers conducting grazing, haying, or mowing programs could flush wildlife from treatment sites and reduce or enhance their observation or photography by Unit visitors. Activities associated with these management programs would not be ongoing and these effects would be infrequent. As noted above, it is expected that the larger effect of these proposed uses would be an improvement of upland and seasonally flooded grasslands and marsh habitats and an increase in abundance and/or diversity of wildlife using these habitats. This would enhance observation and photography opportunities.

Cultural Resources and Values

To date, few cultural resource surveys have been conducted on the Unit. There are no recorded archaeological sites, but some buildings and associated structures are of historic value. By themselves, grazing, haying, mowing, and temporary grazing facilities would not be expected to have

adverse effects on cultural resources. However, if more permanent grazing facilities were constructed, they could impact cultural resources. Prior to construction of any new facilities, the Service would undertake appropriate surveys and engage in consultations consistent with requirements of the National Historic Preservation Act (16 U.S.C. 470). This process would result in avoiding, minimizing, and/or mitigating any potential effects.

Public Review and Comment:

Public availability of this CD has been widely announced together with announcement of the availability of the Unit's draft CCP. The review and comment period has also been the same as for the draft CCP.

Determination: (check one below)

___ Use is Not Compatible

_X_ Use is Compatible with following Stipulations

Stipulations Necessary to Ensure Compatibility:

General

1. In addition to the stipulations listed here, the general permit conditions and requirements, and the special permit conditions, permittees and their employees would be required to comply with Refuge System-related and other applicable laws, regulations, and policies including "Prohibited Acts" listed in the Code of Federal Regulations (50 C.F.R. 27).

2. Permission to graze, hay, or mow on the Unit would be officially authorized through issuance of an SUP, cooperative farming agreement, CLMA, contract, or other agreement. Permits or agreements would include a plan that described what was to be done, conditions associated with this work, and the intended outcome. Permits or agreements would generally be issued on an annual basis, with a renewal option for up to a total of 5 years. Annual renewals would depend on compliance with these stipulations and conditions of any permit or agreement and the results of monitoring data demonstrating the value of the grazing program for target habitats and wildlife. Consistent with Service policy (5 RM 17), fees for permits or agreements would reflect fair market values. Permittees would be prohibited from transferring, assigning, or sub-permitting their Unit grazing authorizations.

3. Grazing, haying, and mowing management tools would be designed to protect sensitive habitats, wildlife species, and cultural resources while still securing needed treatments to enhance grasslands, marshes, and retard invasive plants. Rotational grazing or other systems would be used to avoid over-grazing treatment sites. As needed, specific areas would be avoided through fencing or other means. Off-stream water supplies would be provided to avoid grazing-related impacts to stream banks, erosion, sedimentation, and water pollution. In order to minimize or avoid impacts to ground-nesting birds, haying and mowing would be scheduled to occur outside the nesting season, after July 15. Specific plans tied to each permit/agreement would be developed for each site and each management practice and include timing and location of grazing, haying, or mowing; treatment objectives (e.g., vegetation height and evenness of grazing, grazing stocking densities), types of livestock

permitted, access locations, restrictions on use of pesticides (including herbicides and insecticides) and predator management, and authorized personnel and equipment. Specific conditions may vary annually or seasonally due to differences in objectives, habitat conditions, or weather.

4. Permittees would work out details with the Unit regarding transporting livestock, moving them, and removing them from the Unit; for erecting, maintaining, moving, and removing all needed structures, including fences, gates, cattle guards, corrals, and loading ramps; and for satisfying livestock water and salt needs, consistent with the grazing plan. Grazers would be required to maintain accurate written records on livestock numbers in each treatment area and turn-in, turn-out dates, and provide those records to the refuge manager upon request. Permittees could be required to use single-wire electric fences. With the exception of livestock fences, associated gates, watering troughs, and other grazing related structures specifically described in the grazing plan (see below), grazers would be prohibited from constructing new or maintaining existing structures on the Unit without specific, prior written approval of the refuge manager.

5. Permittees would be required to move heavy equipment (including large trucks and trailers) slowly and carefully while on the Unit. Prior to arrival on the Unit, permittees would be required to clean equipment of nonnative plant and animal matter. Subject to inspection of treatment sites for weed species, permittees may be required to provide livestock with certified weed-free feed for 48 hours prior to arrival at the Unit.

6. The Unit would be open for access and use by permittees daily, year-round, from sunrise to sunset. Special permission to access or use the Unit outside these hours could be authorized by the refuge manager on a case-by-case basis. Permittees would be required to restrict their activities and access on the Unit to their permit areas, the access roads depicted on the attached map, and other areas open to the general public.

7. Grazed pastures would be fenced and gated or animals would need to be otherwise adequately confined or constrained. Grazing permittees would be responsible for ensuring that gates were closed and livestock were not allowed to roam across the Unit or onto neighboring lands outside the pasture fences. Grazers would be responsible for locating and removing livestock that had strayed from fenced pastures within 24 hours of notification by Unit staff. Grazers would be responsible for surveying fences and gates to identify breaks or other problems, and for making needed repairs in a timely fashion. Livestock would need to be removed from the treatment area or Unit within 48 hours of a request from the refuge manager.

8. Grazers may desire the use of pesticides for control of pest plants or diseases and pests of livestock. Prior to application, use of all pesticides (including uses of herbicides, fungicides, and insecticides) would require Service approval. This would involve grazers submitting to the refuge manager a completed Pesticide Use Proposal (PUP) for each proposed pesticide use. These PUPs would need to be submitted at least 90 days prior to proposed use of the pesticide to allow adequate time for evaluation and processing. All pesticides would need to be applied by qualified applicators and consistent with pesticide label restrictions or as modified by a special needs restriction approved by the U.S. Environmental Protection Agency.

9. Approved PUPs would authorize pesticide application for a period of 1 year. If the Service developed and secured approval of an Integrated Pest Management (IPM) Plan for the Unit, the PUPs addressed therein would be valid for 3 years.

10. Application of fertilizers or soil enhancements would require prior approval from the refuge manager.

11. Desirable trees in savannah-like habitats would be protected from potential grazing, haying, or mowing impacts through use of tree collars, fencing, or other techniques.

12. Grazing permittees would be allowed to bring dogs or other guard animals (e.g., llamas) onto the Unit if they were needed to manage livestock (e.g., rounding up, loading, or unloading livestock). However, in order to avoid harassment, disease, and/or death of native wildlife or transport of exotic or invasive plant parts, insects, or other undesirable species, the use of dogs would be limited to grazing pastures and associated loading and unloading areas, and to rounding up trespass livestock, as necessary. Permittees would be prohibited from bringing any other types of pets onto the Unit. The exceptions would be legitimate, leashed guide animals.

13. Consistent with applicable Federal regulations (see Introduction of plants and animals, 50 C.F.R. 27.52), permittees would be prohibited from introducing plants, animals, or invertebrates onto the Unit without specific, prior written approval of the refuge manager. This would not include domestic livestock participating in a permitted grazing program.

14. In the absence of specific, prior written approval of the refuge manager, permittees and their employees would be prohibited from disturbing, collecting, or removing any archaeological or historic artifacts, abiotic or biological specimens or samples, or mementos from the Unit.

15. Consistent with Service policy regarding management of nonhazardous solid waste on refuges (USFWS 2001), permittees would be prohibited from littering, dumping refuse, abandoning equipment or materials, or otherwise discarding any items on the Unit.

16. Permittees would be required to hold the United States Government harmless from any damages or injury to the permittee, their employees, or members of the general public in areas and facilities accessed via the terms of their permit.

17. The Unit would establish a program to monitor compliance with the stipulations enumerated herein and conditions associated with grazing-, haying-, or mowing-related permits, contracts, or agreements.

18. No changes could be made to any of these stipulations without specific, prior written approval of the refuge manager.

Justification:

Grazing, haying, and mowing are not wildlife-dependent general public uses; however, when properly managed, these habitat management practices would be expected to increase the value of Unit grasslands and marshes for a diversity of wildlife species, including grazing animals, small mammals, bats, ground-nesting birds, raptors, marsh birds, waterbirds, waterfowl, amphibians, and

potentially rare species like Oregon spotted frog, streaked horned lark, and water howellia. Grazing, haying, and mowing would help set back succession and enhance the mix of native versus nonnative species in the Unit's savannah-like habitats. In marshes, these management practices would increase interspersion of water and plants in overgrown wetlands or those choked with invasive species, and enhance breeding and sanctuary areas. Thus, allowing haying, mowing, and grazing on the Unit is found to be in support of the purposes for establishment of the Unit and the mission of the Refuge System.

Compatibility Standard

The Service would use permits or agreements to authorize grazing, haying, or mowing on the Unit. These permits or agreements would include a plan that described what was to be done, conditions associated with this work, and the intended outcome. Examples of conditions include protection of sensitive habitats, wildlife species, cultural resources, and private property through use of fencing or other constraints, tree collars, and providing off-stream water supplies and possibly salt blocks for livestock; use of seasonal and rotational grazing or other systems, and limitations on stocking densities to avoid over grazing treatment sites; restrictions on use of pesticides, fertilizers, and predator management; and scheduling haying and mowing after the nesting season for ground-nesting birds. When combined with the stipulations included herein, these permit conditions would be expected to significantly reduce potential adverse effects and enhance beneficial effects of these habitat management practices.

The Unit would monitor wildlife and habitat disturbance, and other potential impacts to determine if these stipulations and conditions were resulting in expected and desirable outcomes. The Unit would apply adaptive management principles to modify stipulations or adjust objectives, as necessary, to achieve desirable results (see USDI 2008 and Williams et al., 2009).

The Unit would reserve the right to add to or otherwise modify the stipulations listed herein in order to ensure the continued compatibility of these uses. New or modified stipulations could be instituted as a result of new information generated by ongoing or new studies; new legal, regulatory, or policy requirements; significant changes to the Unit environment or status of native fish, wildlife, plants, or their habitats; or for other legitimate reasons. Visitors would be appropriately advised of any such changes.

The Unit would also reserve the right to terminate permission for these uses if individuals were violating Unit rules or regulations; if unacceptable impacts were occurring to native fish, wildlife, plants, or their habitats, cultural resources or Unit facilities, or other Unit visitors; or for other legitimate reasons.

In order to be allowed on the Unit, grazing, haying, and mowing would need to be determined compatible. By allowing these uses to occur under the stipulations described above, it is anticipated that wildlife which were disturbed would find sufficient food resources and resting places so their abundance and use would not be measurably lessened on the Unit. Additionally, it is anticipated that monitoring, as needed, would prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats; other public uses; cultural resources; Unit facilities; and private lands. For the several reasons stated above and consistent with the stipulations described herein, this use would not materially interfere with or detract from maintenance of the Unit's biological integrity, diversity, and environmental health; fulfillment of the Black River Unit's purposes; or the Refuge System's mission.

Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for "allowed" uses only)

_____ 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 Unit 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

This compatibility determination has being developed and issued concurrent with the CCP and EA for Grays Harbor NWR and the Black River Unit.

Compatibility Determination for Grazing, Haying, and Mowing at Black River Unit.

Unit Determination

Prepared by: _____
(Signature) (Date)

Approved by Project Leader, Billy Frank Jr. Nisqually National Wildlife Unit Complex: _____
(Signature) (Date)

Concurrence

Unit Supervisor: _____
(Signature) (Date)

Regional Chief, National Wildlife Refuge System, Pacific Region: _____
(Signature) (Date)

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Appendix C. Implementation

C.1 Introduction

Implementation of the comprehensive conservation plan (CCP) would require increased funding, which would 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 would be made available to implement any of these projects. Activities and projects identified would be implemented as funds become available.

The CCP proposes several projects to be implemented over the next 15 years. Some of these projects would be included in the Refuge Operational Needs System (RONS) and accomplished by permanent and temporary staffing, volunteers, and partnerships. Operational management includes staffing; maintenance; and managing public use, cultural resources, biology, administration, and habitat/wildlife restoration and maintenance management programs, both on- and off-Refuge.

The Service Asset Maintenance and Management System (SAMMS) tracks deferred maintenance projects such as boardwalk and fence maintenance, roads and parking areas, and existing buildings. All funding for these types of projects is from Congress and the SAMMS database is used to prioritize and track the projects nationwide.

Neither Grays Harbor NWR nor the Black River Unit has independent budgets. Instead, funding is combined with Billy Frank Jr. Nisqually NWR into the Nisqually NWR Complex budget. Funding is spent on Grays Harbor NWR and the Black River Unit as prioritized projects and needs arise.

C.1.1 Grays Harbor National Wildlife Refuge

New public use facility construction and prioritized staffing would be identified in the RONS database and would be necessary to implement the CCP to meet goals and objectives.

Currently, a backlog of maintenance needs exists for Grays Harbor NWR. In 2015, the deferred maintenance backlog for Grays Harbor NWR was $154,000. An attempt at reducing this backlog needs to be addressed and is included here in the analysis of funding needs. The SAMMS database documents and tracks repairs, replacements, and maintenance of facilities and equipment. Funding would be sought for these projects through a variety of sources, and smaller projects would be implemented as funding allows.

In lieu of property taxes, the Refuge annual revenue sharing payments associated with Grays Harbor NWR would continue. Payments to Grays Harbor County have averaged $3,135 annually from Fiscal Years 2011 to 2013. The U.S. Congress each year determines what percent of funds will be appropriated for all appraised Federal lands. Counties are not restricted in the use of these funds. In addition, Grays Harbor NWR has a no-cost lease from the Port of Grays Harbor for 64 acres of wildlife habitat.

Biological assessments and monitoring activities would be conducted on as many projects as funding allows to document wildlife populations and changes across time, habitat conditions, and responses to management practices. Actual monitoring and evaluation procedures would be detailed in an

Inventory and Monitoring Plan. General scientific activities are discussed in Chapter 2 under Goal 4, which addresses the collection of biological information (inventories, monitoring, feasibility studies, assessments, and research) to support adaptive management decisions on Grays Harbor NWR.

Grays Harbor NWR remains in the acquisition stage of development with 1,408 acres of land purchased and 64 acres leased from the Port of Grays Harbor out of 1,851 total acres within the approved boundary. If those lands come up for sale, the Refuge would attempt to acquire them.

C.1.2 Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

New public use facility construction and prioritized staffing needs would be identified in the RONS database and would be necessary to implement the CCP to meet goals and objectives.

Currently, a backlog of maintenance needs, including building removal from recently acquired lands, exists for the Black River Unit. In 2015, the deferred maintenance backlog for the Black River Unit was $913,229, with more projects likely added as new lands are purchased within the Unit acquisition boundary. The SAMMS database documents and tracks repairs, replacements, and maintenance of existing facilities and equipment. Funding would be sought for these projects through a variety of sources, and smaller projects would be implemented as funding allows.

In lieu of property taxes, the Unit annual revenue sharing payments associated with the Black River Unit would continue. Payments to Thurston County for the Black River Unit and portions of the main unit of Billy Frank Jr. Nisqually NWR within the county have averaged $15,721 annually from Fiscal Years 2011 to 2013. The U.S. Congress each year determines what percent of funds will be appropriated for all appraised federal lands. Counties are not restricted in the use of these funds.

Biological assessments and monitoring activities would be conducted on as many projects as funding allows to document wildlife populations and changes across time, habitat conditions, and responses to management practices. Actual monitoring and evaluation procedures would be detailed in an Inventory and Monitoring Plan. General scientific activities are discussed in Chapter 2 under Goal 4, which addresses the collection of biological information (inventories, monitoring, feasibility studies, assessments, and research) to support adaptive management decisions on the Black River Unit.

The Black River Unit is in an acquisition stage of development with 1,577 acres of land purchased out of 3,873 total acres within the approved boundary. The Unit would continue to work with willing landowners to acquire lands within the approved boundary. Funding to purchase these parcels from private landowners, NGOs, other agencies, or corporations is available through funding of the U.S. Congress. Easements would also be utilized to further land conservation.

C.1.3 Spending Priorities

Priorities are designated in Tables C-1 and C-2 for one-time and ongoing (recurring) projects (strategies) identified under the CCP. Priorities are designated as High (H), Medium (M), or Low (L). The rankings were determined according to the following criteria:

- A high-ranked project/strategy is ongoing, needed immediately, or should be considered in the near future to successfully manage habitat and/or public use activities on refuges. It

should directly support Unit purposes, a wildlife-dependent priority public use, and/or restore a threatened or endangered species or rare/unique habitat.

- A medium-ranked project/strategy is of a lesser degree of urgency, but also directly maintains and restores a threatened, endangered, or Service trust species, rare/unique habitat, supports Unit purposes, or is a wildlife-dependent priority public use.
- A low-ranked project/strategy maintains restored habitat or species and/or addresses a wildlife-dependent priority public use activity that is not widely sought out by the public.

C.2 Costs to Implement CCP

Projects listed below were drawn from the goals, objectives, and strategies and would be implemented over the next 15 years as funding and staffing allows. The following sections detail both one-time and operational/maintenance (or recurring) costs for various projects as described within the CCP for Grays Harbor NWR and Black River Unit alternatives.

The following tables primarily document projects with a physically visible, trackable "on-the-ground" component, such as facility development, 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., memoranda of understanding, agreements), reporting, and establishment or maintenance of partnerships are difficult to estimate in advance and thus are not accounted for in the tables below.

To implement the CCP, funding is needed for new or expanded public uses and facilities, increased habitat management and restoration activities, new habitat assessment and monitoring, and staffing to complete the additional activities of Alternative 2.

C.2.1 One-Time and Operational (Recurring) Costs to Implement the CCP by Alternative

One-time Costs

One-time costs reflect initial start-up costs associated with a project. These are projects that can be completed in 3 years or less and may include the cost of temporary or term salaries associated with a short-term project.

Funds for one-time costs would be sought through increases in the Nisqually NWR Complex base funding, special project funds, and grants. Projects listed below in Tables C-1 and C-2 show one-time start-up and implementation costs for the two alternatives, such as those associated with building and facility needs including removal of old structures and buildings, public use facilities, new signs including interpretive signs, road/trail improvements, purchasing new equipment for land management, and contracting for a service or construction. One-time costs are also associated with projects such as specific habitat restoration, species or habitat inventories, surveys and assessments, and initial invasive plant and animal control. 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.

Under all alternatives, the Service proposes to work with other agencies, current and new partners, the community, and others to review the current Grays Harbor NWR nature center plan and to evaluate other options, including alternate funding, sites, and designs, that could lead to a viable plan for the center. As such, estimated costs for an on-Refuge nature center were not included in Table C-1. However, cost estimates (from 2008) for the construction of an approximately 10,000-square-foot building located on 4 acres of the Refuge, including a small administrative space, medium-sized visitor facilities, and an environmental education module, were $1.237 million dollars for architectural and engineering design and $4.948 million for construction.

Table C-1. Grays Harbor NWR One-Time Costs (in thousands) for Habitat Management, Restoration or Enhancement, Biological Assessments (Baseline Inventories, Surveys, and Monitoring), Research, Visitor Services-Related, and Facility Projects Actions.

Project Description	Priority	Current Management	Future Management
Habitat Management, Restoration, or Enhancement			
Initiate knotweed control project in coordination with GH PUD and other weed partners	High	0	25
Restore tidal action to 17 acres of saltmarsh by removing an existing berm	Medium	65	65
Subtotal (thousands)		**65**	**90**
Biological Assessments (Baseline Inventories, Surveys, and Monitoring)			
Develop a biological Inventory and Monitoring Plan	High	15	15
Conduct inventories for invasive animals and plants on the Refuge	Medium	2	10
Inventory and map the extent of native and nonnative eelgrass	Medium	0	20
Monitor and map the health and abundance of sweetgrass stands in relationship to the threats of climate change and sea level rise	Medium	0	15
Plan, coordinate, and conduct shorebird surveys throughout Grays Harbor estuary	Medium	3	25
Subtotal (thousands)		**20**	**85**
Research			
Develop and implement a collaborative research project to investigate rate of sedimentation accretion and effects on Refuge habitats and wildlife use	High	0	50
Assist or support red knot ecological and conservation research on population trends, habitat needs, and develop management measures as appropriate	High	0	5
Investigate the ramifications of nonnative and invasive Japanese eelgrass	High	0	35
Subtotal (thousands)		**0**	**90**
Visitor-Services Related			
Update Wildlife and Plant lists and convert into Service-standard format	Low	0	5

Project Description	Priority	Current Management	Future Management
Subtotal (thousands)		**0**	**5**
Facilities			
Construct new boardwalks and viewing platforms in coordination with the Port of Grays Harbor and FAA	Medium	0	55
Design, construct, and install new interpretive panels and signage on new boardwalks, viewing platforms, and the existing kiosk and parking area	Medium	0	65
Rehabilitate existing Refuge building for use as a maintenance shop to support habitat management and trail and visitor facility maintenance programs	Medium	0	150
Design, construct, build viewing platform at existing kiosk and enhance parking	Medium	0	85
Subtotal (thousands)		**0**	**355**
Total of all one-time project costs		**85**	**625**

Table C-2. Black River Unit One-Time Costs (in thousands) for Habitat Management, Restoration or Enhancement, Biological Assessments (Baseline Inventories, Surveys, and Monitoring), Research, Visitor Services-Related, and Facility Projects Actions.

Project Description	Priority	Current Management	Future Management
Habitat Management, Restoration, or Enhancement			
Remove derelict structures from Unit parcels	High	5	350
Enhance emergent marsh habitat for Oregon spotted frog by managing reed canarygrass	High	2	75
Evaluate and enhance seasonally ponded areas and improve water management capabilities as needed through installation of water control structures, ditch or culvert removal, and improvements to water level management capabilities.	Medium	0	75
Use standard enhancement techniques (riparian plantings, IPM techniques, placement of large woody debris, etc.) as appropriate to improve tributary channel conditions.	Medium	0	30
Evaluate potential for translocation of rare species as appropriate, including marsh sandwort and water howellia, implement recovery actions if warranted	Medium	0	60

Project Description	Priority	Current Management	Future Management
Plant 3–5 big leaf maples and/or Garry oaks where appropriate on approximately 50-acre blocks to provide habitat for cavity-nesting birds and enhance grassland habitat diversity to benefit appropriate species. Protect solitary or interspersed big leaf maple or Garry oak trees within nonnative grasslands by placing tree collars, fencing saplings, and similar habitat enhancement measures	Medium	0	20
Subtotal (thousands)		**7**	**610**
Biological Assessments (Baseline Inventories, Surveys, and Monitoring)			
Develop and implement a biological Inventory and Monitoring Plan	Medium	0	15
Develop a Water Resources Inventory and Assessment (WRIA)	Medium	0	25
Assess currently owned tracts for species use, habitat suitability, rare and declining species, nonnative species, assess habitats for restoration or enhancement needs, and enter into GIS	High	2	125
Evaluate endemic Olympic mudminnow distribution, needs, and habitat quality in the Unit	Medium	0	35
Inventory and classify all known and unknown bog locations, conduct baseline surveys, and survey for bog specific rare plants or animals	High	0	20
Subtotal (thousands)		**2**	**220**
Research			
Research Oregon spotted frog habitat use, water dependency, movement, predation, and survivorship, especially associated with habitat enhancement techniques	High	0	65
Research status and long-term conditions of bog habitat stability, species health, and determine bog risks and needs	Medium	0	35
Subtotal (thousands)		**0**	**100**
Visitor Services-Related			
Determine options for Unit access to potential Gate-Belmore Trail	Low	0	15
Establish a volunteer program with training to help with a variety of Unit activities	Medium	0	25
Subtotal (thousands)		**0**	**40**
Facilities			
Design and install a small vehicle pull-off area with a small viewing deck and interpretive and regulatory signs on west side of Endicott Road for wildlife viewing	High	0	85

Project Description	Priority	Current Management	Future Management
Design and install a small parking area on the east side of Endicott Road along with a short trail to viewing deck and interpretive panels	Medium	0	75
Partner with Thurston County to design and construct boating access at 123rd Avenue	High	0	90
Subtotal (thousands)		**0**	**250**
Total of all one-time project costs		**9**	**1220**

Annual Operational and Maintenance (Recurring) Costs

Operational and recurring maintenance costs reflect Refuge and Unit spending of the congressionally allocated base funds to Nisqually NWR Complex each year. A portion of the base funds are spent on Grays Harbor NWR and a portion are spent on the Black River Unit. These operational and maintenance costs are also known as recurring costs and are usually associated with day-to-day operations, projects that last longer than 3 years, and permanent staff salaries.

The recurring maintenance program funding need over the next 15 years is defined as funds needed to repair or replace existing buildings, equipment, and facilities. This also includes preventive maintenance; cyclic maintenance; repairs; replacement of parts, components, or items of equipment; adjustments, lubrication, and cleaning (nonjanitorial) of equipment; painting; resurfacing; rehabilitation; special safety inspections; and other actions to assure continuing service, prevent breakdown, and maintain value.

Recurring maintenance also includes maintaining public use, administrative, storage, and shop buildings and facilities. Through normal use and weather conditions, buildings and facilities need annual maintenance and repairs. Maintenance of habitat, from the recurring threat of invasive plants and animals, succession, and protection of threatened, endangered, or candidate species is an annual occurrence.

Maintenance costs include the maintenance backlog needs that have come due but are as yet unfunded in Alternative 1, whereas Alternative 2 reflects future recurring operational and maintenance costs associated with a specific new project or facility (that was included in one-time costs).

Tables C-3 for Grays Harbor NWR and C-4 for the Black River Unit display projected annual operating costs to implement strategies under the CCP and include such things as salary and operational expenditures, including travel, training, supplies, utilities, and maintenance costs. It also includes 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.

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 due to lack of baseline data.

Table C-3. Grays Harbor NWR Operational/Maintenance (Recurring) Costs (in thousands).

Activity Description	Current Management	Future Management
Habitat management, restoration, or enhancement: Continue a joint effort to survey, remove, control existing and prevent new establishment of invasive plants, especially *Spartina* and *Phragmites* through appropriate IPM methods with partners WDFW and WSDA; coordinate with spill response partners; partially fund AmeriCorps WCC crew	10	65
Biological assessment (baseline inventory, survey, and monitoring): Annual or periodic aerial and ground avian surveys; wildlife and fish surveys; habitat surveys, including sweetgrass; shorebird prey resource monitoring; species and habitat monitoring of regional value; species and habitat monitoring related to sea level rise and climate change; invasive species monitoring, efficacy assessments, and GIS mapping; monitor biodiversity trends; salt marsh restoration site monitoring; and providing administrative material support for all biological activities	5	45
Visitor services and environmental education: Provide a variety of both on- and off-Refuge education programs; continue outreach programs and events; continue to improve Refuge's website; manage, enhance, and strengthen the volunteer program	15	60
Maintenance: Maintain existing boardwalks, including keeping clear of vegetation; viewing platforms, kiosks, interpretive signage, parking areas; existing buildings; new facilities; and equipment. Partially fund AmeriCorps WCC crew to assist in facility maintenance	15	25
Total Recurring Costs	**45**	**195**

Table C-4. Black River Unit Operational/Maintenance (Recurring) Costs (in thousands).

Activity Description	Current Management	Future Management
Habitat management, restoration, or enhancement: Remove, control, and prevent new establishment of invasive plants and treat infestations with IPM techniques; continue to determine best methods to control reed canarygrass, especially for Oregon spotted frog habitat needs; maintain dry, short-grass habitat in early successional stage with specific enhancements; partially fund AmeriCorps WCC crew to assist with land management	35	145
Biological assessment (baseline inventory, survey, and monitoring): Annual Oregon spotted frog egg surveys;	15	95

Activity Description	Current Management	Future Management
assessments of habitat quality and native species; periodic bog surveys; invasive species location surveys, treatment efficacy assessments, and GIS mapping; monitor biodiversity trends; provide administrative material support for all biological activities		
Research: Facilitate and cooperate in specific research projects to benefit Unit resources	5	15
Visitor services: Educating visitors to wildlife resources, manage a new volunteer program; patrol and enforce regulations	0	100
Facilities: Continue efforts to remove excess structures on Unit lands; make repairs to Unit infrastructure and equipment; and maintain interpretive and regulatory signs, partially fund AmeriCorps WCC crew to assist with all needs.	20	75
Total Recurring Costs	**75**	**430**

C.2.2 Staffing

The current (2014) staff at the Nisqually NWR Complex split their time to work on Billy Frank Jr. Nisqually and Grays Harbor Refuges and the Black River Unit as projects, funding, and time allows (Table C-5). The future staffing to implement the programs detailed within the CCP are shown for Grays Harbor NWR and the Black River Unit in Table C-6. Currently about 85 percent of current Complex staff time is expended on Billy Frank Jr. Nisqually NWR, about 5 percent of staff time is expended on Grays Harbor NWR, and 10 percent of the time is spent on the Black River Unit.

Table C-5. Current Staffing at Nisqually NWR Complex which includes Grays Harbor NWR and the Black River Unit

Current Positions at Nisqually NWR Complex	Status	Grade
Project Leader	PFT	GS-0485-13
Deputy Project Leader	PFT	GS-0485-12
Wildlife Biologist	PFT	GS-0486-11
Visitor Services Manager	PFT	GS-0026-11
Park Ranger (Vol. Program Specialist)	PFT	GS-025-07
Maintenance Worker	PFT	WG-4749-08
Administrator Officer	PFT	GS-0341-09
AmeriCorps/Nisqually	TEMP	
AmeriCorps/WCC Crew (5 members and Crew Leader)	TEMP	

Table C-6. Future Additional Staffing in Alternative 2 for Grays Harbor NWR and the Black River Unit

Future Positions for Grays Harbor NWR	Status	GS & Grade
Refuge Manager	PFT	GS-0485-07/09/11
Visitor Services Manager	PFT	GS-1001-07/09
Environmental Education Specialist	PFT	GS-1710-5/7

Wildlife Biologist	PFT	GS-486-07/09/11
Biological Technician	PFT	GS-404-05/07
Administrative Assistant		GS-303-04-05
Maintenance Worker	PFT	WG-4749-08
Refuge Law Enforcement Officer	PFT	GS-485/486-07/09/11
Future Positions for the Black River Unit	**Status**	**GS and Grade**
Refuge Operations Specialist	PFT	GS-485-07/09
Biological Technician	PFT	GS-404-05/07
Maintenance Worker	PFT	WG-4749-8

PFT: Permanent Full Time
GS: General Schedule Federal Employee
WG: Wage Grade Federal Employee

AmeriCorps Programs:

The AmeriCorps program engages citizens in intensive community service work including environmental protection and education. The AmeriCorps program partially sponsors the Washington State Service Corps (WSSC, Corps), which is a sub-agency of the Washington Employment Security Department. Up until 2014, Nisqually NWR Compex had obtained a Corps member position that supported several Grays Harbor area elementary schools providing environmental education and outreach programs. The program focused on the ecology of Grays Harbor estuary and shorebirds and in 2012 over 6,143 participants benefitted from both onsite and offsite educational sessions (USFWS 2012). Friends of Nisqually NWR Complex sponsors and funds this position with the help of Grays Harbor Audubon Society. A Corps member position was not secured in 2014 and the education program had to be canceled. The groups will apply again during the next application period to secure a position.

The AmeriCorps program also partially sponsors the Washington Conservation Corps (WCC) which is a sub-agency of the Washington Department of Ecology. WCC employs young adults in an outreach program to protect and enhance Washington's natural resources. Annually, Nisqually NWR Complex cost-shares with WCC for a full-time six-person field crew. Nisqually NWR Complex’s share of the funding comes from the stations’ operational budget. These young adults work at Billy Frank Jr. Nisqually and Grays Harbor Refuges and the Black River Unit on environmental protection and maintenance projects. The crew is an integral staff component completing many projects at all three locations. Without the WCC crew, much needed work would not be accomplished, especially preparation for the Grays Harbor Shorebird Festival and maintenance on the boardwalk.

Volunteer Program:

Grays Harbor NWR

Grays Harbor NWR has a small but dedicated group of volunteers that are critical to the operation of this unstaffed Refuge. In 2012, 22 individual volunteers donated 1,883 hours towards accomplishing Refuge programs, including onsite and outreach environmental education programs, wildlife and habitat, maintenance, wildlife dependent recreation, visitor use assistance, and the annual 3-day Grays Harbor Shorebird Festival event (USFWS 2012).

The standard value per hour of a volunteer equals $22.14. Thus in 2012, the Refuge value of volunteer hours was (1,883 x $22.14) $41,689.62. The amount of volunteer hours donated is the equivalent of almost one full-time employee.

Black River Unit

The Black River Unit does not currently have a volunteer program. However, the volunteer program is a strategy in Chapter 2, Goal 5 and is included in Tables C-2 and C-4.

C.2.3 Budget Summary

Table C-7 summarizes the data from Tables C-1 and C-3 and displays the overall funding needed for Grays Harbor. Table C. 8 summarizes the data from Tables C-2 and C-4 and displays the overall funding needed for Black River Unit to implement the CCP.

Table C-7. Budget Summary (One-time projects and annual recurring operational/ maintenance funding) needs for Grays Harbor NWR as identified in the CCP (in thousands).

Budget Category	Current Management		Future Management	
	One-time cost	Annual recurring cost	One-time cost	Annual recurring cost
Habitat management, restoration, or enhancement	65	10	90	65
Biological assessments (inventory, survey, and monitoring)	20	5	85	45
Research	0	0	90	0
Visitor services and environmental education	0	15	5	60
Facilities	0	15	625	25
Totals	**85**	**45**	**895**	**195**

Table C-8. Budget Summary (One-time projects and annual recurring operational/ maintenance funding) needs for Black River Unit as identified in the CCP (in thousands).

Budget Category	Current Management		Future Management	
	One-time cost	Annual recurring cost	One-time cost	Annual recurring cost
Habitat management, restoration, or enhancement	7	35	610	145
Biological assessments (inventory, survey, and monitoring)	2	15	220	95

Budget Category	Current Management		Future Management	
Research	0	5	100	15
Visitor services and environmental education	0	0	40	100
Facilities	0	20	250	75
Totals	**9**	**75**	**1220**	**430**

C.3 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. Current and past partners include Federal and State agencies, Tribes, NGOs, schools, volunteers, and individuals.

Coordinated partnership efforts will focus on environmental education, habitat management, fish and wildlife monitoring, habitat restoration, land protection, 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.

C.3.1 Grays Harbor NWR

Current and past partners for Grays Harbor NWR include Washington Department of Ecology, Washington Department of Fish and Wildlife, Washington Department of Natural Resources, Washington State Department of Agriculture, Washington State Service Corps, Grays Harbor County Noxious Weed Agency, Grays Harbor Public Utilities District, Grays Harbor County, Port of Grays Harbor, City of Hoquiam, The Nature Conservancy, Grays Harbor Audubon Society, Friends of Grays Harbor, Grays Harbor College, local grade schools of Grays Harbor County, Pacific Coast Joint Venture, Western Hemisphere Shorebird Reserve Network, Point Reyes Bird Observatory, North Pacific Landscape Conservation Cooperative , U.S. Coast Guard, U.S. Geological Service, and the U.S. Fish and Wildlife Service's Washington State Office.

Partnerships like these increase our effectiveness, knowledge, and community support, as well as reduce Refuge operating costs. Presently, there is a six-person field crew funded partially through our partners, supporting the WCC conservation crew's work at Grays Harbor NWR. Additionally some partners provide funding or matching funds for federal grants.

C.3.2 Black River Unit

Current and past partners include Washington Department of Ecology, Washington Department of Fish and Wildlife, Washington Department of Natural Resources, Chehalis Basin Partnership, Chehalis Basin Weed Partnership, Thurston County Noxious Weed Agency, Thurston County, Thurston Conservation District, Chehalis River Cooperative Weed Management working group, Washington's Oregon Spotted Frog working group, Capitol Land Trust, Port Blakely Tree Farm, The Nature Conservancy, Black Hills Audubon Society, U.S. Department of Agriculture's Natural Resource Conservation Service, and U.S. Fish and Wildlife Service Washington State Office.

Partnerships like these increase our effectiveness, knowledge, and community support, as well as reduce Unit operating costs. Presently, there is a six-person field crew funded partially through our partners, supporting the WCC conservation crew's work at the Black River Unit. Additionally, partners assist in providing funding or matching funds for federal grants.

C.4 References

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Appendix D. Wilderness

D.1. Background

D.1.1 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 reevaluation 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) (Wilderness Act), 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.

<u>Wilderness Inventory</u>
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 types 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.

<u>Wilderness Study</u>
The study evaluates all values (ecological, recreational, cultural), resources (wildlife, water, vegetation, minerals, soils), and uses (management and public) within the WSA. The findings of the study determine whether or not we will recommend the area for designation as wilderness.

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 the following:

- the benefits and impacts to wilderness values and other resources
- how each alternative will achieve the purposes of the Wilderness Act and the National Wilderness Preservation System (NWPS)
- how each alternative will affect achievement of the refuge purpose(s) and contribution toward achieving the Refuge System mission
- how each alternative will affect maintaining and, where appropriate, restoring biological integrity, diversity, and environmental health at various landscape scales
- other legal and policy mandates
- 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 prohibited uses listed in the Wilderness Act, Section4(c).

Wilderness Recommendation
If the wilderness study demonstrates that a WSA meets the requirements for inclusion in the NWPS, 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).

The following constitutes the inventory phase of the wilderness review for Grays Harbor National Wildlife Refuge and Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge.

D.1.2 Wilderness Inventory

Criteria for Evaluating Lands for Possible Inclusion in the National Wilderness Preservation System

The Wilderness Act 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 Wilderness 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
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 Wilderness 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.1.3 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

More detail on the actual factors considered and used for each assessment step follows.

Unit Size: Roadless areas meet the size criteria if any one of the following standards apply:

- 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 refers to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means nonmotorized, 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 nonnative 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.

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. Nonnative 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, and 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.

D.2. Inventory Summary and Conclusion

Grays Harbor National Wildlife Refuge is not recommended for further study for inclusion in the Wilderness System because it does not meet the above criteria. The Refuge comprises only 1,500 acres (see Table 1-1 in Chapter 1). The size of this block is insufficient to make practicable its preservation and use as wilderness. The Refuge also has considerable evidence of past human use, does not have outstanding opportunities for solitude or primitive recreation, and is not a roadless island.

Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge is not recommended for further study for inclusion in the Wilderness System because it does not meet the above criteria. This Unit's total acquisition boundary contains approximately 3,900 acres, with 1,581 acres currently managed (see Table 1-1 in Chapter 1). The size of this Unit is insufficient to make practicable its preservation and use as wilderness. The Unit also has considerable evidence of past human use, does not have outstanding opportunities for solitude or primitive recreation, and is not a roadless island.

Appendix E. Biological Resources of Concern

E.1 Resources of Concern for Grays Harbor National Wildlife Refuge.

Table E-1. Comprehensive List of Resources of Concern for Grays Harbor National Wildlife Refuge.

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Sp.	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, n]	Landbirds of OR & WA [o]	WA State Wildlife Plan [g]	USFWS Shorebird Plan (score 1-5) [h]	N.A.Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan [n]	Seabird Cons. Plan [m]
Mammals																	
Black-tailed deer								3[5]								S5[3]	
Harbor seal					SM[1]			2[5]			✓					S4[3]	
Birds																	
Common loon	✓				SS[1]			1,2[5]			✓		TBA[4]			S4N[3]	
Red-throated loon	✓							2[5]					TBA[4]			S5N[3]	
Horned grebe	✓				SM[1]			2[5]					TBA[4]			S5N[3]	
Western grebe	✓				SC[1]	✓	✓	1,2[5]					N-M[4]			S3N[3]	
Double-crested cormorant	✓						✓	2[5]			✓		NAR[4]			S4SB/ S5SN[3]	✓
Brown pelican	✓			SoC[1]	E												
Great blue heron	✓				SM[1]			2[5]			✓		NAR[4]			S4B/ S5N[3]	
Greater white-fronted goose	✓						✓	2,3[5]			✓			✓	N-H[4]	S4N[3]	
Cackling Canada goose	✓						✓	2,3[5]			✓			✓	N-H[4]		
Dusky Canada goose	✓			SoC[1]		✓	✓	2,3[5]			✓			✓	N-H[4]	SNRN	
Pacific Canada goose	✓						✓	2,3[5]			✓			✓	N-MH /B-H[4]	S5B/S 5N[3]	
Pacific brant	✓						✓ +F	2,3[5]			✓			✓	N-H[4]	S3N[3]	
Gadwall	✓						✓	2,3[5]							N- ML[4]	S4N/ S5B[3]	
American wigeon	✓	✓	✓				✓	2,3[5]			✓				N-H[4]	S4B/ S5N[3]	
Mallard	✓						✓	2,3[5]			✓				N-MH /B-M[4]	S5B/ S5N[3]	

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Sp.	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, n]	Landbirds of OR & WA [o]	WA State Wildlife Plan [g]	USFWS Shorebird Plan (score 1-5) [h]	N.A.Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan [n]	Seabird Cons. Plan [m]
Northern shoveler	✓						✓	2,3[5]							N-MH[4]	S4B/S3N[3]	
Northern pintail	✓						✓	2,3[5]			✓				N-H[4]	S3B/S4N[3]	
Green-winged teal	✓						✓	2,3[5]							N-MH/B-MH[4]	S4B/S3N[3]	
Greater scaup	✓						✓+F	2,3[5]							N-H[4]	S3N[3]	
Lesser scaup	✓						✓+F	2,3[5]							N-H[4]	S3N[3]	
Black scoter	✓															S4	
Surf scoter	✓															S3	
White-winged scoter	✓															S5	
Bufflehead	✓	✓	✓					2,3[5]							N-H[4]	S4N[3]	
Common goldeneye	✓						✓	2,3[5]							N-MH[4]	S5N[3]	
Barrow's goldeneye (western)	✓							2,3[5]							N-MH[4]	S3B/S4N[3]	
Red-breasted merganser	✓							2,3[5]							✓	S3N[3]	
Common merganser	✓															S3N[3]	
Waterfowl concentrations	✓	✓	✓					2,3[5]			✓					N[3]	
Western WA non-breeding concentrations of loons, grebes, and cormorants	✓	✓	✓					2,3[5]			✓					N[3]	
Osprey	✓	✓			SM[1]											S4B[3]	
Bald eagle	✓	✓		SoC[1]	SS[1]	✓	✓+F		✓		✓					S4B/S4N[3]	
Northern harrier	✓	✓							✓							S4B/S4N[3]	
Sharp-shinned hawk	✓	✓							✓							S4B/S4N[3]	
Red-tailed hawk	✓	✓							✓							S5B/S5N[3]	
Merlin	✓	✓			SC[1]			1[5]			✓					S3B/S4N[3]	
Peregrine falcon	✓	✓		SoC[1]	SS[1]	✓	✓		BI Ic[6]		✓					S2B/S3N[3]	
Virginia rail	✓						✓						N-M/B-M[4]			S4B/S3N[3]	

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Sp.	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, n]	Landbirds of OR & WA [o]	WA State Wildlife Plan [g]	USFWS Shorebird Plan (score 1-5) [h]	N.A.Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan [n]	Seabird Cons. Plan [m]
Sora*	✓						✓						N-H[4]			S4B[3]	
Black-bellied plover	✓							2[5]			✓	4[2]				S4N[3]	
Semi-palmated plover	✓	✓	✓					2[5]				3[2]				S4N[3]	
Greater yellowlegs	✓							2[5]			✓	4[2]				S5N[3]	
Whimbrel	✓					✓	✓	2[5]				4[2]				S3N[3]	
Red knot (roselaari)	✓					✓	✓ +F	2[5]			✓	4[2]				S3N[3]	
Western sandpiper	✓	✓	✓					2[5]			✓	4[2]				S4S5 N[3]	
Least sandpiper	✓							2[5]				3[2]				S4S/ S5N[3]	
Dunlin	✓							2[5]			✓	4[2]				S5N[3]	
Short-billed dowitcher	✓	✓	✓			✓	✓	2[5]			✓	4[2]				S4N[3]	
Long-billed dowitcher	✓							2[5]			✓	4[2]				S4N[3]	
Marbled godwit	✓					✓	✓ +F	2[5]				4[2]				S3N[3]	
Ruddy turnstone	✓							2[5]				4[2]				S4N[3]	
Concentrations of migrating & wintering shorebirds	✓	✓															
Ring-billed gull	✓							2[5]					✓ NAR[4]			S5B/ S5N[3]	✓
Western gull	✓							2[5]					L[4]			S4B/ S4N[3]	✓
Glaucous gull	✓							2[5]					L[4]			S5B/ S5N[3]	✓
Glaucous-winged x Western hybrid	✓																
Caspian tern	✓	✓	✓		SM[1]	✓	✓	✓2[5]			✓		B-L[4]			S3B[3]	✓
Migratory passerines & landbirds	✓	✓															
Rufous hummingbird	✓					✓	✓		BI[6]	DS[7]	✓					S4B[3]	
Downy woodpecker	✓								✓		✓					S4B/S 5N[3]	
Northern flicker	✓								✓	DS[7]							

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Sp.	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, n]	Landbirds of OR & WA [o]	WA State Wildlife Plan [g]	USFWS Shorebird Plan (score 1-5) [h]	N.A.Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan [n]	Seabird Cons. Plan [m]
Willow flycatcher	✓			SoC[1]		✓			BI[6]	DS[7]	✓					S4B/S5N[3]	
Pacific-slope flycatcher	✓								BI Ia[6]	DS[7]	✓					S4B/S5N[3]	
Tree swallow	✓								✓							S5B[3]	
Violet-green swallow	✓								✓							S5B[3]	
Marsh wren	✓	✓	✓						BI Ic[6]							S5B/S5N[3]	
Bewick's wren	✓								✓								
American robin	✓								✓								
Orange-crowned warbler	✓								✓	DS[7]						S4B[3]	
Yellow warbler	✓	✓	✓						✓		✓					S4B[3]	
Yellow-rumped warbler	✓								✓								
Common yellowthroat	✓								✓							S5B[3]	
Wilson's warbler	✓								BI Ia[6]		✓					S5B[3]	
Song sparrow	✓								✓	DS[7]						S5B/S5N[3]	
Fish																	
Chinook salmon*	✓	✓			SC[1]			1[5]			✓					S3B/S4N[3]	
Chum salmon*	✓				SC[1]			1[5]			✓					S3[3]	
Coho salmon*	✓										✓					S3[3]	
Pink salmon*	✓										✓					S2	
Steelhead*	✓				SC[1]			1[5]			✓					S5[3]	
Coastal cutthroat trout*	✓			SoC[1]							✓					S4[3]	
Bull trout*	✓			T[1]	SC[1]			1[5]			✓					S3[3]	
Green sturgeon*	✓			T[1]	SM[1]						✓					S2[3]	
Pacific lamprey*	✓			SoC[1]	SM[1]						✓					S3/S4[3]	
Eulachon*	✓			T[1]	SC[1]						✓						
Forage fish*	✓							✓			✓						
Amphibians & Reptiles																	
Pacific tree frog	✓																
Plants																	
Sweetgrass	✓	✓	✓														
Native eelgrass		✓	✓														

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Sp.	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, n]	Landbirds of OR & WA [o]	WA State Wildlife Plan [g]	USFWS Shorebird Plan (score 1-5) [h]	N.A.Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan [n]	Seabird Cons. Plan [m]
Invertebrates																	
Newcomb's littorine snail*				SoC[1]	SC[1]											S13	
Benthic invertebrate concentrations	✓	✓	✓									✓					
Habitats																	
Open water	✓	✓	✓										✓	✓			✓
Intertidal mudflat	✓	✓	✓					✓			✓	✓	✓	✓			✓
Salt and brackish marsh	✓	✓	✓					✓			✓	✓	✓	✓			✓
Forest	✓	✓	✓														

[*] = Not documented on Refuge. Species occupies habitat adjacent to Refuge or potential suitable habitat exists on Refuge.
[1] T = Threatened; E = Endangered; FC = Federal candidate; SoC = Refuge species of concern; SC = State candidate; SS = State sensitive; Sm = State Monitor
[2] Regional score. Category codes: 5 = Highly imperiled; 4 = High concern; 3 = Moderate concern; 2 = Low concern; 1 = No risk
[3] S1 = Critically imperiled; S2 = Imperiled; S3 = Rare, uncommon; S4 = Apparently secure; S5 = Demonstrably secure; SX = Apparently extirpated, SH = Historical occurrences, but still expected to occur. B = Breeding, N = Non-breeding, SN = Regularly occurring, non-breeding, SR = Reported but without persuasive documentation
[4] B = Breeding, N = Non-breeding; H = High concern or need, M = Moderate concern or need, L = Low concern or need, NAR = Not currently at risk, TBA = To be assessed, ✓ = included in plan
[5] 1 = State-listed and candidate species, 2 = Vulnerable aggregations, 3 = Species of recreational, commercial, and/or Tribal importance
[6] B = Breeding, N = Non-breeding: I = High continental importance, II = High regional priority, IIa = High regional concern, IIb = High regional responsibility, IIc = High regional threats
[7] DS = Declining species
✓ = Species is relevant to Refuge management and on the appropriate document(s).
✓+F = Species is a Bird of Management Concern as well as a Focal Species (Chapter 4)
[a] U.S. Fish and Wildlife Service 2001 (BIDEH)
[b] U.S. Fish and Wildlife Service 2012; National Oceanic and Atmospheric Administration 2012, 2011; Washington Department of Fish and Wildlife 2012; and Washington Department of Natural Resources 2012.
[c] Washington Department of Fish and Wildlife 2008 & 2012 (State Priority Species and Habitats)
[d] Rich et al. 2004 (Partners In Flight – Landbirds)
[e] U.S. Fish and Wildlife Service 2008 (FWS Birds of Conservation Concern)
[f] U.S. Fish and Wildlife Service 2011 (FWS Birds of Management Concern and Focal Species)
[g] Washington Department of Fish and Wildlife 2005 (State Wildlife Comprehensive Conservation Strategy)
[h] Drut and Buchanan 2000 (North Pacific Coast Shorebird Plan)
[i] Kushlan et al. 2002 (NA Waterbird Plan)
[j] Pacific Flyway Council 1983-2007
[k] North American Waterfowl Management Plan 2004
[l] Washington Department of Natural Resources 2005 & 2007 (Natural Heritage Plan)
[m] US Fish and Wildlife Service 2005 (Seabirds)
[n] Rosenberg 2004 (PIF BCR – WA Level)
[o] Altman 2005 (Conservation Priorities for Landbirds of OR and WA)

Table E-2. Table BIDEH: Natural Plant Communities at for Grays Harbor NWR: Characteristics, Natural Processes Involved in Sustaining Community, and Limiting Factors.

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, serial stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors And Threats
Open Water	• Always inundated despite tidal cycles • Salinity ranges from 5 to 20 parts per thousand (ppt) depending on the season • Water depths vary depending on substrate elevation but are approximately 6 feet deep at 0-foot tide • Zooplankton, phytoplankton, algae, and macro-invertebrates carried in the water • Native eelgrass beds if substrate characteristics, salinity, and light conditions are appropriate • Heavy woody debris brought in by storm events which provide underwater cover and structure for fishes and invertebrates *Potential conservation species: bufflehead and native eelgrass as well as migratory and over-wintering waterfowl and waterbirds, raptors, fish and native eelgrass.*	• Water circulation, salinity gradients, prevailing winds, storm events, high winds, water and air temperatures, watershed drainage of rain (flood events), and river outflow • Storm events move heavy woody debris • Sloughs are created by tidal movement through the substrate	• Invasive species such as Japanese eelgrass • Potential pollution/ contamination of water and sediment substrate from nearby industry, ocean going shipping vessels and local boating industry • Fish, wildlife, and prey species could be compromised by a contamination event
Intertidal Mudflat	• 90% of the habitat is a large expanse of exposed mudflats at low tide levels that are approximately 80% free of rooted vegetation but do support algae growth • Twice daily, tidally driven marine waters flood the mudflats between 0.0 and 9.0 feet NGVD (National Geodetic Vertical Datum) • Tidal salinity ranges from 5 to 20 ppt depending on the season • Abundant, healthy macro benthic and surface invertebrate populations are available prey during low tide levels for migrating shorebirds and other wildlife • Tidal cycles renew moisture to mudflat invertebrates and carry large quantities of phytoplankton, zooplankton, algae, and small invertebrates	• Tidal cycles, water circulation, salinity gradients, prevailing winds, storm events, high winds, water and air temperatures, watershed drainage of rain (flood events), and river outflow • Storm events move heavy woody debris and sediment within the estuarine mudflats • Waves and winds create ridges and low mesas of mud, which become vegetated with pioneering salt marsh species • Sloughs are sinuous channels that are cut through the mudflat by tidal action	• Loss of intertidal mudflat habitat negatively affects shorebird ability to the use the estuary for life needs such as foraging and roosting • Natural processes regarding sedimentation in the basin are not well understood • Sediment aggradation causes mudflats transition to saltmarsh • Increased saltmarsh development causes loss of shorebird foraging habitat • Invasive species encroachment, such as *Phragmites*, *Spartina*, beachgrass, Japanese eelgrass, and potentially the New Zealand mudsnail, and Griffen's isopod • Japanese eelgrass may decrease shorebird foraging habitat and food resources

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, serial stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors And Threats
	• High elevation areas of the mudflat provide vital high-tide roosts or resting sites for shorebirds during incoming tides • Downed trees turn into heavy woody debris that rests on mudflats and both shorebird and raptor perches. These same trees provide underwater cover and structure for fish and invertebrates during higher tides. When woody debris remains above tidal inundation it provides perches for either shorebirds or raptors • The sloughs are the first to flood and create deeper water environments for diving waterfowl and waterbirds and physical cover for fish and marine mammals. During low tide, these channels provide physical protection and moist habitat for small animals and invertebrate populations • ≤2% *Spartina*, and very few other State or county listed, or other detrimental, nonnative, invasive plant species growing in the mudflat • Minimal levels of contaminants and pollutants which are detrimental to invertebrates, fish, and wildlife species *Potential conservation species: Western sandpiper, semi-palmated plover, short-billed dowitcher, benthic invertebrates, Caspian tern, American wigeon. Also migratory and over-wintering shorebirds, raptors, wintering waterfowl, waterbirds, and fish.*		as well as encourage sedimentation and assist in raising the mudflat levels • Nearby Port of Grays Harbor industry development may affect the Refuge and its wildlife • Potential pollution to water, sediment, vegetation, and wildlife from nearby industry, ocean-going shipping vessels, and local boating industry. Foraging habitat for migrating shorebirds could be compromised • Climate change may bring warmer temperatures which may create large algal mats and algal blooms in water • Climate change may cause sea level rise which may convert mudflat to tidal open water or subtidal habitat which would not benefit shorebirds
Salt and Brackish Marsh	• Salt marsh vegetation usually occurs within tidal range of 9 to 13 feet NGVD • Brackish marsh waters (≤5 parts per thousand) are less saline than marine water because they mix with freshwater inputs that usually come from upland drainages • Low salt marshes are those nearest the low-tide line which are covered with each	• Tidal cycles, water circulation, salinity gradients, prevailing winds, storm events, high winds, water and air temperatures, watershed drainage of rain (possible flooding) • Native plant seed source	• As high saltmarsh elevation rises with sedimentation aggradation it converts to shrub-scrub habitat • Potential loss of sweetgrass plant community to mudflat elevation changes or to climate change and sea level rise • Invasive species: *Spartina, Phragmites,* knotweed species, reed canarygrass,

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, serial stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors And Threats
	high tide. Species in low to mid-level salt marshes include pickleweed, salt grass, jaumea, sea arrow-grass, sand-spurry, seaside plantain, lilaeopsis, sea sweetgrass, and orache • Mid-level marshes are covered by about half of the high tides each year. Plant species in mid- to high-level salt marshes include tufted hairgrass, Pacific silverweed, saltmarsh bulrush, gumweed, Baltic rush, and Lyngby's sedge • High salt marshes are generally covered by tides on fewer occasions. Species in high saltmarsh include cow parsnip, sea watch, dunegrass, Douglas aster, foxtail and meadow barley, and paintbrush owl-clover • Brackish to slightly brackish marsh zones can include cattails, slough and Lyngby's sedge, saltmarsh bulrush, Baltic rush, spikerush species, meadow barley, and saline-resistant freshwater marsh plants • Both salt and brackish marshes are major producers of detritus and nutrients and help keep estuary function healthy *Potential conservation species: Marsh wren, fish; migratory and wintering shorebirds, wintering waterfowl, waterbirds, marshbirds, raptors and sweetgrass.*		yellow flag iris, Japanese eelgrass, and potentially perennial pepperweed, European beachgrass and New Zealand mudsnail • Pollution, oil spill, etc., from ocean-going tankers and pleasure boats using nearby shipping channel • Sea level rise may cause salt and brackish marshes to flood and become open water habitats which would not benefit shorebirds
Forest	• 80% multi-species overstory cover dominated by a range of deciduous trees that includes red alder, native willows, cascara, Pacific crabapple, and other small trees • 50% cover of a complex and dense midstory of osoberry, salmonberry, thimbleberry, red elderberry, twinberry, and other native shrubs	• The lands are former dredge sites and these woodlands and forests have most likely grown up from unformed soils and bare ground • These lands will most likely mature into a low elevation coastal forest plant community over time • Climate characterized by	• Early succession doesn't produce snags or downed woody debris important to cavity-nesting birds, insects, and many decomposers • Invasive species such as knotweeds, *Phragmities*, nonnative blackberries, reed canarygrass, and broom overtake the native mid- and understory plant communities

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, serial stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors And Threats
	• A thick understory of waterleaf, waterparsley, swordfern, coltsfoot, and horsetails that completely covers the substrate in some areas and provides open soils in others • A high diversity of mosses and lichens populate the trees and shrubs • Provides migratory and resident passerines and other landbirds dense cover and foraging opportunities for insects, nectar, and seeds *Potential conservation species: yellow warbler. Also other migratory passerines.*	hypermaritime (cool summers, very wet winters), abundant fog, and no major snow pack • Natural disturbance windthrow occurs with occasional intense windstorms • Catastrophic fires and extended droughts are infrequent	• Airport regulations may prevent tall trees growing near the runway • Sea level rise may cause saline inundation of forested areas and cause tree decline, and eventually a vegetation conversion to a shrub-scrub or saltmarsh community. Over time water levels may cover the substrate long enough to cause mudflat to develop • Contamination, pollution, oil spill, etc., from ocean-going tankers and pleasure boats using nearby shipping channel

E.2 Resources of Concern for Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Table E-3. Comprehensive List of Resources of Concern for Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Species	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, m]	Landbirds of Or and WA [n]	WA State Wildlife Plan [g]	US Shorebird Plan –PNW [h 2]	N.A. Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan[i]
Mammals																
Pacific Townsend's big-eared bat*	✓			SoC[1]	SC[1]			✓			✓					S3[3]
Little brown bat	✓			SoC[1]	SM[1]						✓					S5[3]
Yuma bat	✓			SoC[1]	SM[1]						✓					S5[3]
Bats roosting concentrations	✓	✓		SoC[1]	SM[1]			2[5]			✓					
Black bear	✓							✓								S5[3]
Black-tailed deer	✓							3[5]								S5[3]
Roosevelt elk	✓							3[5]			✓					S5[3]
River otter	✓	✓									✓					S4[3]
Mink	✓	✓														S5[3]
Muskrat	✓		✓													S5[3]
Birds																
Pied-billed grebe	✓	✓					✓	2[5]					N-H /B-H[4]			S4B/ S5N[3]
Double-crested cormorant *	✓							2[5]			✓		NAR[4]			S4B/ SN5[3]
American bittern	✓	✓					✓						N-H/ B-H[4]			S4B/ S3N[3]
Great blue heron	✓				SM[1]			2[5]			✓		NAR[4]			S4B/ S5N[3]
Green heron	✓	✓											B-L[4]			S5B[3]
Cackling goose	✓						✓	2,3[5]			✓			✓	N-H[4]	SNR B/SN RN[3]
Pacific Canada goose	✓						✓	2,3[5]			✓			✓	N-MH /B-H[4]	S5B/ S5N[3]
Wood duck	✓						✓	2,3[5]			✓				B-M[4]	S4B[3]
American wigeon	✓						✓	2,3[5]			✓				N-H[4]	S5N[3]
Mallard	✓		✓				✓	2,3[5]			✓				N-MH /B-M[4]	S5B/ S5N[3]
Blue-winged teal*	✓						✓	2,3[5]							B-MH[4]	S5B[3]
Cinnamon teal*	✓						✓	2,3[5]		DS [7]					B-MH[4]	S5B[3]
Northern shoveler	✓						✓	2,3[5]							N-MH	S4B/

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Species	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, m]	Landbirds of Or and WA [n]	WA State Wildlife Plan [g]	US Shorebird Plan –PNW [h 2]	N.A. Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan[i]
															/B-ML[4]	S3N[3]
Northern pintail	✓						✓	2,3[5]			✓				N-H/B-ML[4]	S3B/ S4N[3]
Green-winged teal	✓						✓	2,3[5]							N-ML/B-MH[4]	S4B/ S3N[3]
Ringed-neck duck	✓						✓	2,3[5]							N-ML/ B-ML[4]	S3N[3]
Hooded merganser	✓							2,3[5]							UNK N	S4B/ S3N[3]
Waterfowl concentrations	✓	✓	✓					2,3[5]			✓					N[3]
Bald eagle	✓			SoC[1]	SS[1]	✓	✓ + F	✓			✓					S4B/ S4N[3]
Northern harrier	✓								✓							S4B/ S4N[3]
Sharp-shinned hawk*	✓								✓							S4N[3]
Cooper's hawk*	✓								BIIa [6]							S4N[3]
Red-tailed hawk	✓								✓							S5B/ S5N[3]
American kestrel	✓	✓	✓						✓	DS [7]	✓					S4B/ SN5[3]
Virginia rail	✓	✓					✓						N-M/ B-M[4]			S3N/ S4B[3]
Sora	✓	✓					✓						N-H[4]			S4B[3]
American coot	✓	✓					✓	2[5]					N-L[4]			S4B/ S4N[3]
Killdeer	✓								✓	DS [7]	✓	4 [2]				S4B/ S4N[3]
Greater yellowlegs	✓	✓	✓					2[5]			✓	4 [2]				S5N[3]
Wilson's snipe	✓	✓					✓	2[5]			✓	4 [2]				S4B[3]
Band-tailed pigeon	✓						✓	3[5]	BI/ NI[6]	DS [7]	✓			✓		S4B[3]
Mourning dove	✓	✓				✓	✓	3[5]	✓	DS [7]						S4B/ S4N[3]
Barn owl	✓								✓							S4B/ S4N[3]
Western screech	✓								BIIa		✓					S4B/

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Species	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, m]	Landbirds of Or and WA [n]	WA State Wildlife Plan [g]	US Shorebird Plan –PNW [h 2]	N.A.Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan[i]
owl*									[6]							S4N[3]
Short eared owl*	✓							✓								
Migrant passerines & landbirds	✓	✓														
Vaux's swift*	✓	✓			SC[1]				BIIa [6]	DS [7]	✓					S3B[3]
Rufous hummingbird	✓	✓				✓	✓		BI[6]	DS [7]	✓					S4B[3]
Belted kingfisher	✓	✓							✓	DS [7]						unkn
Red-breasted sapsucker	✓	✓							BIIa /NII a[6]							S4B/ SN5[3]
Downy woodpecker	✓								✓		✓					S4B/ S5N[3]
Hairy woodpecker*	✓															
Northern flicker	✓	✓								DS [7]						unkn
Pileated woodpecker	✓	✓			SC[1]			1[5]	✓		✓					S4B/ S4N[3]
Willow flycatcher	✓	✓	✓	SoC[1]		✓		✓	BI[6]	DS [7]	✓					S4B[3]
Pacific-slope flycatcher	✓								BIIa [6]	DS [7]	✓					S4B[3]
Western Wood-pewee	✓								✓	DS [7]						S5B[3]
Purple martin*	✓	✓			SC[1]			1[5]	✓		✓					S3B[3]
Tree swallow	✓	✓							✓							S5B[3]
Barn swallow	✓								✓	DS [7]						S4S5 B[3]
Black-capped chickadee	✓		✓						✓							S5B/ S5N[3]
Chestnut-backed chickadee	✓	✓	✓						BIIa /NII a[6]	DS [7]						S5B/ S5N[3]
Bushtit	✓								NII a[6]	DS [7]						
Marsh wren	✓	✓	✓						BIIa [6]		✓					S5B[3]
Winter wren	✓								✓							S5B/ S5N[3]
Bewick's wren*								✓								
Golden-crowned kinglet	✓	✓							BIIa [6]							S4S5 B[3]
Swainson's thrush	✓	✓	✓						✓	DS	✓					S5B[3]

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Species	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, m]	Landbirds of Or and WA [n]	WA State Wildlife Plan [g]	US Shorebird Plan –PNW [h 2]	N.A. Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan[i]
										[7]						
Varied thrush	✓	✓	✓						BIIa [6]							S5B/ S5N[3]
Steller's jay	✓								✓							S5B[3]
Orange-crowned warbler	✓	✓							✓	DS [7]						S5B[3]
Yellow warbler	✓	✓							✓		✓					S4B[3]
Black-throated gray warbler	✓	✓							BIIa [6]							S5B[3]
Townsend's warbler*	✓	✓							BIIa /NII c[6]							S5B/ S4N[3]
MacGillivray's warbler*	✓	✓							✓	DS [7]	✓					S5B[3]
Common yellowthroat	✓	✓														S5B[3]
Wilson's warbler	✓	✓							BIIa [6]	DS [7]	✓					S5B[3]
Spotted towhee	✓	✓							BIIa [6]							S5B/ S5N[3]
Golden-crowned sparrow	✓								✓							S5B[3]
Song sparrow	✓								✓	DS [7]						S4B/ S5N[3]
Savannah sparrow	✓	✓	✓						✓	DS [7]						S5B[3]
Black-headed grosbeak	✓	✓							BIIa [6]	DS [7]						S5B[3]
Western meadowlark*	✓	✓							✓	DS [7]						S4S5 B/S4 N[3]
Purple finch	✓					✓			BIIa [6]	DS [7]						S5B/ S5N[3]
American goldfinch	✓								✓	DS [7]						S5B/ S5N[3]
Fish																
Olympic mudminnow	✓	✓	✓		SS			✓			✓					S2B/ SN3
Chinook salmon	✓	✓			SC[1]			1[5]			✓					S3B/ S4N[3]
Coho salmon	✓	✓						✓			✓					S3[3]
Steelhead	✓			T	SC[1]			1[5]			✓					S5[3]
Coastal cutthroat trout*	✓	✓	✓	SoC[1]				✓			✓					S4[3]
Pacific lamprey	✓			SoC[1]				✓			✓					S3/S 43

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Species	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, m]	Landbirds of Or and WA [n]	WA State Wildlife Plan [g]	US Shorebird Plan –PNW [h 2]	N.A.Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan[i]
Amphibians & Reptiles																
Northwestern salamander	✓	✓	✓													S5[3]
Long-toed salamander	✓															S5[3]
Rough-skinned newt	✓															S5[3]
Pacific tree frog	✓	✓	✓													S5[3]
Red-legged frog	✓	✓	✓	SoC[1]	SC[1]											S4[3]
Oregon spotted frog	✓	✓	✓	T[1]	E[1]			✓								S1[3]
Northern alligator lizard	✓															S5[3]
Western terrestrial garter snake	✓															S5[3]
Northwestern garter snake	✓															S5[3]
Invertebrates																
Oregon floater					SM[1]						✓					S3[3]
Freshwater mussels		✓						✓								
Freshwater sponges		✓														unkn
Crayfish, native		✓														unkn
Beller's ground beetle*		✓		SoC[1]	SC[1]											S3/ NNR [3]
Hatch's click beetle*		✓		SoC[1]	SC[1]											S1
Pacific clubtail Dragonfly		✓									✓					S1/N 4[3]
Plants																
Water howellia*		✓		T[1]	T[1]			1[5]								unkn
Bristley sedge		✓														unkn
Sphagnum moss (bog)		✓	✓													unkn
Labrador Tea (bog)		✓	✓													unkn
Habitats																
River channel	✓	✓	✓		PR H	✓		✓	✓							
Tributary channel	✓	✓	✓		PR H			✓								
North Pacific bog and fen	✓	✓	✓													

Species/Habitat	Refuge Purpose	BIDEH [a]	CCP Priority RoC w/ Focal Species	ESA [b]	Washington Listed [b]	USFWS BCC [e]	USFWS BMC [f]	WDFW PHS [c]	Partners in Flight [d, m]	Landbirds of Or and WA [n]	WA State Wildlife Plan [g]	US Shorebird Plan –PNW [h 2]	N.A. Waterbird Conservation Plan [i]	Pacific Flyway Management Plans [j]	NA Waterfowl Management Plan [k]	WA Natural Heritage Plan[i]
Freshwater emergent marsh	✓	✓	✓		PRH	✓		✓	✓							
Seasonally flooded nonnative grassland	✓	✓	✓		PRH											
North Pacific shrub swamp	✓	✓	✓		PRH	✓		✓	✓							
North Pacific lowland riparian forest and shrubland	✓	✓	✓		PRH	✓		✓	✓							
North Pacific maritime dry-mesic Douglas-fir and western hemlock forest	✓	✓	✓					✓								
Dry nonnative grassland	✓	✓	✓													

[*] = Not documented on Refuge. Species occupies habitat adjacent to Refuge or potential suitable habitat exists on Refuge.
[1] T = Threatened; E = Endangered; FC = Federal candidate; SoC = Refuge species of concern; SC = State candidate; SS = State sensitive; Sm = State Monitor
[2] Regional score. Category codes: 5 = Highly imperiled; 4 = High concern; 3 = Moderate concern; 2 = Low concern; 1 = No risk
[3] S1 = Critically imperiled; S2 = Imperiled; S3 = Rare, uncommon; S4 = Apparently secure; S5 = Demonstrably secure; SX = Apparently extirpated, SH = Historical occurrences, but still expected to occur. B = Breeding, N = Non-breeding, SN = Regularly occurring, non-breeding, SR = Reported but without persuasive documentation
[4] B = Breeding, N = Non-breeding; H = High concern or need, M = Moderate concern or need, L = Low concern or need, NAR = Not currently at risk, TBA = To be assessed, ✓ = included in plan
[5] 1 = State-listed and candidate species, 2 = Vulnerable aggregations, 3 = Species of recreational, commercial, and/or Tribal importance
[6] B = Breeding, N = Non-breeding: I = High continental importance, II = High regional priority, IIa = High regional concern, IIb = High regional responsibility, IIc = High regional threats
[7] DS = Declining species
✓ = Species is relevant to Refuge management and on the appropriate document(s).
✓+F = Species is a Bird of Management Concern as well as a Focal Species (Chapter 5)
[a] U.S. Fish and Wildlife Service 2001 (BIDEH)
[b] U.S. Fish and Wildlife Service 2012; National Oceanic and Atmospheric Administration 2012, 2011; Washington Department of Fish and Wildlife 2012; and Washington Department of Natural Resources 2012 .
[c] Washington Department of Fish and Wildlife 2008 & 2012 (State Priority species and habitats)
[d] Rich et al. 2004 (Partners In Flight – Landbirds)
[e] U.S. Fish and Wildlife Service 2008 (FWS Birds of Conservation Concern)
[f] U.S. Fish and Wildlife Service 2011 (FWS Birds of Management Concern and Focal Species
[g] Washington Department of Fish and Wildlife 2005 (State Wildlife Comprehensive Conservation Strategy)
[h] Drut and Buchanan 2000 (North Pacific Coast Shorebird Plan)
[i] Kushlan et al. 2002 (NA Waterbird Plan)
[j] Pacific Flyway Council 1983-2007
[k] North American Waterfowl Management Plan 2004

[l] Washington Department of Natural Resources 2005 and 2007 (Natural Heritage Plan)
[m] Rosenberg 2004 (PIF BCR – WA Level)
[n] Altman 2005 (Conservation Priorities for Landbirds of OR and WA)

Table E-4. Table BIDEH: Natural Plant Communities at the Black River Unit: Characteristics, Natural Processes Involved in Sustaining Community and Limiting Factors.

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, seral stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors and Threats
River Channel and some Tributary Channels with Mud Bottoms	• Habitat is confined to the channel portions of the Black River and its tributaries • Habitat also includes a small ribbon of bank habitat along the channel • Water flow is exceedingly slow • Water depth ranges about 3–15 feet deep in the main channel (depth possibly from dredging) • Water tends to be stained brown from tannic acid • Thick growth of submersed, native species such as water starwort, native milfoil species, duckweed, American waterweed , mosquito fern, and emergent plants such as spatterdock, smartweeds, and water pennywort *Potential conservation species*: *Olympic mudminnow and cutthroat trout. Additionally, Oregon spotted frog, pied-billed grebe, purple martin, tree and barn swallows, belted kingfisher, coho and Chinook salmon, freshwater sponges, bat species*	• Moderate to high annual rainfall levels (~60”/ yr) in winter • Almost annual winter flooding	• Altered hydrologic regime including reduced water in the system from diversion ditches and excessive water well withdrawals • Older logging practices allowed soil movement into river channel and silt to build up • Loss of naturally occurring flood events (due to altered hydrologic regime) allows silt to build up and loss of cobble bottom • Low water flow speed creates low dissolved oxygen levels • Nonnative, invasive plant species including reed canarygrass, purple loosestrife, and yellow flag iris are changing the plant community and choking water flow • Nearby threats not yet known to be in the system, such as New Zealand mud snail, hydrilla, Eurasian watermilfoil, parrotfeather, fanwort, etc.
Tributary Channels with Cobble Bottoms	• Tributaries run clear and shallow • Some elevational incline provides water movement • Cobble substrate • Higher oxygen content water from riffles than is found in the river channel • Cooler water temperatures than river channel • Riparian overstory provides shade and particulate matter • Heavy woody debris accumulation from natural sources *Potential Conservation Species: Coho salmon, and native crayfish*	• Moderate to high annual rainfall levels (~60”/ yr) in winter • Unpolluted and undisturbed water sources • Intact riparian habitat in headwaters • Springs near headwaters	• Altered hydrologic regime • Nonnative, invasive plant species specifically reed canarygrass is changing the associated riparian plant community • Threats not yet known to be in the system such as New Zealand mud snail, hydrilla, Eurasian watermilfoil, parrotfeather, fanwort, etc.

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, seral stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors and Threats
	spp. Additionally, cutthroat trout, invertebrates, freshwater mussels, bat species.		
Bog	• Bogs are dictated by sphagnum peat soil presence • Peat soils are dominated by sphagnum and/or with living *Sphagnum spp.* over the soil surface • Peat soils of different types retain water and provide a natural filtration • Bogs are domed in structure and rely on rain to provide moisture • Bog species may include sphagnum, native bog cranberry, sundew, white beak-rush, Labrador tea, western bog laurel, and shore pine *Potential conservation species: Bog specialist species such as Beller's ground beetle and Hatch's click beetle. Possibly Oueen Charlotte's copper butterfly, bristly sedge, sphagnum moss, Labrador tea, bog orchids, and possibly Pacific clubtailed dragonfly*	• Isolated from surface water flow • Fed primarily by precipitation and are generally restricted to areas in which precipitation exceeds evapotranspiration • Unpolluted and undisturbed water sources • Low pH and low nutrient levels in soils and water • Organic material accumulates faster than it decomposes • No fire disturbance	• Disturbance of any kind especially hydrologic changes, water loss or changes in water sources and timing • Loss of appropriate ground water levels • High nutrient, polluted, contaminated, or alkaline waters seeping or draining in from surrounding development or land use. • Invasive, nonnative plants will change plant community function and dynamics • Fire
Shrub Swamp	• Deciduous, tall shrublands dominate a wet, muddy substrate that is seasonally flooded • Occurs adjacent to the river or in lowland oxbows • Soils are poorly drained, fine-textured, organic muck • This shrub swamp grows so densely it could be described as impenetrable • Woody plants that developed from clear cutting include Oregon ash, Pacific crabapple, willows, red-osier dogwood, ninebark, and spirea • Other plants include skunk cabbage, touch-me-not, cleavers, bog violet, hedge nettle, water parsley, sedges, and horsetails • Oregon ash snags may reflect	• Seasonal flood conditions or periodic ponding or root zone saturation during the growing season • Consistent source of shallow freshwater is essential • Beaver and dam structures	• Loss of seasonally occurring, surface covering, flood waters • Water diversion, hydrologic changes • Former landowner logging helped to convert forested wetland or swamp to shrub swamp conditions • Fragmentation • Invasive, nonnative plants

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, seral stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors and Threats
	sustained flood conditions that cause larger growing shrubs to die *Potential conservation species: Willow flycatcher, Olympic mudminnow, and mink. Additionally, red-legged frog, Pacific tree frog, green heron, tree and barn swallows, purple martin, and spring migratory passerines, possibly Pacific clubtailed dragonfly*		
Riparian	• Occurs further upland from the river • Is in low-elevation, alluvial floodplains • This habitat was most likely logged years ago and has grown back with Oregon ash as the dominate tree along with ninebark, Pacific crabapple, black hawthorn and snow berry. Over time, big leaf maple, red alder, black cottonwood mixed with conifers will become the overstory with Sitka willow, Pacific willow, red-osier dogwood as the midstory *Potential resources of concern: yellow warbler, Swainson's thrush, Pacific tree frog. Additionally migratory passerines such as orange-crowned, black-throated gray, MacGillivray's, and Wilson's warblers, black-headed grosbeak, rufus hummingbird, purple martin, tree swallow, willow and Pacific-slope flycatchers, golden-crowned kinglet, and red-breasted sapsucker, northern flicker, pileated woodpecker,*	• Flooding and the plant succession that occurs after major flooding events	• Off-Refuge water diversion and withdrawal prevents natural flooding events • Fragmentation • Excess nutrient or contaminant runoff from agriculture or development • Invasive plant species
Emergent Marsh	• Freshwater marshes are dominated by emergent herbaceous species in depressions such as abandoned river channels, isolated swales, ponds and land depressions • Regular plant components include a wide variety of sedges, rushes, spike rushes, slough sedge, bristly sedge, cattails, bur-reed, tickseed,	• Semi-permanently flooded between 4"- 3' depths • Periodic ponding or saturation of the root zone during the growing season • Undrained hydric soils (muck or mineral) with high-nutrient water at or above the surface for the growing season • Consistent source of freshwater is essential	• Hydrologic regime alteration, water Ouality issues (i.e. temperature and sedimentation), increased nutrients, and passage barriers • Invasive, nonnative plant reed canarygrass has changed the native plant distribution and wildlife population in these areas • System wide water loss

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, seral stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors and Threats
	water hemlock, water parsley, yellowcress, monkeyflower, and skunk cabbage • Vegetation varies from <4" to 20" in height • Open patches of mud exposure • A small portion of the emergent marsh may include wet prairie and associated species. Inventory and monitoring is needed to verify this over time *Potential conservation species: Oregon spotted frog, northwestern salamander, and marsh wren. Additionally, Pacific tree frog, red-legged frog, American bittern, sora, Wilson's snipe, tree and barn swallows, common yellowthroat, purple martin, and possibly water howilla or bristly sedge, possibly Pacific clubtailed dragonfly*	• Land depressions that hold water where surface water lingers creating shallow wetlands	reduces surface water and critical shallow water habitats
Seasonally Flooded, Nonnative Grasslands	• Generally are former emergent marsh, possibly wet prairies that are now dominated by invasive RCG • RCG was planted in former private lands as a pasture grass in moist areas to provide livestock forage and it thrives • Adequate surface and river water availability throughout the seasons for maintaining wetland habitats and sustaining wildlife populations *Potential conservation species: red-legged frog, mallard, and greater yellowlegs, Oregon spotted frog, American bittern, sora, muskrat, American kestrel, Wilson's snipe, killdeer, possibly water howilla, or bristly sedge*	• Saturated to moist soils year round • Low elevation areas, open with little woody growth, and generally are proximal to the aquatic bed or tributaries	• Invasive and nonnative plant species such as RCG displace and outcompete native plant communities • Area subjected to almost annual flood (rising water) conditions resulting in 5 inches to 4 feet of standing water depth. Flood conditions may last as long as 3-4 months • RCG changes plant community structure and negatively affects wildlife species diversity • Lack of frequent fire (~ 3–4 year intervals), during dry season • Polluted or contaminated waters and possibly soils
Dry Nonnative Grassland	• Are residual agricultural pasturelands of nonnative grass and perennials such as timothy, quackgrass, fescues, foxtail, orchardgrass, ryegrass, velvetgrass, alfalfa, etc. • Nonnative pasture grasses planted in former private upland areas	• Low nutrient, gravelly, glacial outwash soils • Cool summers, wet winters	• Scot's broom, wild chervil, poison hemlock, burdock, Himalayan blackberry, and other upland invasive plants • Fire suppression • Forest encroachment

Habitat & Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age class, structure, seral stage, species composition)	Natural Processes Responsible for these Conditions	Limiting Factors and Threats
	Potential conservation species: Savannah sparrow and American kestrel. Additionally, western meadowlark, western bluebird, lazuli bunting, tree and barn swallows, purple martin, killdeer, and mourning dove.		
Mixed Forest	• Most areas on the Refuge are early to mid-successional stage stands recovering from logging. • Tree species generally include Douglas-fir and big leaf maple with young western hemlock and western red cedar growing in. • Mid-story plants include vine maple, red-osier dogwood, and osoberry. Understory with sword fern, salal, dull Oregon grape, trailing blackberry, twinflower, and vanilla leaf *Potential resources of concern: black-capped and chestnut-backed chickadees and varied thrush. Additionally, Steller's jay, rufous hummingbird, red-breasted sapsucker, northern flicker, pileated woodpecker, varied thrush, Vaux's swift, purple martin, tree swallow, golden-crowned kinglet, Wilson's, Townsend's, and MacGillivray's warblers, Pacific tree frog*	• Mild, moist climate • 35–100 inches of winter rain • Well-drained mesic to dry soils • Mosaic structure from fire	• Habitat fragmentation • Invasive species

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Appendix F. Statement of Compliance

STATEMENT OF COMPLIANCE
for implementation of the
Grays Harbor National Wildlife Refuge, Grays Harbor County, Washington
Black River Unit of Nisqually National Wildlife Refuge, Thurston County, Washington
Comprehensive Conservation Plan

The following executive orders and legislative acts have been reviewed as they apply to implementation of Grays Harbor National Wildlife Refuge and Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge Comprehensive Conservation Plan (CCP).

National Environmental Policy Act (1969), as amended
The planning process has been conducted in accordance with National Environmental Policy Act (NEPA) Implementing Procedures, with 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.C. §4321 et seq.) and its implementing regulations in 40 C.F.R. Parts 1500–1508 have been satisfied in the procedures used to reach this decision. 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/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. In addition, the Service participated in a variety of public outreach efforts throughout the planning process (see Appendix J).

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
The management of the archaeological and cultural resources of the Refuge and the Unit will comply with the regulations of Section 106 of the National Historic Preservation Act. Under the proposed action, historic properties would be maintained and repaired as funding becomes available. Maintenance and improvement of historic resources would 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 any 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 and Unit staff, 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 of June 5, 1997 (American Indian Tribal Rights, Federal Tribal Responsibilities, and the Endangered Species Act), the Refuge and Unit acknowledge the responsibilities to communicate meaningfully with federally recognized Tribes on a government-to-government basis. This responsibility includes working directly with Tribes in developing programs for healthy ecosystems, remaining sensitive to Indian culture, and making information available to Tribes.

Executive Order 12898. Federal Actions to Address Environmental Justice in Minority and Low-Income Populations
All Federal actions must address and identify, as appropriate, disproportionately 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. Actions in all alternatives were 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
The Service has evaluated the suitability of the Refuge and the Unit 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 either Grays Harbor NWR or Black River Unit 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).

National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (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 refuges; fish, wildlife, and plant populations and related habitats on the refuges; archaeological and cultural values of the refuges; issues that may affect populations and habitats of fish, wildlife, and plants; actions necessary to restore and improve biological diversity on the refuges; 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 and the Unit. 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 and Unit migratory birds' habitats, public use activities, and cultural resources actions were assessed within the draft CCP/EA.

Endangered Species Act (1973), as amended
The Endangered Species Act (ESA) 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 ESA. Refuge policy requires the refuge manager to document issues that affect or may affect endangered species before initiating projects. Consultation on specific projects will be conducted prior to implementation to avoid any adverse impacts to these species and their habitats.

Executive Order 11990. Protection of Wetlands
The CCP is consistent with Executive Order 11990 because CCP implementation would protect any existing wetlands.

Integrated Pest Management. 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 and the Unit. In accordance with 517 DM 1, only pesticides registered with the U.S. Environmental Protection Agency (USEPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act and as provided in regulations, orders, or permits issued by USEPA may be applied on lands and waters under Refuge and Unit jurisdiction (see Appendix G).

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 Grays Harbor NWR and Black River Unit CCP implementation would maintain and enhance habitats located within floodplains on the Refuge and the Unit, which will minimize flood impacts and continue to contribute to the natural and beneficial fish and wildlife resource values unique to the area.

Architectural Barriers Act of 1968, as amended
This 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/EA.

_____	_____
Project Leader, Nisqually National Wildlife Refuge Complex	Date

Appendix G. Integrated Pest Management

G.1 Background

Integrated Pest Management (IPM) applies equally to Grays Harbor NWR and the Black River Unit. In this appendix, the terms "refuge" and "Refuge" refer to both Grays Harbor NWR and the Black River Unit.

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 would 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 would be particularly relevant where long-term impacts may be uncertain and future monitoring would 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, would 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 would be considered when determining feasibility/practicality of various treatments.

IPM techniques to address pests are presented as CCP strategies (see Section 2.0 of this CCP/EA) 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 draft CCP/EA:

- Habitat and/or wildlife objectives that identify pest species and appropriate thresholds to indicate the need for and successful implementation of IPM techniques
- 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 Section 4.0 (Environmental Consequences) of this draft CCP/EA. Only pesticide uses that likely would cause minor, temporary, or localized effects to refuge biological resources and environmental quality with appropriate 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. Moreover, it does not address the effects of mosquito control with pesticides (larvicides, pupacides, or adulticides). However, the basic framework to assess

potential effects to refuge biological resources and environmental quality from aerial application of pesticides or use of insecticides for mosquito management 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
- 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 draft CCP/EA, 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, which are considered pests, may be managed if the following criteria are met:

- Threat to human health and well-being 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
- 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 well-being
- 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
- 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 staffs and public (e.g., auto tour routes) driving on structurally compromised levees and dikes can be threaten 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 would 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.
- 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.
- 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 would 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.
- 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 staffs, 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).
- 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.
- 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.
- Refuge staff would require grazing permittees to utilize preventative measures for their livestock while on refuge lands.
- Refuge staff would inspect borrow material for invasive plants prior to use and transport onto and/or within refuge lands.
- Refuge staff would consider invasive plants in planning for road maintenance activities.
- 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:

- 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 US Forest Service (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, sheering, 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 would 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 US 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
- 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, US Forest Service, National Park Service, US 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 Shelly 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 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 FW7.7A, 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 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 FW7.18A 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]), a 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 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 4.0) 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 US Environmental Protection Agency (2004). Assumptions for these risk assessments are presented in Section 6.2.3.

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 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 US 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

Risk Presumption		Level of Concern	
		Listed Species	Non-listed Species
	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 1993a). 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 Kenaga nomogram method (USEPA 2012, Pfleeger et al. 1996) through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.5 (USEPA 2012). 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 Kenaga 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 1.5 (USEPA 2012) contains a submodel which automates Kenaga 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-% 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 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, US Forest Service, National Park Service, US 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 US 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 US 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 US 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 Kenaga 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 Kenaga 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 Kenaga 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 will tend 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 US 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 will 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 effects pesticide degradation.
- Soil pH would influence chemical reactions that occur in the soil which in turn determines whether or not a pesticide will 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 is 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 5.0), 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 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 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 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 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 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 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 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 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 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 7.2.1.2 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 Kenaga nomogram method through the USEPA's T-REX version 1.5. 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 7.2.1.1.2 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 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 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 provides 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 4.0 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, US Environmental Protection Agency, Washington, DC. (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, US Department of Agriculture, US 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 the Interior; Bonneville Power Administration, U.S. Department of Energy; and Forest Service, US 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. US Environmental Protection Agency, Washington, DC (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, DC (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. US Geological Survey, Department of Interior, Washington, D.C. (http://www.pwrc.usgs.gov/contaminants-online/)
17. One-liner database. 2000. US Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

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 (t½):	

Soil Dissipation (DT_{50}):	
Aquatic Persistence (t½):	
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 References

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Appendix H. Abbreviations and Glossary

H.1 Abbreviations

Below is a list of the most common acronyms and abbreviations within this CCP document.

a.i.	Active Ingredient
Act	National Wildlife Refuge System Improvement Act of 1997 (also Improvement Act or NWRSIA)
ABC	American Bird Conservancy
ADA	Americans with Disabilities Act
Administration Act	National Wildlife Refuge System Administration Act of 1966
AHPA	Archaeological and Historic Preservation Act
AM	Adaptive Management
ARPA	Archaeological Resources Protection Act
AUD	Appropriate Use Determination
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BIDEH	Biological Diversity, Integrity, and Environmental Health
BMC	Birds of Management Concern
BMP	Best Management Practice
BP	Before Present
CCP	Comprehensive Conservation Plan
CD	Compatibility Determination
CEQ	White House Council on Environmental Quality
CFR	Code of Federal Regulations
CLMA	Cooperative Land Management Agreement
CMP	Conceptual Management Plan
COE	U. S. Army Corps of Engineers
CRBAP	Chehalis River Basin Action Plan
CWCS	Comprehensive Wildlife Conservation Strategy
CZMP	Coastal Zone Management Program (Washington State)
DO	Dissolved Oxygen
DOI	Department of the Interior
DM	U.S. Department of the Interior Manual
DPS	Distinct Population Segment
DSL	Department of State Lands
EA	Environmental Assessment
EE	Environmental Education
EIS	Environmental Impact Statement
E.O.	Executive Order

EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Ecological Significant Unit
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FWS	U.S. Fish and Wildlife Service (also, Service, USFWS)
GHG	Greenhouse Gas
GHPUD	Grays Harbor Public Utility District
GIS	Geographic Information System
GHCNWB	Grays Harbor County Noxious Weed Board
GLO	Government Land Office
IBA	Important Bird Area
Improvement Act	National Wildlife Refuge System Improvement Act of 1997 (also Act, NWRSIA)
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
LE	Law Enforcement
LPP	Land Protection Plan
LCC	Landscape Conservation Cooperative
LCD	Landscape Conservation Design
LWCF	Land and Water Conservation Fund
LWD	Large Woody Debris
MAPS	Monitoring Avian Productivity System
MBCC	Migratory Bird Conservation Commission
MBCF	Migratory Bird Conservation Fund
MBTA	Migratory Bird Treaty Act
MHW	Mean High Water
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MMS	Maintenance Management System
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
mph	Miles per Hour
MSDS	Material Safety Data Sheet
NAS	National Audubon Society
NAWCA	North American Wetlands Conservation Act
NAWCP	North American Waterbirds Conservation Plan
NAWMP	North American Waterfowl Management Plan
NEPA	National Environmental Policy Act
NGO	Non-Governmental Organization

NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPCRSCP	Northern Pacific Coast Region Shorebird Conservation Plan
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
NWRC	National Wildlife Refuge Complex
NWRS	National Wildlife Refuge System
NWRSIA	National Wildlife Refuge System Improvement Act of 1997
OSF	Oregon Spotted Frog
PBRO	Point Reyes Bird Observatory
PCJV	Pacific Coast Joint Venture
PFMP	Pacific Flyway Management Plan
PIF	Partners in Flight
PPE	Personal Protective Equipment
PPP	Preliminary Project Proposal
PPT	Parts Per Thousand
PUD	Public Utilities District
PUP	Pesticide Use Proposal
PUPS	Pesticide Use Proposal System
R1	Region 1 of the U.S. Fish and Wildlife Service
RAPP	Refuge Annual Performance Plan
RCRA	Resource Conservation and Recovery Act.
RCG	Reed Canarygrass
Refuge System	National Wildlife Refuge System
RM	Refuge Manual
RM	River Mile
RNA	Research Natural Area
ROC	Resource of Concern
RONS	Refuge Operating Needs System
ROS	Recreational Opportunity Spectrum
ROW	Right-of-Way
SAMMS	Service Asset Maintenance and Management System
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SCP	Seabird Conservation Plan
Service	U.S. Fish and Wildlife Service (also FWS, USFWS)
SHPO	State Historic Preservation Office
SLAMM	Sea Level Affecting Marshes Model
SOC	Species of Concern
SUP	Special Use Permit

T&E	Threatened and Endangered Species
TNC	The Nature Conservancy
TCNWCB	Thurston County Noxious Weed Control Board
TESS	Federal Threatened and Endangered Species list
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
U.S.C.	United States Code
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service (also FWS, Service)
USGS	U.S. Geological Survey
USSCP	U.S. Shorebird Conservation Plan
WAP	Washington Wildlife Action Plan
WCC	Washington Conservation Corps
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WDOE	Washington Department of Ecology
WFWO	Washington Fish and Wildlife Office (of USFWS)
WHSRN	Western Hemisphere Shorebird Reserve Network
WPA	Works Progress Administration
WRIA	Water Resources Inventory and Assessment
WRP	Wetland Reserve Program
WSSC	Washington State Service Corps
WSDA	Washington State Department of Agriculture
WSPRC	Washington State Parks and Recreation Commission
WTHP	Washington Trust for Historic Preservation
USSCP	U.S. Shorebird Conservation Plan

H.2 Glossary

Accessible. Without fences or vegetative barriers (tall, dense vegetation) at its margins.

Adaptive Management. The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels (Service Manual 602 FW 1.4).

Alternative. Different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues (Service Manual 602 FW 1.6). The "no action" alternative is current refuge management, while the "action" alternatives are all other alternatives.

Appropriate Use. A proposed or existing use on a refuge that meets at least one of the following four conditions:
(1) The use is a wildlife-dependent recreational use as identified in the Improvement Act.
(2) The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
(3) The use involves the take of fish and wildlife under State regulations.
(4) The use has been found to be appropriate as specified in section 1.11 of the USFWS Appropriate Use Policy (Service Manual 603FW1).

Approved Acquisition Boundary. National wildlife refuge boundary approved by the National or Regional U.S. Fish and Wildlife Service Director for potential acquisition of lands by the Service.

Approved Refuge Boundary. A national wildlife refuge boundary approved by the National or Regional U.S. Fish and Wildlife Service Director. Within this boundary, the Service may negotiate with landowners to acquire lands not already owned by the Service (Modified from Region 1 Landowner Guide, USFWS Division of Refuge Planning).

Archaeology. The scientific study of material evidence remaining from past human life and culture (Webster's II).

Benefiting Resources. Those species, species groups, or resources expected to benefit from actions taken for a resource of concern.

Big Six. Wildlife-dependent recreational uses identified in the Refuge System Improvement Act that receive priority consideration in planning: hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

Birds of Conservation Concern. A category assembled by the U.S. Fish and Wildlife Service Division of Migratory Birds identifying the migratory and nonmigratory species (beyond those already designated as federally threatened or endangered) that represent the Division's highest conservation priorities (FWS, Division of Migratory Birds).

Biological Diversity (also Biodiversity). 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 (Service Manual 601FW3). The Refuge System's focus is on indigenous species, biotic communities, and ecological processes.

Biological Integrity. 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 (Service Manual 601FW3).

Bog. A slightly domed, low-nutrient, and low-pH plant system which grows on sphagnum peat. The system depends on low-nutrient rainfall for its moisture. Plants growing in these sensitive wetlands are specifically adapted to these severe conditions and are uncommon elsewhere.

Bulkhead. A man-made wall-like structure whose primary purpose is to hold or prevent sliding of soil caused by erosion and wave action. In Grays Harbor, a bulkhead was constructed in the 1940s to hold rock and soil. The entire bulkheaded area eventually was filled and became Bowerman Airport.

Candidate Species (Federal). Fish, wildlife, or plant species for which the Service or NOAA has on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened under the ESA, but the proposal is precluded by other priorities.

Candidate Species (State). Fish, wildlife, or plant species that a state will review for possible listing as a state-endangered, -threatened, or -sensitive species. A species will be considered for designation as a state candidate if sufficient evidence suggests that its status may meet the listing criteria defined for state-endangered, -threatened, or -sensitive.

Categorical Exclusion. A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a Federal agency pursuant to the National Environmental Policy Act (40 CFR 1508.4).

Channel. Channel habitat is where water flows within the confines of river or tributary banks and includes the nearby edges of the gently sloped bank.

Compatibility Determination. A written determination signed and dated by the refuge manager and regional chief signifying that a proposed or existing use of a national wildlife refuge is a compatible use or is not a compatible use. The Director makes this delegation through the Regional Director (Service Manual 603 FW 2).

Compatible Use. A wildlife-dependent recreational use or any other use of a refuge 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 (Service Manual 603 FW 3.6). A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

Comprehensive Conservation Plan. A plan that describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purpose(s) of the refuge; helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the biological integrity, diversity, and environmental health of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System, if appropriate; and meets other mandates (Service Manual 602 FW 1.4).

Concern: See Issue.

Connectivity. The arrangement of habitats that allows organisms and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation.

Conservation Targets (also see **Resources of Concern; Priority Species, Species Groups, Focal Species,** and **Communities).** Term used by land management agencies and conservation organizations to describe the resources (ecological systems, ecological communities, species, species groups, or other natural resources) selected as the focus of conservation actions (Adapted from Low, Functional Landscapes 2003).

Consumptive Use. Recreational activities such as hunting and fishing that involve harvest or removal of wildlife or fish, generally to be used as food by humans.

Contaminants or Environmental Contaminants. Chemicals present at levels greater than those naturally occurring in the environment resulting from anthropogenic or natural processes that potentially result in changes to biota at any ecological level (USGS, assessing EC threats to lands managed by USFWS). Pollutants that degrade other resources upon contact or mixing (Adapted from Webster's II).

Cooperative Agreement. An official agreement between two parties.

Cover. The estimated percent of an area, projected onto a horizontal surface, occupied by a particular plant species.

Cover Type. The present vegetation of an area.

Cultural Resources. The physical remains, objects, historic records, and traditional lifeways that connect us to our Nation's past (USFWS, Considering Cultural Resources).

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 background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or 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).

Deciduous. Describes trees and shrubs which shed all their leaves each year.

Direct Loss. Loss of food or habitat when nonnative species outcompete native species.

Dissolved Oxygen. The concentration of oxygen dissolved in water, expressed in mg/l or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature.

Distinct Population Segment (DPS). A subdivision of a vertebrate species that is treated as a species for purposes of listing under the Endangered Species Act. To be so recognized, a potential DPS must satisfy standards specified in a Service or NOAA policy statement (See the February 7,

1996, Federal Register, pages 4722-4725). The standards require it to be separable from the remainder of and significant to the species to which it belongs.

Disturbance. Significant alteration of habitat structure or composition, or of the behavior of wildlife. May be natural (e.g., fire) or human-caused (e.g., aircraft overflight) events.

Ecological Attribute. A characteristic or condition required to support the life history, habitat, physical processes, or community interaction of conservation targets.

Ecosystem. A dynamic and interrelated complex of plant and animal communities and their associated nonliving 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.

Effect (Impact). A direct result of an action which occurs at the same time and place, or an indirect

result of an action which occurs later in time or in a different place and is reasonably foreseeable, or the cumulative results from the incremental impacts of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions (40 CFR 1508.8).

Emergent Vegetation. Herbaceous plants that require a water environment to grow for at least part of their life cycle, stem structure is rigid and self-supporting, and vegetative growth continues above the waterline.

Endemic. A species that is native to the area in which it is found; a species confined to a specific region.

Environmental Assessment. 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).

Environmental Impact Statement. A detailed written statement required by section 102(2) (C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short term uses of the environmental versus the maintenance and enhancement of long-tern productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Endangered Species (Federal). An animal or plant species 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 a state 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 Health. 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 (Service Manual 601FW3).

Enhance. To improve the condition of an area or habitat, usually for the benefit of certain native species.

Estuarine. Deepwater tidal habitats and adjacent tidal wetlands that are usually partly enclosed by land but have some access to the open ocean and are diluted by fresh water.

Ethnography. The study and systematic recording of human cultures; a descriptive work produced from such research.

Exotic Species. A species from another part of the state or the world that does not occur naturally in an area. A nonnative species, either plant or animal **(**see nonnative, invasive, nuisance, noxious).

Executive Order. A President's or Governor's declaration which has the force of law, usually based on existing statutory powers, and requiring no action by the Congress or state legislature.

Experimental Population. A population (including its offspring) of a listed species designated by a rule published in the Federal Register that is wholly separate geographically from other populations of the same species. An experimental population may be subject to less stringent prohibitions than are applied to the remainder of the species to which it belongs.

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).

Floodplain. A flood plain is an area of relatively level land—usually bordering a lake, stream, or river—that gets inundated with water from time to time. The flood plain includes the floodway, the border area of land that normally gets inundated during annual or 10-year floods, and the floodway fringe, which may get inundated during a 100-year or 500-year flood (WDOE).

Focal Conservation Target. A suite of conservation targets that for purposes of planning are sorted and condensed to represent threats to biological integrity, diversity, and environmental health at the refuge level.

Focal Species. Those species whose ecological requirements are used to define quality habitat (on a refuge), to measure habitat conditions and ecological processes, and maintain the range required by the species and many other species using the same habitats.

Forb. An herbaceous, flowering plant that is not a grass, sedge, or rush.

Goal. Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Service Manual 620 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 Connectivity (also Landscape Connectivity). The arrangement of habitats that allows organism and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation. The opposite of fragmentation.

Habitat Management Plan. A plan that provides refuge managers with a decision-making process; guidance for the management of refuge habitat; long-term vision, continuity, and consistency for habitat management on refuge lands (Service Manual Habitat Management Planning policy 620FW1.4).

Habitat Restoration. Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

Historic Conditions. Composition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human-related changes to the landscape. (Service Manual 601FW3)

Hydrology. A science dealing with the properties, distribution, and circulation of water on and below the earth's surfaces and in the atmosphere.

Hydrograph. A graph of water flows in a river or stream. A hydrograph provides a way of seeing seasonal and yearly changes in the flow or discharge of a waterway.

Hydroperiod. A segment of a hydrograph for a specific time frame.

Important Bird Area. A site that provides essential habitat for one or more species of bird and that is recognized as being important on a global, continental, or state level.

Indicator. A measurable characteristic of a key ecological attribute that strongly correlates with the status of the key ecological attribute. Something that serves as a sign or symptom.

Inholding. Refers to lands within an approved refuge boundary that are not owned by the Service. These can be private lands or lands owned by city, county, state, or other Federal agencies.

Integrated Pest Management (IPM). The use of pest and environmental information in conjunction with available pest control technologies to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to persons, property, and the environment (U.S. EPA Pesticide Glossary).

Interpretation. A teaching technique that combines factual information with stimulating explanation. Frequently used to help people understand natural and cultural resources (yourdictionary.com).

Interpretive Trail. A trail with informative signs that provide factual and stimulating explanations of what the visitors see, hear, feel, or otherwise experience while on the trail.

Intertidal Mudflat. Expanses of silt, mud, or sandy mud affected by rising and falling tides. They are often components of estuaries and are revealed when the tide goes out.

Invasive. Nonnative species (plant or animal) disrupting and replacing native species and disrupting ecological function and processes (thebiotechdictionary.com) (see exotic, nonnative, nuisance).

Inventory. A survey of the plants or animals inhabiting an area.

Inviolate Sanctuary. The original intent of the term *inviolate sanctuary* is found in the Migratory Bird Conservation Act (first passed in 1918 as the Migratory Bird Treaty Act and amended in 1934 and 1938). This Act originally required that all refuges be inviolate sanctuaries and deemed refuges' primary purposes were as breeding grounds and habitat for migratory birds. Migratory bird hunting was prohibited on migratory waterfowl areas by the Act, but most other human uses were not addressed. The 1938 amendment to the Act gave refuge managers authority to decide if, when, and how bird hunting would be allowed. After World War II, public demand for opening refuges to recreation increased. The 1949 Duck Stamp Act allowed waterfowl hunting on refuges, but restricted the percentage of each refuge open to hunting. Current policy states that portions of a refuge are considered "inviolate sanctuaries" if they were (a) acquired with the approval of the Migratory Bird Conservation Commission (MBCC) for the purpose of an inviolate sanctuary; (b) acquired with MBCC approval or Land and Water Conservation Funds to protect a threatened or endangered species; or (c) established by an instrument or document which states the intent to manage the area as an "inviolate sanctuary for migratory birds" or to fulfill the purpose of the Migratory Bird Conservation Act. Policy further allows migratory game bird hunting on no more than 40 percent of the area considered inviolate sanctuary if compatible with a refuge's purposes and mission. Inviolate sanctuary classification imposes no limits on hunting nonmigratory birds, fur bearers, or other game species.

Issue. 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 (Service Manual 620 FW 1.6).

Key Ecological Attributes. Those aspects of the environment, such as ecological processes or patterns of biological structure and composition, that are critical to sustain the long-term viability of the target. These key ecological attributes are further divided into measurable indicators.

Keystone Species. Species who enrich ecosystem function in a unique and significant manner through their activities, and the effect is disproportionate to their numerical abundance. Their removal initiates changes in ecosystem structure and often loss of diversity. These keystones may be habitat modifiers (i.e., cottonwood or beaver), predators (i.e., puma or coyote) or herbivores (i.e., prairie dog) (Sonoran Desert Conservation Plan).

Land Protection Plan (LPP). A plan detailing the protection, via acquisition of fee-title, easement, lease, cooperative agreement, or other means, of a given land parcel to protect important natural resource values on the land. An LPP is prepared by the Service to evaluate the needs, goals, and appropriate strategies for implementing land protection.

Legacy Data. Historic or past data collected from surveys, monitoring, or study projects conducted upon refuges.

Listed Species (Federal). Species that have been formally listed under the Endangered Species Act as threatened or endangered. Also includes candidate and proposed species. An endangered species is one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered in the foreseeable future. Candidate species include those taxa for which there is sufficient biological information to support a proposal to list as endangered or threatened. Proposed species include taxa for which the Service or NOAA has

published a proposal to list as endangered or threatened in the Federal Register. (Oregon Fish and Wildlife Office).

Macrophyte. A macrophyte may be an emergent, submergent, or floating type of aquatic plant. Its ecological significance is to provide cover for fish and act as substrate for aquatic invertebrates, as well as to produce oxygen and serve as food for some fish and other wildlife.

Maintenance. The upkeep of constructed facilities, structures, and capitalized equipment necessary to realize the originally anticipated useful life of a fixed asset. Maintenance includes preventative maintenance; cyclic maintenance; repairs; replacement of parts, components, or items of equipment; periodic condition assessment; periodic inspections, adjustment, lubrication, and cleaning (nonjanitorial) of equipment; painting, resurfacing, rehabilitation; special safety inspections; and other actions to assure continuing service and to prevent breakdown.

Maintenance Management System (MMS). A national database of refuge maintenance needs and deficiencies. It serves as a management tool for prioritizing, planning, and budgeting purposes (RMIS descriptions).

Mean High Water. The average level of the surface of the river, as used as a standard in determining land elevation or sea depths.

Mean Higher High Water. The average of the two high waters of any tidal day (24-hr period).

Migration. The seasonal movement from one area to another and back.

Migratory Birds. Those species of birds listed under 50 CFR 10.13 (Service Manual 720 FW 1, Policies and Responsibilities of the Migratory Bird Program).

Mixed Forest. Mixed forest is a habitat type in uplands that consists of a group of native plant species in a layered structure appropriate to this Puget Sound lowland area. The forest includes native deciduous and coniferous trees, a midstory of small trees and shrubs, and an understory of herbaceous ground cover plants.

Monitoring. The process of collecting information to track changes of selected parameters over time.

Monoculture. Vegetation composed primarily of a single species, such as areas dominated by invasive weeds.

National Environmental Policy Act of 1969 (NEPA). Requires all Federal agencies 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).

Native Species. A species that naturally or historically occurs in a particular ecosystem.

National Natural Landmark. A nationally significant natural area that has been designated by the Secretary of the Interior. To be nationally significant, a site must be one of the best examples of a type of biotic community or geologic feature in its physiographic province.

National Register of Historic Places. The Nation's master inventory of known historic properties administered by the National Park Service. Includes buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archeological, or cultural significance at the national, state, and local levels (USFWS, Considering Cultural Resources).

National Wildlife Refuge. A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System, excluding coordination areas (Service Manual 601 FW1.3).

National Wildlife Refuge System. Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management areas; or waterfowl production areas.

National Wildlife Refuge System Administration Act of 1966. A Federal law creating the National Wildlife Refuge System and stating its mission 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 (16 U.S.C. 668dd) (Public Law 114-38).

National Wildlife Refuge System Improvement Act of 1997 A Federal law that amended and updated the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668) (Public Law 105-57).

Naturalized. A nonnative plant or animal that has been established for so long it is sometimes considered part of the native flora and fauna.

Neotropical migrant. A bird that winters in southern Mexico, Central or South America, or the West Indies and migrates northward to breed in North America.

Nonnative Grasslands. Upland areas formerly used for agricultural purposes such as pastures and include a mixture of nonnative pasture grasses and herbaceous plants.

Nonnative Species. An introduced species that did not naturally occur in an area prior to Euroamerican settlement of the Americas.

Nonconsumptive recreation. Recreational activities that do not involve harvest, removal, or consumption of fish, wildlife, or other natural resources.

Nonpoint Source. Coming from more than one location. Frequently refers to pollution or erosion that comes from a widespread area and accumulates in streams and rivers.

Noxious Weed. A plant species designated by Federal or state law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insect or disease; or nonnative, new, or not common to the United States. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

Nuisance Species. An aggressive or difficult to manage species that impairs plant community function or natural processes. Usually a noxious, nonnative, or invasive species of plant or animal.

Objective. A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Objectives should be attainable, time-specific, and measurable (Service Manual 620 FW 1.6).

Operations. Activities related to the normal performance of facilities and equipment. Costs such as utilities (electricity, water, sewage) fuel, janitorial services, window cleaning, rodent and pest control, upkeep of grounds, vehicle rentals, waste management, and personnel costs for operating staff are generally included within the scope of operations.

Open Water. A habitat type that may include ponds, freshwater lakes, oceans, or estuaries. Regarding an estuary, it is the area of water that remains in the estuary regardless of tidal exchange processes.

Outreach. Providing information to the public on a specific issue through the use of the media, printed materials, and presentations.

Pacific Flyway. One of several major north-south travel corridors for migratory birds. The Pacific Flyway is west of the Rocky Mountains.

Passerines (also Songbirds). A category of birds that are medium to small, perching landbirds. Most are territorial singers and migratory.

Peat. The least decomposed of all organic soil material. Peat contains a large amount of well-preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material. Peat forms in bottomland hydric soils and in the Black River these are the Semiahmoo and Mukilteo muck soils.

Planning Team. The primary U.S. Fish and Wildlife Service staff and others who play a key role in developing and writing the CCP. Planning teams are interdisciplinary in membership and function. Teams generally consist of a planning team leader, refuge manager, and staff biologists, a state natural resource agency representative, and other appropriate program specialists (e.g., social scientist, ecologist, recreation specialist). We also include other natural resource agencies to provide team members, as appropriate. The planning team prepares the CCP and appropriate NEPA documentation (Service Manual 620 FW 1.6).

Plant Association. A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community (e.g., Oregon white oak/ovalleaf viburnum/poison oak plant association).

Plant Community. An assemblage of plant species that is unique in its composition, occurs in particular locations under particular influences, reflects or integrates the environmental influences on the site, such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall, and that denotes a general kind of climax plant community (e.g., Oregon white oak woodland).

Port of Grays Harbor. State legislation established the laws that would allow communities like Grays Harbor to form their own public port. Founded in 1911, PGH district was founded and is governed by three elected commissioners.

Parts Per Thousand (Ppt). A measure of salinity in oceans, estuaries, river mouths, and other waters.

Preferred Alternative. The alternative determined to best achieve the Refuge purpose, vision, and goals; to best contribute to the Refuge System mission; to best address the significant issues; and to be consistent with principles of sound fish and wildlife management.

Preplanning. The first phase of comprehensive conservation planning. It includes identifying the planning area and data needs, establishing the planning team and planning schedule, reviewing available information, preparing a public involvement plan, and conducting internal scoping.

Priority Public Uses. Hunting, fishing, wildlife observation and photography, environmental education and interpretation, where compatible, are defined under the National Wildlife Refuge System Improvement Act of 1997 as the six priority public uses of the National Wildlife Refuge System (See **Big Six**).

Priority Species. Fish and wildlife species that the Washing Department of Fish and Wildlife believes require protective measures and/or management guidelines to ensure their perpetuation. Priority species include:

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;

3) Species of recreation, commercial, and/or Tribal importance.

Proclamation. The official designation of the reason(s) a particular national monument was established and the purposes for which it is to be managed.

Public. Individuals, organizations, and groups; officials of Federal, state, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the planning team. It includes those who may or may not have indicated an interest in Service issues and those who may or may not realize that Service decisions may affect them.

Public Land Order. Public lands consist of that class of land remaining from the original public domain that was acquired by the United States by treaty, purchase, or cession from a foreign power.

Public Use Area. A designated area within a refuge that is open to the public.

Raptor. A category of carnivorous birds, most of which have heavy, sharp beaks and strong talons, and take live prey (e.g., peregrine falcon, bald eagle).

Refuge Operating Needs System (RONS). A national database of unfunded refuge operating needs required to meet and/or implement station goals, objectives, management plans, and legal mandates.

It is used as a planning, budgeting, and communication tool describing funding and staffing needs of the Refuge System.

Refuge Purpose(s). The purposes 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 620 FW 1.6).

Research Natural Area (RNA). Special designation areas on national wildlife refuges established to (1) Preserve examples of major ecosystem types or other outstanding physical or biological phenomena; (2) Provide research and educational opportunities; and (3) Preserve a full range of genetic and behavioral diversity for native plants and animals, including endangered or threatened species.

Resource of Concern (ROC). All plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), Refuge 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 (FWS Habitat Management Planning policy, 620 FW1.4).

Restoration/Restore. The act of bringing back to a former or original condition (Webster's II).

Riparian Forest. A wooded habitat between upland and aquatic habitats. The forest is higher in elevation than a swamp, but has seasonally wet or moist soils. The forest is generally composed of more deciduous than conifer trees and has a species-rich and dense mid- and understory.

River Mile. The river is measured and numbered by mile, from the river mouth (starting number 0) to the head waters.

Salmonid. A category of elongate, boney fishes that have the last three vertebrate upturned, such as salmon, steelhead, and trout.

Salt and Brackish Marsh. Emergent wetlands growing on the edge of the mudflat up to the highest tide lines and are frequently inundated with tidal (saline) water depending on tide height. Salt marsh plants are adapted to and tolerant of higher saline levels ranging from moderate to essentially that of sea water (18- to 30-ppt salt). Brackish marshes need greater freshwater inputs to reduce the intensity of marine water levels (0.5 to 18 ppt salt).

Scoping. Engaging State, local and tribal governments and the public in the early identification of concerns, potential impacts, relevant effects of past actions, and possible alternative actions. Outreach is used to notify the public of the opportunity to participate.

Seasonally Flooded, Nonnative Grasslands. Low-lying lands flooded from October to May that are dominated by the aggressive, dense, and nonnative reed canarygrass. Most likely farmers established reed canarygrass in these floodplain sites to provide livestock forage.

Seral. Of or relating to an ecological sere; a seral stage.

Shrub Swamp. Freshwater wetlands found in broad low-lying zones where soils are poorly drained, fine-textured organic muck, and the substrate is permanently saturated or underwater during 6 months of the year. The habitat is dominated by shrubby native plants adapted to very wet conditions that can grow into virtually impenetrable thickets.

Significant Effect. Use of the term in NEPA requires consideration of both context and intensity (40 CFR 1508.27). Context means the significance of an action must be analyzed in its current and proposed short- and long-term effects on the whole of a given resource (e.g., affected region). Intensity refers to the severity of the effect.

Songbirds (also Passerines). A category of birds that are medium to small, perching landbirds. Most are territorial singers and migratory.

Source. An extraneous factor that causes stress (the most proximate cause) (TNC 2000).

Species of Concern. An informal term referring to a species determined by a refuge or fish and wildlife office to be in need of conservation action. This could include a need for periodic monitoring of populations and the threats to the species and its habitat. Such species receive no legal protection, and use of the term does not imply that a species will eventually be proposed for Federal listing.

Step-down Management Plan. A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives (Service Manual 620 FW 1.6).

Strategy. A specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 620 FW 1.6).

Stress. The impairment or degradation of a key ecological attribute for a conservation target (TNC 2000).

Sweetgrass. Also known as "common three-square bulrush." Its current scientific name is *Schoenoplectus pungens*; its former scientific name was *Scirpus americanus.* This sedge (not a grass) is a component of basket weaving in Pacific Northwest Native American cultures.

Threatened Species (Federal). An animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Threatened Species (State). A plant or animal species likely to become endangered in a state within the near future if factors contributing to population decline or habitat degradation or loss continue.

Turbidity. A level or measurement of water clarity based on particles suspended in the water.

Vegetation Type (Also **Habitat Type**, **Forest Cover Type, Plant Community**). A land classification system based upon the concept of distinct plant associations.

Vision Statement. A concise statement of what the planning unit should be, or what we hope to do, based primarily upon the Refuge System mission and specific refuge purposes and other mandates. The vision statement for a refuge is tied to the mission of the Refuge System; the purpose(s) of a refuge; the maintenance or restoration of the ecological integrity of each refuge and the Refuge System; and other mandates (Service Manual 620 FW 1.6).

Waterfowl. Resident and migratory ducks, geese, and swans.

Water Quality. A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Watershed. The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds, like the Mississippi River basin, contain thousands of smaller watersheds.

Wetlands. Wetlands are transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water at some time during the growing season of each year (Service Manual 660 FW 2; Cowardin et al. 1979).

Wildlife-Dependent Recreational Use. A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation. These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. The Service will also consider these other uses in the preparation of refuge CCPs; however, the six priority public uses always will take precedence. (Service Manual 620 FW 1.6)

Appendix I. CCP Team Members and Contributors

I.1 Planning Team Members

The Comprehensive Conservation Plan was developed primarily by a core planning team. Team members are the primary strategists, analysts, and writers, and attended all team meetings. To avoid scheduling and logistical conflicts, the core team had a limited number of participants.

The extended team, which included professionals from several different agencies, organizations, and Service programs, played a supporting role to the core team. Extended team members provided critical input early in the alternatives development process, and continued to provide review and comment as the document evolved. They attended periodic planning meetings, and provided comments on portions of the plan within their areas of expertise. In addition, content specialists from other agencies, universities, or organizations were contacted as needed by members of the core and extended teams for specific planning needs. Core and extended team members are listed below.

The following Service personnel served as core planning team members for the Comprehensive Conservation Plan:

Name and title	Degree(s)	Organization
Glynnis Nakai, Refuge Manager	MS, Wildlife Biology BS, Zoology	USFWS Nisqually NWRC
Jean Takekawa, Former Refuge Manager	BS, Wildlife Biology	USFWS Nisqually NWRC (retired)
Doug Roster, Deputy Refuge Manager	BS, Wildlife Biology	USFWS Nisqually NWRC
Marian Bailey, Wildlife Biologist	MS, Biology BS, Wildlife Biology	USFWS Nisqually NWRC
Sheila McCartan, Visitor Services Manager	BS, Environmental Education	USFWS Nisqually NWRC
Rebecca Young, Former Conservation Planner	BS, Natural Resource Management	USFWS/Region 1/Branch of Planning
Khemarith So, Conservation Planner	MS, Resource Ecology and Management BS, English and Environmental Science	USFWS/Region 1/Branch of Planning
Brian Root, Wildlife Biologist	BS, MS, PhD, Wildlife Biology	USFWS/Region 1/ Inventory and Monitoring

The following personnel served as extended planning team members for the Comprehensive Conservation Plan:

Name and title	CCP Contributions
Jonathan Bloomfield, Realty Specialist, Lands Division, National Wildlife Refuge System, Region 1, *replaced*	Realty analysis, review of related sections in document, assisted with verifying map accuracy

Name and title	CCP Contributions
Dave Allen, Realty Specialist, Division of Realty and Refuge Information, National Wildlife Refuge System, Region 1	
Brad Bortner, Chief, Migratory Birds and Habitat Programs, USFWS Region 1 (departed)	General guidance on migratory bird planning
Joseph Buchanan, Natural Resource Scientist, Washington Department of Fish and Wildlife	Subject matter expert on shorebird ecology, raptors, estuary habitats
Erin Carver, Economist, USFWS	Economic analysis
Rex Crawford, Ecologist, Washington Natural Heritage Program, Washington Department of Natural Resources (retired)	Subject matter expert on habitat descriptions and ecology
Liz Cruz, Geographer, Lands Division, National Wildlife Refuge System, Region 1, *replaced* Tom Miewald, Geographer, Lands Division, National Wildlife Refuge System, Region 1	Development of working, public involvement, and document maps; GIS data gathering and analysis
Joe Engler, Assistant Regional Refuge Biologist, National Wildlife Refuge System, Region 1	Lead reviewer of biological goals/ objectives/strategies; AUFs and CDs; IPM
Bridgette Flanders-Wanner, Assistant Regional Refuge Biologist and Regional IPM Coordinator, National Wildlife Refuge System, Region 1	Reviewer of IPM; mosquito management
Kevin Foerster, Regional Refuge Chief , National Wildlife Refuge System, Region 1, *replaced,* Robin West, Regional Refuge Chief , National Wildlife Refuge System, Region 1 (retired)	Major decisions on CCP direction, CCP/EA and Federal Register Notice approvals
Glenda Franich, Visitor Services and Communication, National Wildlife Refuge System, Region 1	Document and related products (e.g., planning update) print management; CCP cover design
Brock Hoenes, Wildlife Biologist, Washington Department of Fish and Wildlife	Subject matter expert on invasive species; reviewer
Jeff Holm, Chief, Branch of Transportation, National Wildlife Refuge System, Region 1	Review of transportation-related goals/ objective/strategies
Kay Kier-Haggenjos, Technical Writer/Editor, National Wildlife Refuge System, Region 1	Processing Federal Register notices; development of related products (e.g., planning updates); website management
Charles Houghten, Chief, Lands Division, National Wildlife Refuge System, Region 1	CCP advisor for realty, planning policy and guidance; reviewer
Linda Kunze, Washington Department of Natural Resources (retired)	Subject matter expert on wetland habitats, rare species; scientific information gathering; preliminary writing and documentation
Judy Lantor, Fish and Wildlife Biologist, Environmental Assessment and Restoration, USFWS Washington Fish and Wildlife Office,	Subject matter expert on grassland, prairie habitats

Name and title	CCP Contributions
Region 1	
Deanna Lynch, Fish and Wildlife Biologist, Listing and Recovery, USFWS Washington Fish and Wildlife Office, Region 1	Subject matter expert on Oregon spotted frog ecology, wetland habitats, invasive species, resource management
Mike Marxen, Branch Chief ,Visitor Services, National Wildlife Refuge System, Region 1	Visitor services review and guidance on public use goals/objectives/strategies; assistance with related alternatives development workshop
Scott McCarthy, Branch Chief, Conservation Planning, National Wildlife Refuge System, Region 1	CCP advisor for planning policy and guidance; planning workload priorities; coordination with other divisions; reviewer
Nicole McCarthy, Technical Writer/Editor, National Wildlife Refuge System, Region 1	Technical edit and review of CCP; pre-print production
Virginia Parks, Archaeologist, National Wildlife Refuge System, Region 1	Cultural and historic resources goals/ objectives/strategies and affected environment and environmental consequences
Sylvia Pelizza, Refuge Supervisor, National Wildlife Refuge System, Region 1, *replaced* Bob Flores, Refuge Supervisor, National Wildlife Refuge System, Region 1 (retired)	Assist with coordination; reviewer of document and related products; guidance on overall process and components
Miranda Plumb, Fish and Wildlife Biologist, Environmental Assessment and Restoration, USFWS Washington Fish and Wildlife Office, Region 1	Subject matter expert on fish, aquatic habitats; reviewer
Kayla Saville, Park Ranger, Nisqually National Wildlife Refuge Complex (departed)	Gathering preliminary information; draft writing, organizing, and documentation
Michelle Tirhi, District Wildlife Biologist, Washington Department of Fish and Wildlife	Subject matter expert on Oregon spotted frog, wetland habitats, invasive species, grasslands, elk, resource management
Brad Thompson, Division Manager, Listing and Recovery, USFWS Washington Fish and Wildlife Office, Region 1	Subject matter expert on fish, freshwater invertebrates, aquatic habitats; advised on communications and interpretation
Robyn Thorson, Regional Director, National Wildlife Refuge System, Region 1	Final decision-maker, CCP/EA and Federal Register Notice approvals
Kim Trust, Deputy Regional Refuge Chief, National Wildlife Refuge System, Region 1, *replaced* Ben Harrison, Deputy Regional Refuge Chief (formerly Division Chief, Natural and Cultural Resources), National Wildlife Refuge System, Region 1, (retired)	CCP advisor CCP advisor, reviewer of policy, AUF, CDs, and wilderness

Appendix J. Public Involvement

J.1 Summary of Public Involvement

The Comprehensive Conservation Plan process for Grays Harbor National Wildlife Refuge and Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge began in 2010. A core team and an expanded team were formed to guide development of the CCP. However, CCP development was not restricted to just these teams: we also held workshops and meetings with local, State, and Federal agencies, other organizations, and the public.

Public scoping was initiated in 2011 to help us to further identify issues and priorities to consider during CCP development. The first planning update was published and distributed on May 6, 2011, to a mailing list of approximately 500 recipients. A press release was also sent to 25 media sources for distribution. In addition, the planning update was posted on the Refuge and Unit websites and copies were available at public open houses, along with a comment form.

The Service held two public open houses: May 18, 2011, in Aberdeen, Washington, and May 19, 2011, in Littlerock, Washington. Press releases notifying the public of the open houses were sent to several daily newspapers (including The Daily World and The Olympian). In addition, The Daily World and The Olympian published articles regarding the planning meetings.

At each open house, the Nisqually NWR Complex project leader gave a brief presentation and explained the CCP process; the Refuges and Unit purposes and current management; and preliminary management issues, concerns, and opportunities that had been identified early in the planning process. At the end of the presentation, Refuge and Unit staff were stationed at tables to write down comments and questions on flipchart. A total of 44 private citizens and representatives from various organizations attended the open houses, providing comments on the issues and opportunities presented. Eight people attended the open house in Aberdeen and 36 people attended in Littlerock.

In addition to comments recorded by staff during the public open house meetings, a total of 18 written responses were received from individuals or organizations from May 6 through June 2011. Ten of these were comment forms returned by mail or fax, at the public meetings, or hand delivered to the Refuge or Complex. Five comments/letters were sent via email and three were letters received through the postal service.

On June 8, 2011, a notice of intent to prepare a comprehensive conservation plan and associated NEPA document was published in the Federal Register (76 FR 33339).

The Service provided newsletters and planning updates at strategic points during the planning process to keep the public updated. The mailing list grew from the initial scoping of approximately 300 recipients to over 470 recipients. To date, the three planning updates distributed to the public included:

- Planning Update 1 (May 2011): Announced the start of public scoping for the CCP.
- Planning Update 2 (December 2012): Provided information on public comments received during public scoping.

- Planning Update 3 (June 2013): Provided the preliminary management alternatives.

J.2 Issues Identification during Public Scoping

The preliminary issues distributed with Planning Update 1 and presented during the public open house meetings in 2011 posed the following questions for Grays Harbor NWR:

- ***Habitat Management and Restoration.*** *What actions are needed to sustain and restore priority species and habitats over the next 15 years? How is sedimentation affecting shorebird habitat quality? What will the effects of climate change and sea level rise have on Refuge habitats and species?*

- ***Invasive Species Control.*** *Invasive plant species degrade habitat quality for shorebirds, migratory birds, and many other fish and wildlife species. Invasive animals may compete with native fish and wildlife for limited resources. How can we reduce the incidence and spread of invasive species?*

- ***Visitor Services and Education Opportunities.*** *Wildlife observation, interpretation, photography, and environmental education are provided at Grays Harbor NWR. How can we improve these services and programs? What visitor services facilities are needed or planned? What volunteer programs and partnerships can be developed or strengthened to improve outreach and education? Trespassing, vandalism, and other illegal activities take place at the Refuge. What can be done to reduce these activities and improve wildlife and habitat protection?*

Additional public issues, concerns, and opportunities raised during public scoping included the following:

- ***Hunting and Fishing Opportunities.*** *Are there opportunities to provide hunting and/or fishing at the Refuge?*

- ***Contaminants.*** *What can be done to address potential sources and impacts of contaminants on and around the Refuge?*

The preliminary issues distributed with Planning Update 1 and presented during the public open house meetings in 2011 posed the following questions for the Black River Unit of Billy Frank Jr. Nisqually National Wildlife Refuge:

- ***Land and Water Protection.*** *What actions are needed to sustain and restore priority species and habitats over the next 15 years? How can we help improve habitat protection and connectivity and reduce habitat fragmentation? How can we improve water quality and quantity in the Black River system for fish and wildlife?*

- ***Habitat Management and Restoration.*** *Most habitats have been altered by human actions and are in need of management and restoration to increase value as fish and wildlife habitat. What actions will help provide important information on key species, habitat composition, and the management prescription needed for the Black River Unit? What will the effects of*

climate change and sea level rise have on Unit habitats and species? How can we enhance Oregon spotted frog recovery?

Invasive Species Control. *Invasive plant species degrade habitat quality for migratory birds, fish, amphibians, and many other forms of fish and wildlife. Nonnative animals may compete with native fish and wildlife for limited resources. How can we reduce the incidence and spread of invasive species?*

- ***Visitor Services and Education Opportunities.*** *The Black River Unit has remained largely closed because of the fragmented nature of current Unit land ownership. Trespassing, vandalism, and other illegal activities take place. How can we reduce these activities and improve wildlife habitat and protection? What wildlife-dependent priority public uses should be considered at the Unit?*

Additional public issues, concerns and opportunities raised during public scoping included the following:

- ***Visitor Facilities/Enhancements (Boats and River Access).*** *What opportunities are there for improving access to Black River, boat launching, and parking on the Unit?*

- ***Education, Outreach, and Volunteer Programs.*** *What opportunities are there for providing environmental education, interpretation, and outreach activities focused on the Black River Unit? How can partnerships and volunteers be developed to support visitor service programs?*

- ***Hunting and Fishing.*** *Are there opportunities to provide hunting and/or fishing?*

- ***Conservation Partnership.*** *How can the Service develop a coordinated approach with other groups and agencies including Washington Department of Fish and Wildlife, United States Coast Guard, Washington Department of Natural Resources, Washington Department of Ecology, Soil Conservation Service, Thurston County, Fish and Wildlife Service Ecological Services, law enforcement agencies, Capitol Land Trust, and The Nature Conservancy to plan and manage for the protection, restoration, and interpretation of lands and waters within the Black River corridor?*

Appendix K. List of Grays Harbor NWR Species

This is a list of species that have been documented to be currently on the Refuge, or are strongly suspected to be. More species are expected to be added upon conducting additional baseline monitoring, surveys, and scientific studies.

Birds

Common Name	Scientific Name
Waterfowl	
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Cackling Goose	*Branta hutchinsii*
Canada Goose	*Branta canadensis*
Brant	*Anser albifrons*
Trumpeter Swan	*Cygnus buccinator*
Tundra Swan	*Cygnus columbianus*
Wood Duck	*Aix sponsa*
Gadwall	*Anas strepara*
Eurasian Wigeon*	*Anas penelope*
American Wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Ana clypeata*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Black Scoter	*Melanitta nigra*
Long-tailed Duck	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*

Common Name	Scientific Name
Pheasants, Grouse	
Ring-necked Pheasant*	*Phasianus colchicus*
Ruffed Grouse	*Bonasa umbellus*
Loons	
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Grebes	
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Pelicans, Cormorants, Herons	
Brandt's Cormorant	*Phalacrocorax penicillatus*
Double-crested Cormorant	*Phalacrocorax auritus*
Pelagic Cormorant	*Phalacrocorax pelagicus*
Brown Pelican	*Pelecanus occidentalis*
American Bittern^	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
Green Heron^	*Butroides virescens*
Raptors,Vultures	
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
White-tailed Kite^	*Elanus leucurus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-tailed Hawk	*Buteo jamaicensis*
Rough-legged Hawk	*Buteo lagopus*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Gyrfalcon^	*Falco rusticolus*
Peregrine Falcon	*Falco peregrinus*
Rails, Coots, Cranes	
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
American Coot	*Fulica americana*
Sandhill Crane	*Grus canadensis*
Shorebirds	
Black-bellied Plover	*Pluvialis squatrarola*

Common Name	Scientific Name
American Golden Plover	*Pluvialis dominica*
Pacific Golden Plover	*Pluvialis fulva*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
American Avocet	*Recurvirostra americana*
Spotted Sandpiper	*Actitis macuaria*
Greater Yellowlegs	*Tringa melanoleuca*
Willet	*Catotrophorus semipalmatus*
Lesser Yellowlegs	*Tringa flavipes*
Whimbrel	*Numenius phaeopus*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Ruddy Turnstone	*Arenaria interpres*
Black Turnstone	*Arenaria melanocephala*
Red Knot	*Calidris canutus*
Sanderling	*Calidris alba*
Semipalmated Sandpiper	*Calidris pusilla*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Pectoral Sandpiper	*Calidris melanotus*
Dunlin	*Calidris alpina*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Wilson's Snipe	*Gallinago delicata*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicaria*
Gulls, Terns, Jaegers	
Black-legged Kittiwake	*Rissa tridactyla*
Bonaparte's Gull	*Larus philadelphia*
Heerman's Gull	*Larus heermanni*
Mew Gull	*Larus canus brachyrhynchus*
Ring-billed Gull	*Larus delawarensis*
Western Gull	*Larus occidentalis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Thayer's Gull	*Larus thayeri*
Glaucous-winged Gull	*Larus glaucescens*
Glaucous-winged X Western (*Hybrid)	*Larus sp.*
Caspian Tern	*Sterna caspia*
Common Tern	*Sterna hirundo*
Common Murre	*Uria aalge*

Common Name	Scientific Name
Rhinoceros auklet	*Cerorhinca monocerata*
Doves, Pigeons	
Rock Pigeon*	*Columba livia*
Band-tailed Pigeon	*Columba fasciata*
Eurasian Collared-Dove^*	*Streptopelia decaocto*
Mourning Dove	*Zenaida macroura*
Owls	
Western Screech-Owl	*Otus kennicottii*
Great Horned Owl	*Bubo virginianus*
Short-eared Owl^	*Asio flammeus*
Northern Saw-whet Owl^	*Aegolius acadicus*
Swifts, Hummingbirds	
Vaux's Swift	*Chaetura vauxi*
Rufous Hummingbird	*Selaphorus rufus*
Kingfishers	
Belted Kingfisher^	*Megaceryle Alcyon*
Woodpecker	
Red-breasted Sapsucker	*Sphyrapicus ruber*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Flycatchers	
Western Wood-pewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Pacific-slope Flycatcher	*E. difficilis*
Shrikes, Vireos	
Northern Shrike	*Lanius excubitor*
Cassin's Vireo	*Vireo cassinii*
Hutton's Vireo	*Vireo huttoni*
Warbling Vireo	*Vireo gilvus*
Jays, Crows	
Steller's Jay	*Cyanocitta stelleri*
American Crow	*Corvus brachyrhynchos*
Northwest Crow	*Corvus caurinus*
Common Raven	*Corvus corax*
Larks, Swallows	
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*

Common Name	Scientific Name
Chickadees and Allies	
Black-capped Chickadee	*Poecile atricapilla*
Chesnut-backed Chickadee	*Poecile rufescens*
Bushtit	*Psaltriparus minimus*
Creepers, Wrens	
Red-breasted Nuthatch	*Sitta canadensis*
Brown Creeper	*Certhia americana*
Bewick's Wren	*Thryomanes bewickii*
Pacific Wren	*Troglodytes pacificus*
Marsh Wren	*Cistothorus palustris*
Kinglets	
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Thrushes, Pipits	
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
Waxwings, Starlings	
European Starling*	*Sturnus vulgaris*
American Pipit	*Anthus rubescens*
Cedar Waxwing	*Bombycilla cedrorum*
Lapland Longspur	*Calcarius lapponicus*
Warblers	
Orange-crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Townsend's Warbler	*Dendroica townsendi*
MacGillivray's Warbler	*Oporornis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
Towhee, Sparrows	
Spotted Towhee	*Pipilo maculatus*
Savannah Sparrow	*Passerculus sandwichensis*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*

Common Name	Scientific Name
Tanager, Grosbeak	
Western Tanager	*Piranga ludoviciana*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Blackbirds	
Red-winged Blackbird	*Agelaius phoeniceus*
Western Meadowlark	*Sturnella neglecta*
Brown-headed Cowbird*	*Molothrus ater*
Finches	
Purple Finch	*Carpodacus purpureus*
House Finch	*Carpodacus mexicanus*
Pine Siskin	*Carduelis pinus*
American Goldfinch	*Carduelis tristis*
Evening Grosbeak	*Coccothraustes vespertinus*
Old World Sparrows	
House sparrow*	*Passer domesticus*
Accidentals	
Bean Goose	*Anser fabalis*
Ross's Goose	*Chen rossii*
Arctic Loon	*Gavia arctica*
American White Pelican	*Pelecanus erythrorhynchos*
Great Egret	*Ardea alba*
Gyrfalcon	*Falco rusticolus*
Black-necked Stilt	*Himantopus mexicanus*
Snowy Plover	*Charadrius alexandrinus*
American Avocet	*Recurvirostra americana*
Wandering Tattler	*Heteroscelus incanus*
Bristle-thighed Curlew	*Numenius tahitiensis*
Hudsonian Godwit	*Limosa haemastica*
Bar-tailed Godwit	*Limosa lapponica*
Surfbird	*Aphriza virgata*
Baird’s Sandpiper	*Calidris bairdii*
Sharp-tailed Sandpiper	*Calidris acuminata*
Rock Sandpiper	*Calidris ptilocnemis*
Black-headed Gull	*Larus ridibundus*
Little Gull	*Larus minutus*
Glaucous Gull	*Larus hyperboreus*
Parasitic Jaeger	*Stercorcarius parasiticus*
Common Murre	*Uria aalge*
Marbled Murrelet	*Brachyramphus marmoratus*
Rhinoceros Auklet	*Cerorhinca monocerata*
Snowy Owl	*Nyctea scandiaca*
Common Nighthawk	*Chordeiles minor*

Common Name	Scientific Name
Black Swift	*Cypseloides niger*
Olive-sided Flycatcher	*Contopus cooperi*
Cassin's Vireo	*Vireo cassinii*
Horned lark (streaked)	*Eremophila alpestris*
Palm Warbler	*Dendroica palmarum*
American Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
White-throated Sparrow	*Zonotrichia albicollis*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Red Crossbill	*Loxia curvirostra*

Mammals

Common Name	Scientific Name
Bear, Black	*Urus americanus*
Cottontail, Eastern ^*	*Sylvilagus floridanus*
Deer, Columbian Black-tailed	*Odocoileus heminous columbianus*
Oppossum^*, Virginia	*Didelphis virginiana*
Otter, River	*Lontra canadensis*
Squirrel*, Eastern Gray	*Sciurus carolinensis*
Weasel, Long-tailed	*Mustela frenata*
Weasel, Short-tailed (Ermine)	*Mustela erminea*

Fish

Common Name	Scientific Name
Anchovy^	*Engraulis mordax*
Bacaccio^	*Sebastes pacispinis*
Blenny, Snake	*Lumpenus saggitta*
Cabezon^	*Scorpaenichthys marmoratus*
Char Native (Bull Trout)^	*Salvelinus confluentus*
Cod^, Pacific	*Gadus macrocephalus*
Dogfish^, Spiny	*Squalus acanthias*
Eelpout^	*Lycodes species*
Euhaclon^ (Pacific Smelt)	*Thaleichthys pacificus*
Flounder^, Starry	*Platichthys stellatus*
Goby^, Arrow	*Clevelandia ios*
Greenling^, Kelp	*Hexagrammos decagrammus*
Gunnel^, Crescent	*Pholis laeta*
Gunnel^, Saddleback	*Pholis ornata*
Herring^, Pacific	*Clupea harengus*

Common Name	Scientific Name
Lamprey^, Pacific	*Lampetra tridentata*
Lingcod^	*Ophiodon elongatus*
Mackerel^, Pacific	*Trachurus symmetricus*
Market Squid^	*Loligo opalescens*
Peamouth^*	*Mylocheilus caurinus*
Perch^, Shiner	*Cymatogaster aggregata*
Perch^, Surf	*Embiotocids*
Pikeminnow^*northern	*Ptychocheilus oregonensis*
Pipefish^, bay	*Syngnathus leptorhynchus*
Ratfish^	*Hydrolagus colliei*
Rockfish ^, Black	*Sebastes melanops*
Rockfish^, Brown	*Sebastes auriculatus*
Rockfish^, Copper	*Sebastes caurinus*
Rockfish^, Quillback	*Sebastes maliger*
Sablefish^	*Anoplopoma fimbria*
Salmon, Chinook^	*Oncorhynchus tshawytscha*
Salmon, Chum^	*Oncorhynchus keta*
Salmon, Coho^	*Oncorhynchus. kisutch*
Sanddab^, Pacific	*Citharichthys sordidus*
Sandlance^, Pacific	*Ammodytes hexapterus*
Sardine^, Pacific	*Sardinops sagax*
Sculpin ^, Pacific staghorn	*Leptocottus armatus*
Shad^*, American	*Alosa sapidissima*
Shark^, Soupfin	*Galeorhinus galeus*
Skate^, California	*Raja inornata*
Smelt, Longfin	*Spirinchus thaleichthys*
Smelt^, Surf	*Hypomesus pretiosus*
Sole^, English	*Parophrys vetulus*
Sole^, Sand^	*Psettichthys sp.*
Steelhead^	*Oncorhynchus. mykiss*
Stickleback^,Threespine	*Gasterosteus aculeatus*
Sturgeon^, Green	*Acipenser medirostris*
Surfperch^, Walleye	*Hyperprosopon argenteum*
Tomcod^, Pacific	*Microgadus proximus*
Trout^, Coastal Cutthroat	*Oncorhynchus clarki clarki*
Whiting^, Pacific	*Merluccius productus*

Plants

Common name	Scientific name
Trees	
Alder, Red	*Alnus rubra*
Cascara	*Rhamnus purshiana*
Cottonwood, Black	*Populus trichocarpa*
Crabapple, Oregon	*Malus fusca*
Dogwood, Pacific	*Cornus nuttallii*
Mountain-ash*, European (or Rowan tree)	*Sorbus aucuparia*
Willow Species	*Salix species*
Willow, Hooker's	*Salix hookeri*
Willow, Scouler's	*Salix scouleriana*
Willow, Sitka	*Salix sitchensis*
Shrubs, Brambles, Vines	
Bindweed^	*Convolvulus arvensis*
Blackberry*, Himalayan	*Rubus discolor*
Blackberry*, Evergreen	*Rubus laciniatus*
Blackberry, Trailing	*Rubus ursinus*
Broom*, Scotch	*Cytisus scoparius*
Bush^*,**, Butterfly	*Buddleia davidii*
Elderberry, Red	*Sambucus racemosa*
Huckleberry, Evergreen	*Vaccinium ovatum*
Ivy^, English	*Hedera helix*
Laurel, Spurge^,*	*Daphne laureola*
Plum, Indian Or Osoberry	*Oemleria cerasiformis*
Rose, Nootka	*Rosa nutkana*
Salmonberry	*Rubus spectabilis*
Spirea, Douglas'	*Spiraea douglasi*var. *d.*
Thimbleberry	*Rubus parviflorus*
Twinberry	*Lonicera involucrata*
Forbs (Herbaceous)	
Angelica, Kneeling	*Angelica genuflexa*
Angelica, Sharptoothed	*Angelica arguta*
Arrow-grass, Seaside	*Triglochin maritimum*
Aster, Douglas ^	*Aster subspicatus*
Avens, Oregon	*Geum macrophyllum*
Bittersweet*	*Solanum dulcamara*
Bulrush, Saltmarsh	*Scirpus maritimus*
Bulrush, Small-fruit	*Scirpus microcarpus*
Buttercup*, Creeping	*Ranunculus repens*
Buttercup, Celeryleaf	*Ranunculus sceleratus*
Canarygrass*, Reed	*Phalaris arundinacea*

Common name	Scientific name
Cat's-ear*, Spotted	*Hypochaeris radicata*
Cattail, Common	*Typha latifolia*
Chickweed*, Common	*Stellaria media*
Cleavers	*Galium aparine*
Clover*, Alsike	*Trifolium hybridum*
Clover*, Least Hop	*Trifolium dubium*
Clover*, Red	*Trifolium pratense*
Clover*, White	*Trifolium repens*
Clover, Springbanks	*Trifolium wormskjoldii*
Cow-Parsnip	*Heracleum lanatum*
Dandelion*, Common	*Taraxacum officinale*
Dock*, Bitter	*Rumex obtusifolium*
Dock*, Curly	*Rumex crispus*
Dock, Golden	*Rumex maritimus*
Dodder, Salt-marsh	*Cuscuta salina*
Dunegrass, American	*Elymus mollis*
Eelgrass	*Zostera marina*
Eelgrass*, Japanese (Or Asian/Narrow Blade/Dwarf)	*Zostera japonica*
Foxglove*	*Digitalis purpurea*
Gumweed^	*Grindelia integrifolia*
Iris*, Yellow Flag	*Iris pseudacorus*
Jaumea	*Jaumea carnosa*
Knotweed*,** (Japanese, Giant, Bohemian, Himalayan, & Hybrids)	*Polygonum species*
Miners Lettuce, Common^	Claytonia perfoliata
Miners Lettuce, Siberian (Or Western Spring-Beauty Or Candyflower)	*Claytonia sibirica*
Nipplewort*	*Lapsana communis*
Orache / Goosefoot*	*Atriplex patula*
Paintbrush Owl-clover	*Orthocarpus castillejoides*
Parentucellia*, Yellow	*Parentucellia viscosa*
Pea, Beach	*Lathyrus japonicus*
Pepperweed^,*,**, Perennial	*Lepidium latifolium*
Pickleweed	*Salicornia virginica*
Plantain*, English	*Plantago lanceolata*
Plantain, Seaside	*Plantago maritima*
Sea Rocket*, European	*Cakile maritima*
Sea Rocket, American	*Cakile edentuala*
Sea Watch	*Angelica lucida*
Silverweed, Pacific	*Potentilla pacifica*
Sorrel^, Sheep	*Rumex acetosella*
Sowbane	*Chenopodium hybridum*

Common name	Scientific name
Sow-thistle^*, Prickly	*Sonchus asper*
Speedwell, American	*Veronica americana*
Spike-rush, Common	*Eleocharis palustris*
Spurry, Sand	*Spergularia spp*
St. John's-wort*, Common	*Hypericum perforatum*
Starwort, Longstalk	*Stellaria longipes*
Tansy^*,**, Common	*Tanacetum vulgare*
Teasel^*,**, Common	*Dipsacus sylvestris*
Thistle*,**, Canada	*Cirsium arvense*
Thistle*.**, Bull	*Cirsium vulgare*
Touch-Me-Not	*Impatiens noli-tangere*
Vetch, Common	*Vicia sativa*
Vetch, Giant	*Vicia gigantea*
Waterleaf, Pacific	*Hydrophyllum tenuipes*
Water-parsley, Pacific	*Oenanthe sarmentosa*
Water-starwort, Pond	*Callitriche stagnalis*
Willow-herb*, Watson's	*Epilobium watsonii*var *w.*
Yarrow, Common	*Achillea millefolium*
Sedges, Rushes	
Bullrush, Saltmarsh	*Scirpus maritimus*
Bulrush, Small-Fruit	*Scirpus microcarpus*
Rush, Baltic	*Juncus balticus*
Rush, Soft	*Juncus effusus*
Sedge, Lyngby's	*Carex lyngbyei*
Sedge, Sawbeak	*Carex stipata*
Sedge, Slough	*Carex obnupta*
Spike-rush, Common	*Eleocharis palustris*
Sweetgrass	*Schoenoplectus pungens*
Grasses	
Canarygrass*, Reed	*Phalaris arundinacea*
Cordgrass*, **Smooth	*Spartina alternifolora*
Cordgrass*,**Dense- Flowered	*Spartina densiflora*
Dunegrass, American	*Elymus mollis*
Grass, Orchard	*Dactylis glomerata*
Grass, Salt	*Distichlis spicata*
Grass, Tufted Hair	*Deschampsia caespitosa*
Reed*, Common	*Phragmites communis*
Fern And Allies	
Fern, Deer	*Blechnum spicant*
Fern, Northern Lady	*Athyrium filix-femina*
Fern, Spreading Wood	*Dryopteris austriaca*
Fern, Sword	*Polystichum munitum*

Common name	Scientific name
Horsetail, Field	*Equisetum arvense*
Horsetail, Giant	*Equisetum telmateia*

Key:

All plants or animals were actual biological observations except those with a ^ character.

^ indicates probable plants or animals that may be within the Refuge boundary

* indicates nonnative plants or animals

** indicates nonnative/invasive plants or animals that are priority to control

Appendix L. List of Black River Unit Species

This is a list of species that have been documented to be currently on the Unit or are strongly suspected to be. More species are expected to be added upon conducting additional baseline monitoring, surveys, and scientific studies.

Birds

Common Name	Scientific Name
Waterfowl	
Greater White-fronted Goose	*Anser albifrons*
Cackling Goose	*Branta hutchinsii*
Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Eurasian Wigeon^*	*Anas penelope*
American Wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Ana clypeata*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Ring-necked Duck	*Aythya collaris*
Bufflehead	*Bucephala albeola*
Hooded Merganser	*Lophodytes cucullatus*
Pheasants, Grouse	
California quail	*Callipepla californica*
Ring-necked Pheasant^*	*Phasianus colchicus*
Ruffed Grouse	*Bonasa umbellus*
Dusky Grouse	*Dendragapus obscurus*
Grebes	
Pied-billed Grebe	*Podilymbus podiceps*
Pelicans, Cormorants, Herons	
American Bittern	*Botaurus lentiginosus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butroides virescens*
Raptors, Vultures	
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk^	*Accipiter striatus*
Cooper's Hawk^	*Accipiter cooperii*
Red-tailed Hawk	*Buteo jamaicensis*

Common Name	Scientific Name
American Kestrel	*Falco sparverius*
Rails, Coots, Cranes	
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
American Coot	*Fulica americana*
Shorebirds	
Black-bellied Plover	*Pluvialis squatrarola*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Greater Yellowlegs	*Tringa melanoleuca*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Dunlin	*Calidris alpina*
Long-billed Dowitcher^	*Limnodromus scolopaceus*
Wilson's Snipe	*Gallinago delicata*
Gulls	
Gull spp.	
Doves, Pigeons	
Rock Pigeon^*	*Columba livia*
Band-tailed Pigeon	*Columba fasciata*
Eurasian Collared-Dove^*	*Streptopelia decaocto*
Mourning Dove	*Zenaida macroura*
Owls	
Barn Owl	*Tyto alba*
Western Screech-Owl^	*Otus kennicottii*
Great Horned Owl	*Bubo virginianus*
Short-eared Owl^	*Asio flammeus*
Northern Saw-whet Owl^	*Aegolius acadicus*
Swifts, Hummingbirds	
Vaux's Swift^	*Chaetura vauxi*
Rufous Hummingbird	*Selaphorus rufus*
Kingfishers	
Belted Kingfisher	*Megaceryle Alcyon*
Woodpecker	
Red-breasted Sapsucker	*Sphyrapicus ruber*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker^	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Flycatchers	
Olive-sided Flycatcher^	*Contopus cooperi*
Western Wood-pewee	*Contopus sordidulus*

Common Name	Scientific Name
Willow Flycatcher	*Empidonax traillii*
Pacific-slope Flycatcher	*E. difficilis*
Vireos	
Cassin's Vireo	*Vireo cassinii*
Hutton's Vireo^	*Vireo huttoni*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Corvids	
Steller's Jay	*Cyanocitta stelleri*
Western Scrub Jay	*Aphelocoma californica*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Swallows	
Purple Martin	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Chickadees and Allies	
Black-capped Chickadee	*Poecile atricapilla*
Chesnut-backed Chickadee	*Poecile rufescens*
Bushtit	*Psaltriparus minimus*
Creepers, Wrens	
Red-breasted Nuthatch	*Sitta canadensis*
Brown Creeper	*Certhia americana*
Bewick's Wren	*Thryomanes bewickii*
House Wren	*Troglodytes aedon*
Pacifc Wren	*Troglodytes pacificus*
Marsh Wren	*Cistothorus palustris*
Kinglets	
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet^	*Regulus calendula*
Thrushes, Pipits	
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
Waxwings, Starlings	
European Starling*	*Sturnus vulgaris*
Cedar Waxwing	*Bombycilla cedrorum*

Common Name	Scientific Name
Warblers	
Orange-crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Townsend's Warbler^	*Dendroica townsendi*
MacGillivray's Warbler^	*Oporornis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
Towhees, Sparrows	
Spotted Towhee	*Pipilo maculatus*
Savannah Sparrow	*Passerculus sandwichensis*
Fox Sparrow^	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow^	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*
Tanager and Allies	
Western Tanager	*Piranga ludoviciana*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Lazuli Bunting^	*Passerina amoena*
Blackbirds	
Red-winged Blackbird	*Agelaius phoeniceus*
Western Meadowlark^	*Sturnella neglecta*
Brewer's blackbird^	*Euphagus cyanocephalus*
Brown-headed Cowbird*	*Molothrus ater*
Bullocks Oriole	*Icterus bullockii*
Finches	
Purple Finch	*Carpodacus purpureus*
House Finch	*Carpodacus mexicanus*
Red Crossbill^	*Loxia Curvirostra*
Pine Siskin	*Carduelis pinus*
American Goldfinch	*Carduelis tristis*
Evening Grosbeak	*Coccothraustes vespertinus*
Old World Sparrows	
House Sparrow*	*Passer domesticus*

Mammals

Common Name	Scientific Name
Bat, Big Brown	*Eptesicus fuscus*
Bat, California	*Myotis californicus*

Common Name	Scientific Name
Bat^, Keen's	*Myotis keenii*
Bat, Little Brown	*Myotis lucifugus*
Bat, Long-eared	*Myotis evotis*
Bat, Long-legged	*Myotis volans*
Bat, Silver-haired	*Lasionycteris noctivagans*
Bat, Townsend's Big-eared^	*Plecotus townsendii*
Bat, Yuma	*Myotis yumanensis*
Bear, Black	*Ursus americanus*
Beaver	*Castor canadensis*
Beaver^, Mountain	*Aplodontia rufa*
Bobcat^	*Lynx rufus*
Chipmunk, Townsend's	*Tamias townsendii*
Cottontail*, Eastern	*Sylvilagus floridanus*
Cougar^	*Puma concolor*
Coyote	*Canis latrans*
Deer, Columbian Black-tailed	*Odocoileus heminous columbianus*
Elk, Roosevelt	*Cervus elaphus*
Mink	*Neovison vison*
Mole, Coast	*Scapanus orarius*
Mole^, Townsend's	*Scapanus townsendii*
Mole, Shrew	*Neurotrichus gibbsii*
Mouse, Deer	*Peromyscus sp.*
Mouse^, Pacific jumping	*Zapus trinotatus*
Muskrat	*Ondatra zibethicus*
Nutria*	*Myocastor coypus*
Opossum^*, Virginia	*Didelphis virginiana*
Otter, River	*Lontra canadensis*
Shrew, Dusky	*Sorex monticolus*
Shrew^, Masked	*Sorex cinereus*
Shrew^, Trowbridger's	*Sorex trowbridgii*
Shrew, Vagrant	*Sorex vagrans*
Shrew, Water	*Sorex bendirii*
Skunk^, Spotted	*Spilogale gracilis*
Skunk^, Striped	*Mephitis mephitis*
Squirrel, Douglas	*Tamiasciurus douglasii*
Squirrel*, Eastern Gray	*Sciurus carolinensis*
Vole, Creeping	*Microtus oregonii*
Vole^, Gapper's red-backed	*Clethrionomys gapperi*
Vole^, Long-tailed	*Microtus longicaudus*
Vole, Townsend's	*Microtus townsendii*
Weasel, Long-tailed	*Mustela frenata*
Weasel, Short-tailed (Ermine)	*Mustela erminea*

Common Name	Scientific Name
Woodrat^, Bushy-tailed	*Neotoma cinerea*

Reptiles and Amphibians

Common Name	Scientific Name
Boa^, Rosy	*Charina bottae*
Frog*, Bull	*Rana catesbeiana*
Frog, Pacific chorus (Or Pacific tree frog)	*Hyla regilla*
Frog, Red-legged	*Rana aurora*
Frog, Oregon spotted	*Rana pretiosa*
Lizard, Northern Alligator	*Elgaria coerulea*
Lizard^, Western fence	Sceloporus occidentalis
Newt, Roughskin	*Taricha granulosa*
Salamander, Long-toed	*Ambystoma macrodactylum*
Salamander, Northwestern	*Amybstoma gracile*
Snake, Garter	*Thamnophis sp.*
Snake^, Gopher	*Pituphis catenifer*
Turtle*, Red-eared Slider	*Trachemys scripta elegans*
Turtle^*, Painted	*Chrysemys picta*

Fish

Common Name	Scientific Name
Bass*, Largemouth	*Micropterus salmoides*
Bass^*, Smallmouth	*Micropterus dolomieu*
Bass*, Rock	*Ambloplites rupestris*
Bluegill*	*Lepomis macrochirus*
Bullhead*, Brown	*Ameiurus nebulosus*
Crappie*, Black	*Pomoxis nigromaculatas*
Dace, Speckled	*Rhinichthys osculus*
Lamprey, Pacific	*Lampetra tridentata*
Lamprey, Western Brook	*Lampetra richardsoni*
Lamprey^, Pacific	*Lampetra tridentata*
Lamprey^, Western Brook	Lampetra richardsoni
Mudminnow, Olympic	*Novumbra hubbsi*
Peamouth	*Mylocheilus caurinus*
Perch*, Yellow	*Perca flavescens*
Pikeminnow*, Northern	*Ptychocheilus oregonensis*
Pumpkinseed*	*Lepomis gibbosus*
Salmon, Chinook	*Oncorhynchus tshawytscha*
Salmon, Chum	*Oncorhynchus keta*

Common Name	Scientific Name
Salmon, Coho	*Oncorhynchus kisutch*
Sculpin, Prickly	*Cottus asper*
Sculpin, Reticulate	*Cottus perplexus*
Sculpin, Riffle	*Cottus gulosus*
Sculpin, Torrent	*Cottus rhotheus*
Shad*, American	*Alosa sapidissima*
Shiner, Redside	*Richardsonius balteatus*
Steelhead	*Oncorhynchus mykiss*
Stickleback, Three-spined	*Gasterosteus aculeatus*
Sturgeon, Spp Unknown	*Acipenseridae*
Sucker, Largescale	*Catostomus macrocheilus*
Trout, Cutthroat (Anadromous)	*Oncorhynchus clarki*
Trout, Cutthroat (Resident)	*Oncorhynchus clarki*
Trout, Steelhead	*Oncorhynchus mykiss*
Trout^*, Rainbow	*Oncorhynchus mykiss*
Whitefish, Mountain	*Prosopium williamsoni*

Mussels and Sponges

Common Name	Scientific Name
Floater, Oregon	*Anodonta oregonensis*
Sponge, Freshwater (no common name).	*Spongilla lacustris*
Crayfish, Signal	*Pacifasticus leniusculus*

Plants

Common Names	Scientific Names
Trees	
Alder, Gray	*Alnus incana*
Alder, Red	*Alnus rubra*
Apple, Cultivated*	*Pyrus malus*
Ash, Oregon	*Fraxinus latifolia*
Aspen, Quaking	*Populus tremuloides*
Cascara	*Rhamnus purshiana*
Cedar, Western Red	*Thuja plicata*
Cherry*, Sweet	*Prunus avium*
Cherry, Bitter	*Prunus emarginata*
Cottonwood, Black	*Populus balsamifera*
Crabapple, Pacific	*Malus fusca*
Dogwood, Pacific	*Cornus nuttalli*
Fir, Douglas	*Pseudotsuga menziesii*

Common Names	Scientific Names
Fir, Grand	*Abies grandis*
Hemlock, Western	*Tsuga heterophylla*
Holly*, English	*Ilex aquifolium*
Locust*, Black	*Robinia pseudoacacia*
Madrone	*Arbutus menziesii*
Maple, Big-leaf	*Acer macrophyllum*
Oak, Garry (Or Oregon)	*Quercus garryana*
Pear*, Cultivated	*Pyrus communis*
Pine, Lodgepole	*Pinus contorta*
Pine, Ponderosa	*Pinus ponderosa*
Plum*, Cultivated	*Prunus domestica*
Spruce, Sitka	*Picea sitchensis*
Willow, Geyer	*Salix geyeriana*
Willow, Hooker	*Salix hookeriana*
Willow, Pacific	*Salix lucida*
Willow, Scouler's	*Salix scouleriana*
Willow, Sitka	*Salix sitchensis*
Shrubs, Brambles, Vines	
Birch, Bog	*Betula glandulosa*
Bittersweet*, European	*Solanum dulcamara*
Blackberry*, Evergreen	*Rubus laciniatus*
Blackberry*, Himalayan	*Rubus armeniacus*
Blackberry, Trailing	*Rubus ursinus*
Blueberry*, Cultivated	*Vaccinium sp.*
Bog-laurel, Western	*Kalmia microphylla*
Broom*, Scot's (Or Scotch)	*Cytisus scoparius*
Bush*,** Butterfly	*Buddleia davidii*
Cranberry, Highbush	*Viburnum edule*
Cranberry,Bog	*Vaccinium oxycoccus*
Currant, Wax	*Ribes divaricatum*
Dogwood, Red-Osier	*Cornus sericea*
Elderberry, Red	*Sambucus racemosa*
Hawthorn*, Ornamental	*Crataegus sp.*
Hazel, Beaked	*Corylus cornuta*
Holly*, English	*Ilex aquifolium*
Honeysuckle, Bearberry	*Lonicera involucrata*
Honeysuckle, Orange	*Lonicera ciliosa.*
Huckleberry, Red	*Vaccinium parvifolium*
Ivy*, English	*Hedera helix*
Ivy*, Irish	*Hedera hibernica*
Juniper*, Ornamental	*Juniperus sp.*
Kinnikinnick	*Arctostaphylos uva-ursi*

Common Names	Scientific Names
Labrador-Tea	*Ledum groenlandicum*
Laurel^*,** Spurge	*Daphne laureola*
Lilac*	*Syringa sp.*
Maple*, Japanese	*Acer palmatum*
Maple, Vine	*Acer circinatum*
Nightshade*, Black	*Solanum americanum*
Ninebark, Pacific	*Physocarpus capitatus*
Ocean-spray	*Holodiscus discolor*
Oregon-grape, Dull	*Berberis nervosa*
Oregon-grape, Tall	*Berberis aquifolium*
Plum, Indian	*Oemleria cerasiformis*
Rhododendron*, Ornamental	*Rhododendron sp.*
Rose*, Ornamental	*Rosa sp.*
Rose, Baldhip	*Rosa gymnocarpa*
Rose, Clustered (Or Swamp)	*Rosa pisocarpa*
Rose, Nootka	*Rosa nutkana*
Salal	*Gaultheria shallon*
Salmonberry	*Rubus spectabilis*
Serviceberry	*Amelanchier alnifolia*
Snowberry, Common	*Symphoricarpos albus*
Snowberry, Creeping	*Symphoricarpos hesperius*
Spirea, Douglas'	*Spiraea douglasii*
Thimbleberry	*Rubus parviflorus*
Twinflower, Western	*Linnaea borealis*
Forbes (Herbaceous)	
Aster, Douglas	*Aster subspicatus*
Baneberry	*Actaea rubra*
Bedstraw, Small	*Galium trifidum*
Bedstraw, Sweetscented	*Galium triflorum*
Beggar-ticks, Nodding	*Bidens cernua*
Bindweed*, Field	*Convolvulus arvensis*
Bindweed*, Hedge	*Convolvulus sepium*
Bleeding Heart, Pacific	*Dicentra formosa*
Brooklime, American	*Veronica americana*
Bugleweed, Northern	*Lycopus uniflorus*
Bunchberry	*Cornus canadensis*
Burdock*,** Common	*Arctium minus*
Bur-reed, Narrow-leaved	*Sparganium angustifolium*
Buttercup*, Creeping	*Ranunculus repens*
Buttercup, Western	*Ranunculus occidentalis*
Campion*, Bladder	*Silene vulgaris*
Carrot, Wild	*Daucus carota*

Common Names	Scientific Names
Cat's-Ear*, Hairy [Spotted]	*Hypochaeris radicata*
Chamomile*, Stinking	*Anthemis cotula*
Chervil*, Burr	*Anthriscus caucalis*
Chervil*,** Wild	*Anthriscus sylvestris*
Chicory	*Chicorium intybus*
Cinquefoil, Marsh	*Potentilla palustris*
Cleavers	*Galium aparine*
Clover*, Red	*Trifolium pratense*
Clover*, White	*Trifolium repens*
Colt's Foot	*Petasites palmatus*
Coontail	*Ceratophyllum demersum*
Corydalis, Scouler's	*Corydalis scouleri*
Cottongrass	*Eriophorum chammisonis*
Creeping Charlie*	*Glechoma hederacea*
Cudweed*, Marsh	*Gnaphalium uliginosum*
Currant, Wax	*Ribes divaricatum*
Dandelion*, Common	*Taraxacum officinale*
Dock*, Curly	*Rumex crispus*
Dock, Western	*Rumex occidentalis*
Duckweed, Small	*Lemna minor*
Fairy-Bell, Hooker	*Disporum hookeri*
False Lily-of-the-Valley	*Maianthemum dilatatum*
False Solomon-Seal, Star-flowered	*Smilacina stellata*
Fireweed*	*Epilobium angustifolium*
Forget-me-Not, Small Water	*Myosotis laxa*
Foxglove*	*Digitalis purpurea*
Fringecup	*Tellima grandiflora.*
Gentian, King	*Gentiana sceptrum*
Ginger, Wild	*Asarum caudatum*
Goldenrod, Canada	*Solidago canadensis*
Groundsel*, Wood	*Senecio vulgaris*
Hawksbeard*, Smooth	*Crepis capillaris*
Hedge-Nettle , Cooley's	*Stachys cooleyae*
Hemlock*,**, Poison	*Conium maculatum*
Hogweed^*,** Giant	*Heracleum mantegazzianum*
Inside-out Flower	*Vancouveria hexandra*
Iris*,** Yellow flag	*Iris pseudacorus*
Knapweed^* Spp.	*Centaurea spp.*
Kneeling Angelica	*Angelica genuflexa*
Knotweed*,** (Japanese, Giant, Bohemian, Himalayan, & Hybrids)	*Polygonum spp.*
Ladysthumb*, Spotted	*Polygonum persicaria*

Common Names	Scientific Names
Lamb's-quarters	*Chenopodium album*
Lettuce*, Prickly	*Lactuca serriola*
Letuce, Wall	*Lactuca muralis*
Lily*, Ornamental	*Lilium sp.*
Loosestrife, Purple	*Lythrum salicaria*
Marsh Yellow Cress	*Rorippa palustris*
Meadowrue, Western	*Thalictrum occidentale*
Miner's Lettuce, Siberian (Or Western Spring-Beauty Or Candyflower)	*Claytonia sibirica*
Mint, Field	*Mentha arvensis*
Mint, Spear	*Mentha spicata*
Monkeyflower, Yellow	*Mimulus guttata*
Mullein*, Common	*Verbascum thapsus*
Mustard Spp. *	*Brassica spp.*
Mustard, Hedge	*Sisymbrium officinale*
Nettle, Stinging	*Urtica dioica*
Nipplewort*	*Lapsana communis*
Old man’s Beard^*	*Clematis vitalba*
Orchid, White Bog	*Habenaria dilatata*
Oxeye-daisy*	*Leucanthemum*
Parentucellia*, Yellow	*Parentucellia viscosa*
Pathfinder	*Adenocaulon bicolor*
Pea, Perennial	*Lathyrus latifolius*
Pearly Everlasting	*Anaphalis margaritacea*
Pennywort, Water	*Hydrocotyle ranunculoides*
Phacelia	*Phacelia sp.*
Pineapple Weed*	*Matricaria discoidea*
Plantain*, Common	*Plantago major*
Plantain*, English	*Plantago lanceolata*
Pondweed, Fern Leaf	*Potamogeton robbinsii*
Pondweed, Sago	*Potamogeton pectinatus*
Purslane*, Water	*Ludwigia palustris*
Queen-Anne's-lace*	*Daucus carota*
Ragweed*, Common	*Ambrosia artemisiifolia*
Ragwort*, Tansy	*Senecio jacobaea*
Sandwort, Big-leaved	*Moehringia macrophylla*
Self-heal	*Prunella vulgaris*
Shepherd's Purse*	*Capsella bursa-pastoris*
Skullcap, Blue	*Scutelaria lateriflora*
Skullcap, Mad-Dog	*Scutellaria lateriflora*
Skunk-cabbage	*Lysichiton americanum*
Smartweed, Willow	*Polygonum lapathifolium*

Common Names	Scientific Names
Sorrel*, Sheep	*Rumex acetosella*
Sow-thistle*, Prickly	*Sonchus asper*
St. John's-wort*, Common	*Hypericum perforatum*
Starflower, Broad-Leaved	*Trientalis latifolia*
Starflower, Western	*Trientalis borealis*
Stork's-bill*, Common	*Erodium cicutarium*
Strawberry, Wild	*Fragaria virginiana*
Strawberry, Woods	*Fragaria vesca*
Sundew, Round-Leaved	*Drosera rotundifolia*
Sweet-cicely, Mountain	*Osmorhiza chilensis*
Sweet-clover*, White	*Melilotus alba*
Tapegrass*, Water Celery	*Vallisneria americana*
Thistle*,**, Bull	*Cirsium vulgare*
Thistle*,**, Canada	*Cirsium arvense*
Touch-me-Not	*Impatiens noli-tangere*
Trail-plant	*Adenocaulon bicolor*
Trefoil*,Birdsfoot-	*Lotus corniculatus*
Trefoil, Big	*Lotus uliginosis*
Trillium, Western	*Trillium ovatum*
Vanilla-leaf	*Achlys triphylla*
Vetch Spp.	*Vicia spp.*
Violet Spp.	*Viola spp.*
Violet, Marsh	*Viola palustris*
Water hemlock, Western	*Cicuta douglasii*
Water-carpet, Ground Ivy-leaved	*Chrysosplenium glechomaefolium*
Watercress, white*	*Rorippa nasturtium-aquaticum*
Waterleaf, Pacific	*Hydrophyllum tenuipes*
Water-lily*	*Nymphaea sp.*
Water-lily, Yellow (Or Spatterdock)	*Nuphar polysepalum*
Water-parsley, Pacific	*Oenanthe sarmentosa*
Waterpepper	*Polygonum hydropiperoides*
Waterplantain, American	*Alisma plantago-aquatica*
Water-shield	*Brasenia schreberi*
Water-starwort, Diverse-leaved	*Callitriche heterophylla*
Waterweed, Common (Or American)	*Elodea canadensis*
Willow-herb*, Hairy	*Epilobium ciliatum*
Yarrow	*Achillea millefolium*
Yerba Buena	*Satureja douglasii*
Youth-on-Age	*Tolmiea menziesii*
Sedges, Rushes	
Beak-rush, White	*Rhynchospera alba*
Bulrush, Hard-stem	*Scirpus lacustris*

Common Names	Scientific Names
Bulrush, Soft-stemmed	*Scirpus tabernaemontanii*
Rush Spp.	*Juncus spp.*
Rush, Baltic	*Juncus balticus*
Rush, Common (Or Soft)	*Juncus effusus*
Rush, Pointed	*Juncus oxymeris*
Rush, Swordleaf	*Juncus ensifolius*
Rush, Tapered	*Juncus acuminatus*
Sedge, Beaked	*Carex rostrata*
Sedge, Bristly	*Carex comosa*
Sedge, Bristlystalked	*Carex leptalea*
Sedge, Kellogg's	*Carex kelloggii*
Sedge, Lenticular	*Carex lenticularis*
Sedge, Slough	*Carex obnupta*
Sedge, Water	*Carex aquatilis*
Spike-rush, Creeping	*Eleocharis palustris*
Spike-rush, Needle	*Eleocharis acicularis*
Water Whorlgrass	*Catabrosa aquatica*
Grasses	
Bentgrass	*Agrostis sp.*
Canarygrass*, Reed	*Phalaris arundinacea*
Cat-tail, Common	*Typha latifolia*
Fescue	*Festuca sp.*
Grass, Bluejoint	*Calamagrostis canadensis*
Ryegrass	*Lolium spp.*
Trisetum, Nodding	*Trisetum cernuum*
Velvetgrass, Common	*Holcus lanatus*
Ferns And Allies	
Fern, Deer	*Blechnum spicant*
Fern, Licorice	*Polypodium glycyrrhiza*
Fern, Northern Lady	*Athyrium filix-femina*
Fern, Spiny (Or Spreading) Wood	*Dryopteris expansa*
Fern, Sword	*Polystichum munitum*
Fern, Western Bracken	*Pteridium aquilinum*
Horesetail, Scouring-rush	*Equisetum hyemale v*
Horsetail, Field	*Equisetum arvense*
Horsetail, Giant	*Equisetum telmatiea*
Mosses	
Moss, Peat	*Sphagnum sp.*
Water Moss, Common	*Fontinalis antipyretica*

Key:

All plants or animals were actual biological observations except those with a ^ character.

^ indicates probable plants or animals that may be within the Refuge boundary

* indicates non-native plants or animals
** indicates non-native / invasive plants or animals that are priority to control

Appendix M. Grays Harbor Nature Center Plans

Public Law 100-406, which established Grays Harbor NWR, directed the Service to develop a management plan that would include a nature (visitor) center for education and research. The Refuge created a Management and Development Plan (1990) that identified facilities as a high priority. Establishing legislation for the Refuge authorized Congress to appropriate funds for facility development, but specific funding has never been appropriated.

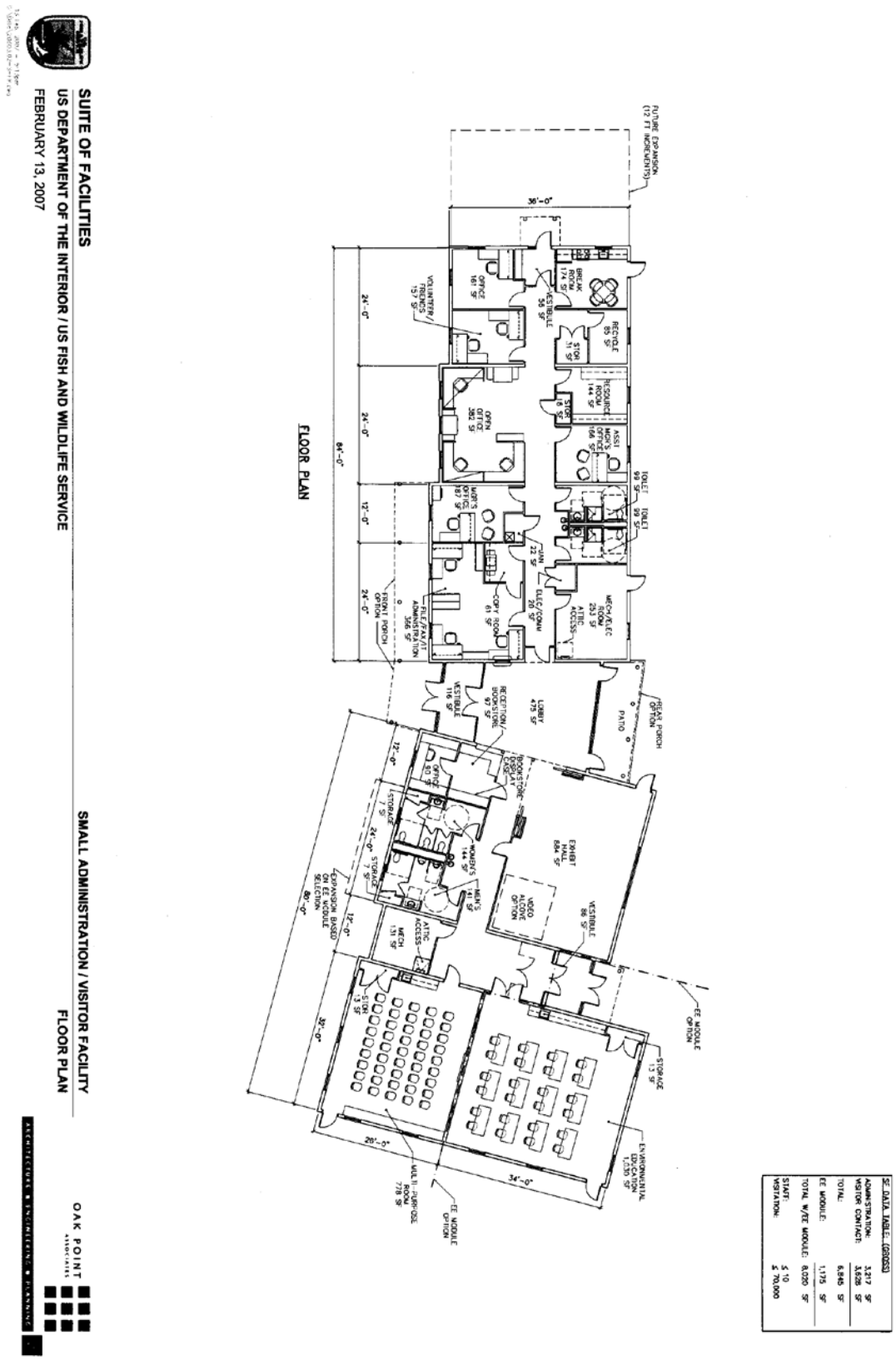
Many meetings have been held with partners to develop facilities for Grays Harbor NWR. In 2005, the Grays Harbor Food Bank moved off the Refuge to make way for facility development; however, funding has not been approved.

The location for the proposed nature center was chosen based on placing it in the only location that was not a wetland. The decision for the existing Refuge building was to convert it to a maintenance yard/shop. The proposed building site is 4 acres located along the east boundary of Grays Harbor NWR and the west side of Paulson Road.

In 2007, an approximately 10,000-square-foot conceptual building was designed and included a small administrative space, medium-sized visitor facilities, and an environmental education module. In 2008, cost estimates were $1.237 million dollars for architectural and engineering design and $4.948 million for construction.

Today, in the Common-To-All Section (see Chapter 2, Section 2.2, Grays Harbor NWR, Nature Center Planning) the proposed nature center project will continue the planning and development process. During the CCP preparation, ideas were suggested and reviewed. The nature center would include a small parking area, restrooms, office space, an information/exhibit area, and a classroom for the environmental education program, as well as to hold meetings, trainings, and outreach events.

Figure M.1. Conceptual Drawing of Nature Center Building (in 2008).



Appendix N. Maps

Map 1. Chehalis Basin Overview.

Map 2. Grays Harbor NWR Habitats.

Map 3. Grays Harbor NWR Alternative 1.

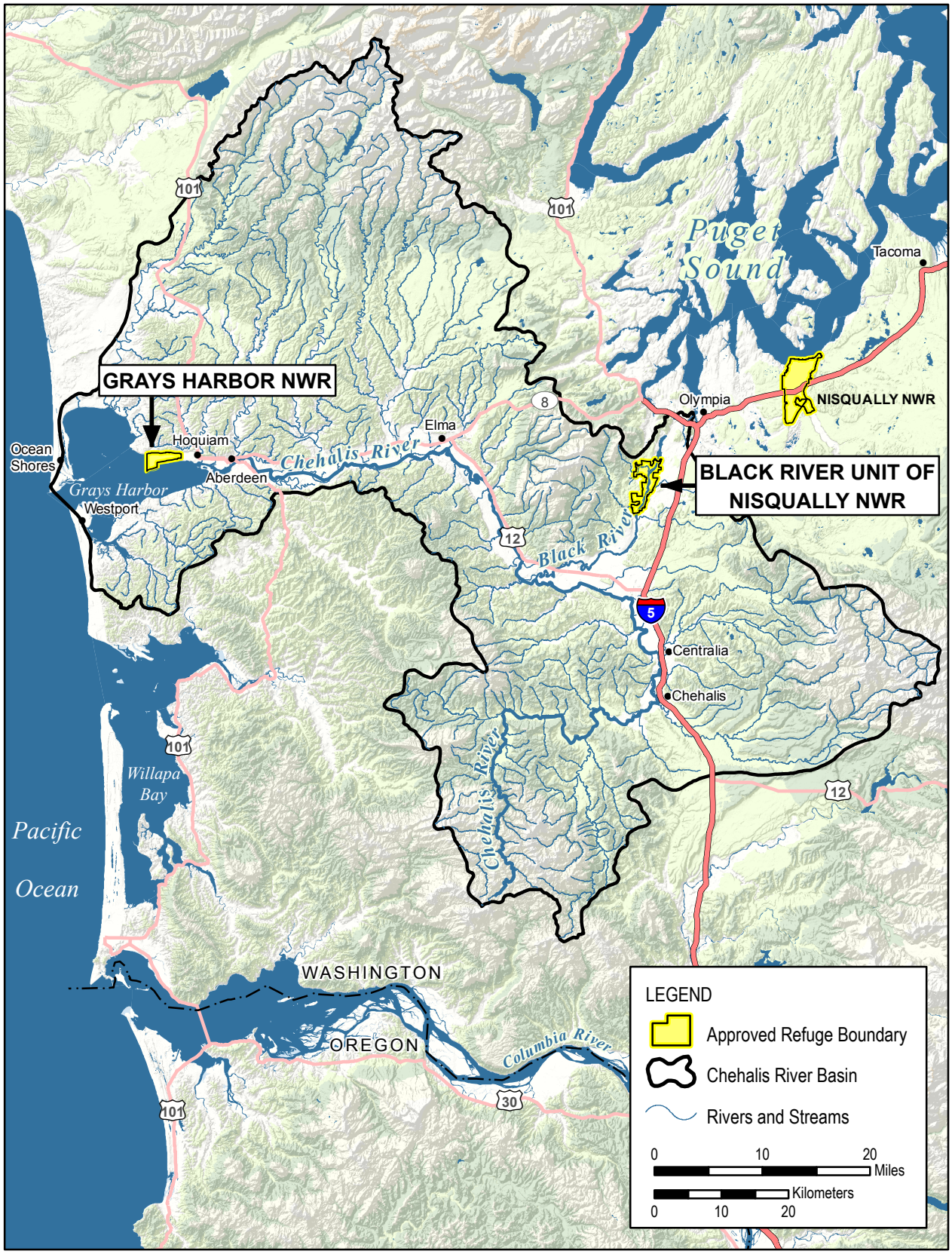
Map 4. Black River Unit Alternative 1.

Map 5. Black River Unit Habitats.

Map 6. Grays Harbor NWR Alternative 2.

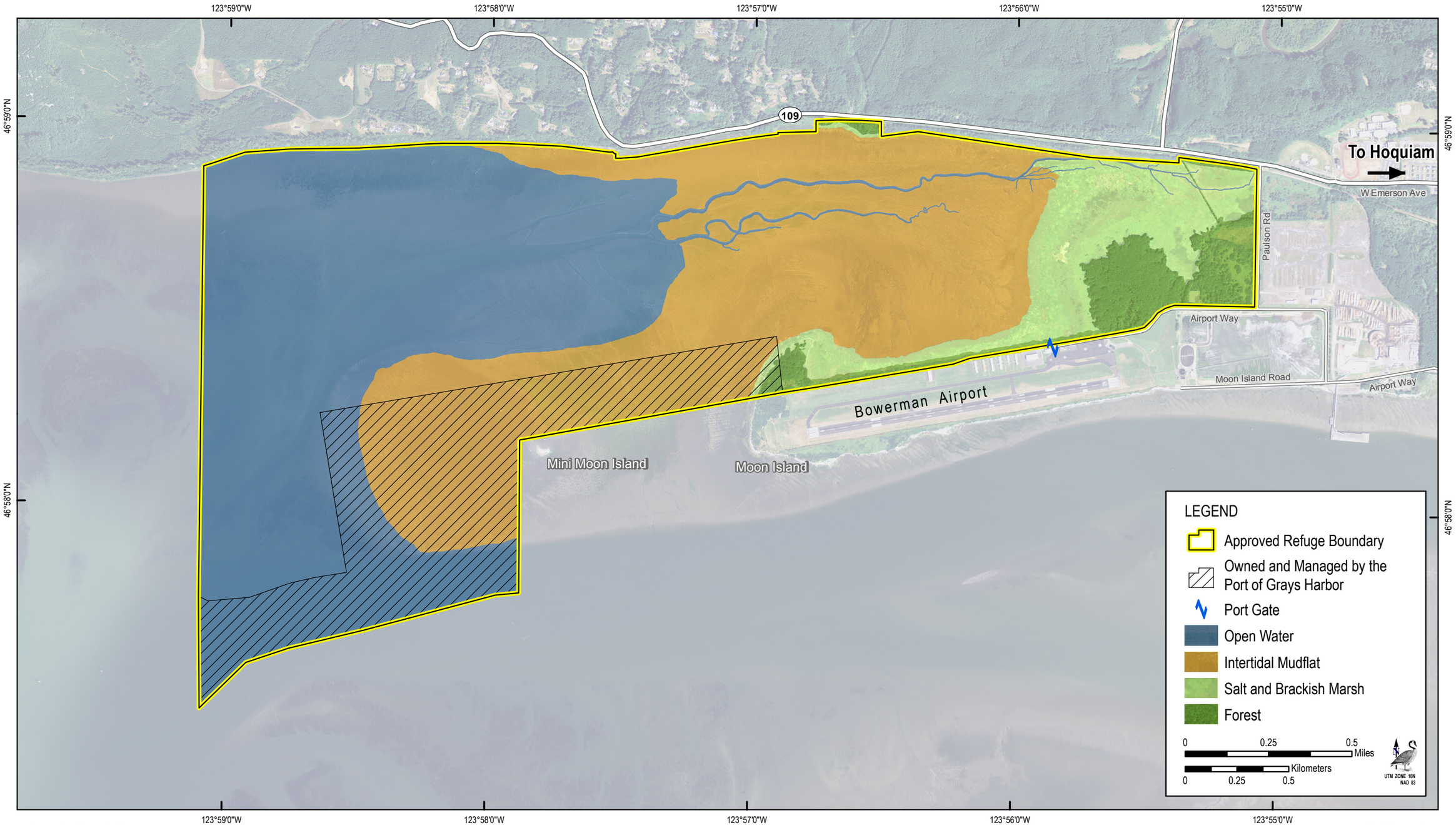
Map 7. Black River Unit Alternative 2.

Map 1. Chehalis River Basin Overview.



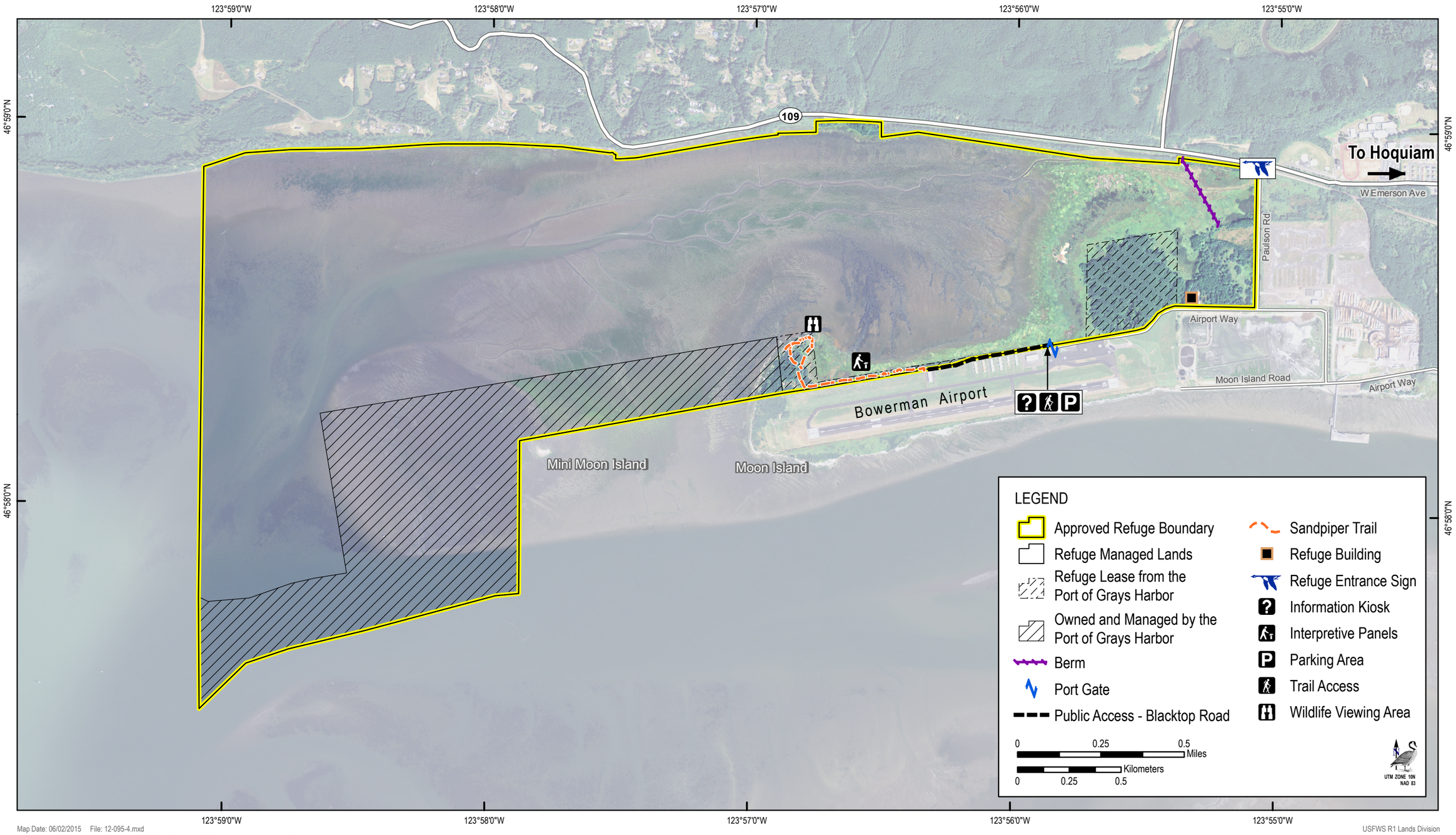
Map Date: 06/02/2015 File: 12-095-10.mxd USFWS R1 Lands Division
Data Sources: Refuge Boundaries from USFWS/R1; Elevation from NED; Hydrology from NHD; Roads from ESRI

Map 2. Grays Harbor NWR Habitats.



Map Date: 06/02/2015 File: 12-095-6.mxd
Data Sources: Refuge Boundaries and Habitats from USFWS/R1; Roads from ESRI; Imagery from 2011 NAIP
USFWS R1 Lands Division

Map 3. Grays Harbor NWR Land Status and Alternative 1.



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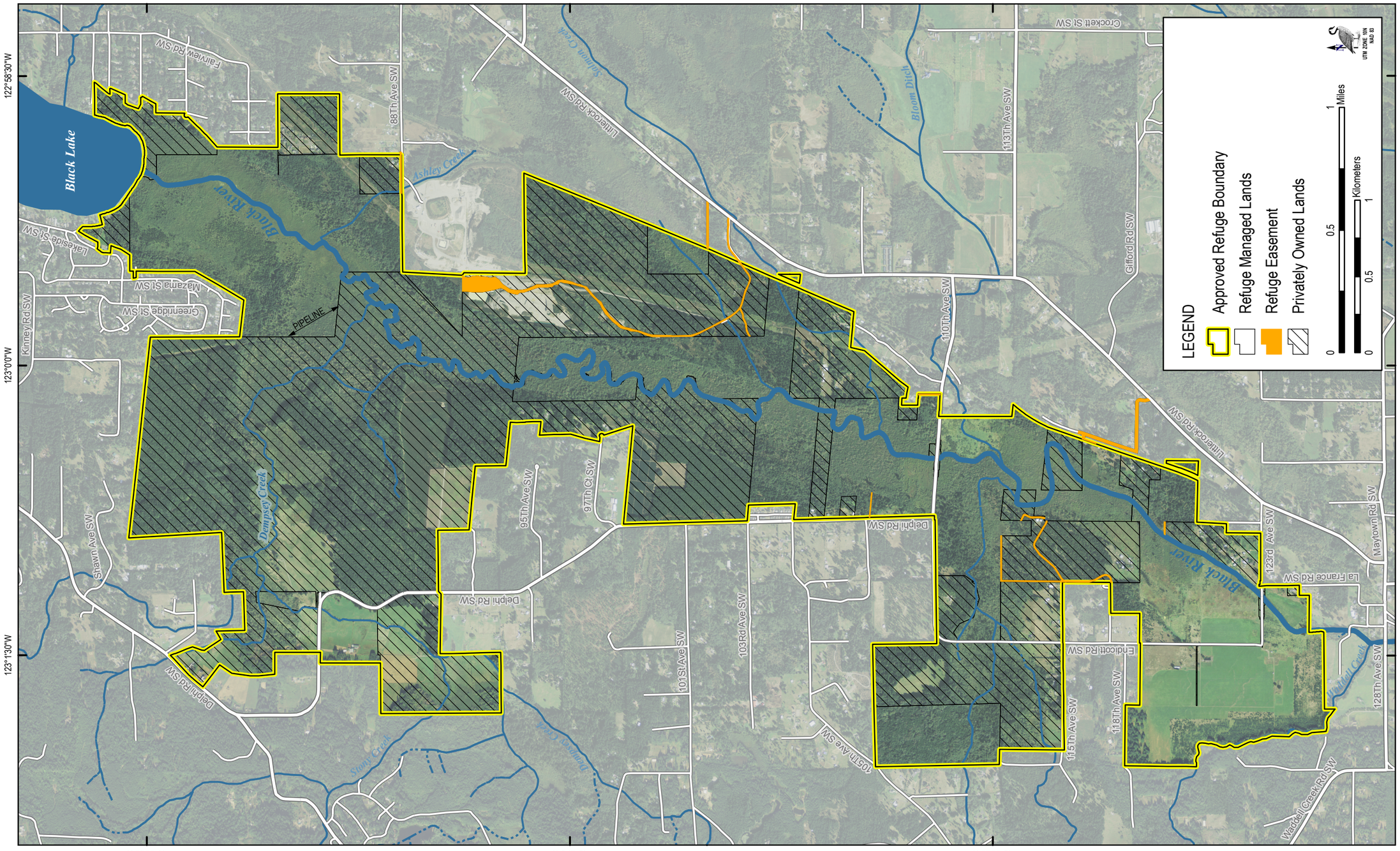
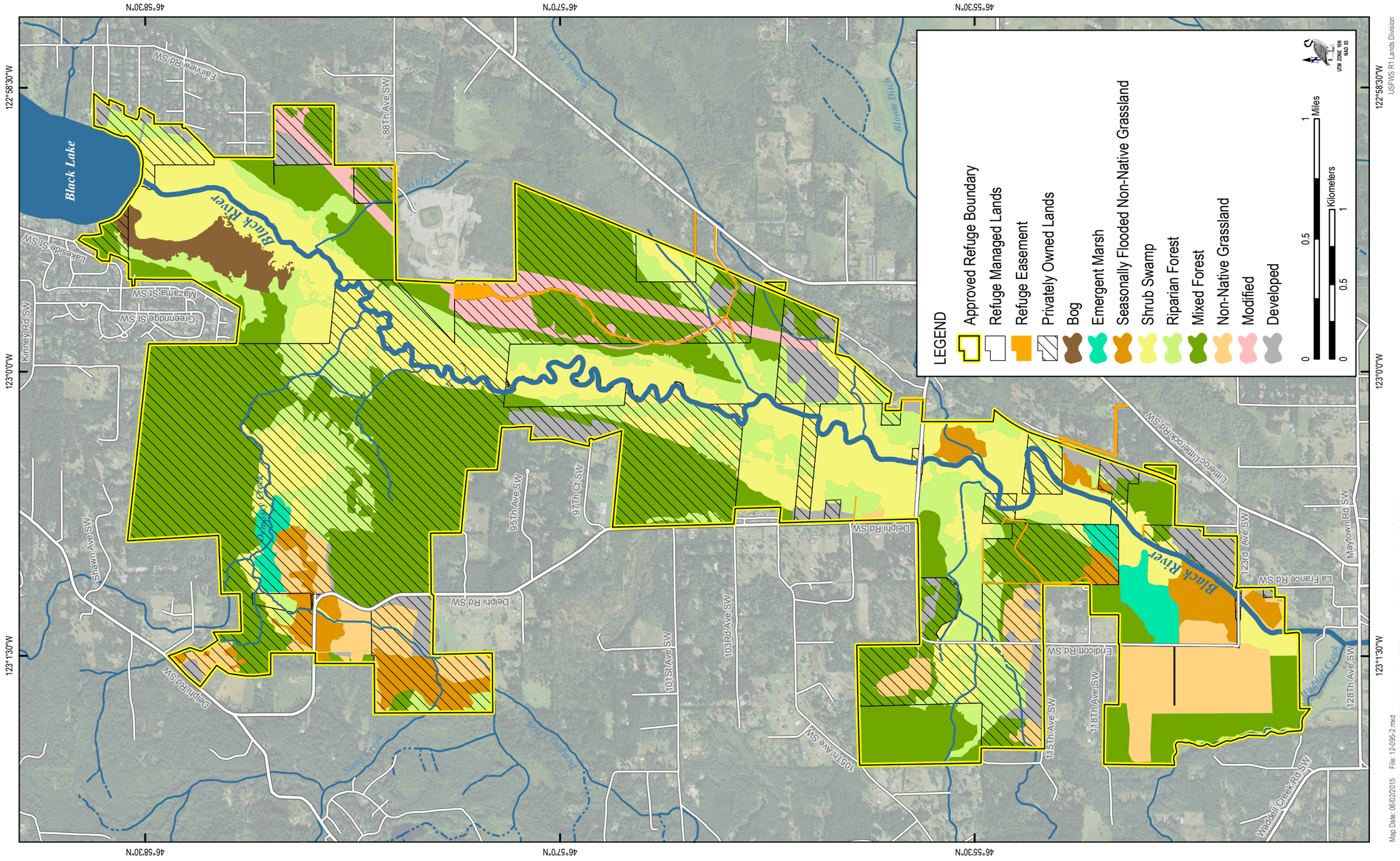
Data Sources: Refuge Boundaries from USFWS/R1; Roads from ESRI; Imagery from 2011 NAIP
USFWS R1 Lands Division

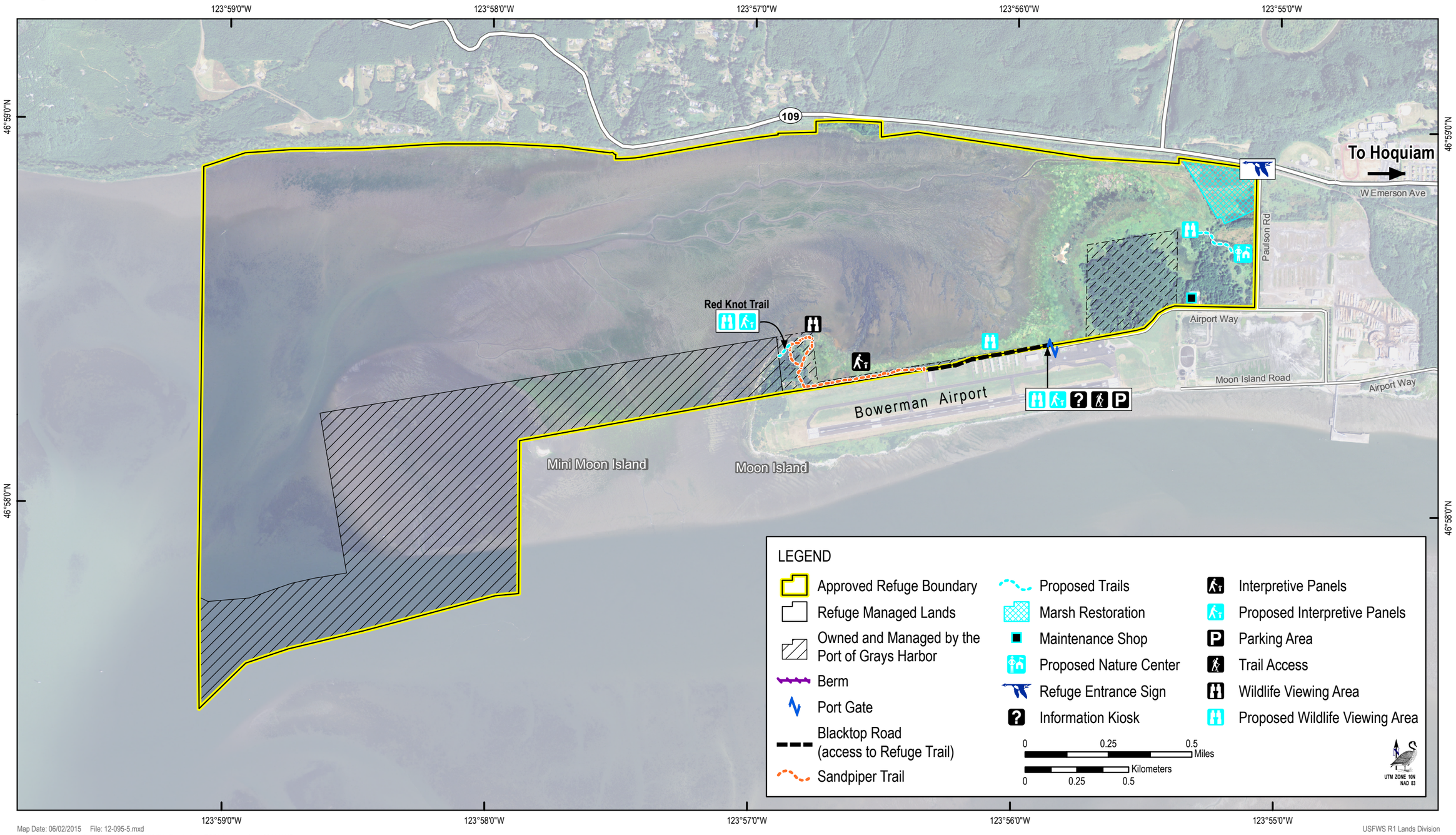
Map 4. Black River Unit Land Status and Alternative 1.



Map 5. Black River Unit Habitats.

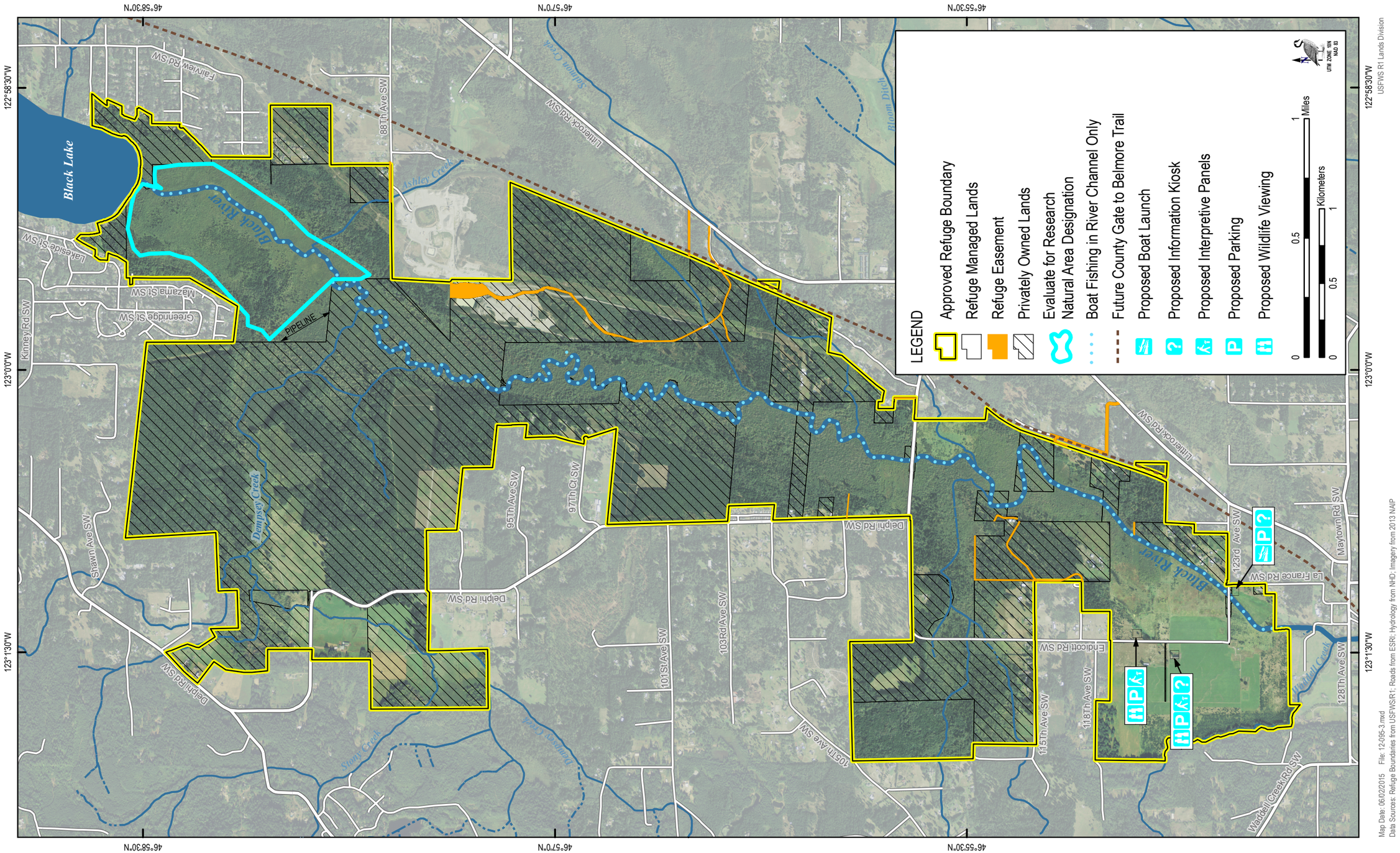


Map 6. Grays Harbor NWR Alternative 2.



Map Date: 06/02/2015 File: 12-095-5.mxd
Data Sources: Refuge Boundaries from USFWS/R1; Roads from ESRI; Imagery from 2011 NAIP
USFWS R1 Lands Division

Map 7. Black River Unit Alternative 2.



U.S. Fish & Wildlife Service, September 2016
Grays Harbor National Wildlife Refuge and the
Black River Unit of Nisqually National Wildlife Refuge
Draft Comprehensive Conservation Plan
and Environmental Assessment

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.

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National Wildlife Refuge System Information
1 800/344 WILD

September 2016

The mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect, andenhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

Grays Harbor saltmarsh and mudflats
Katherine Stevens

Cover:
Above: Western sandpiper. Gerit Vyn
Below: Marsh wren. Michael Schramm/USFWS