

Nisqually National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Impact Statement

Thurston and Pierce Counties, Washington

Type of Action: Administrative

Lead Agency: U.S. Department of the Interior, Fish and Wildlife Service

Responsible Official: Anne Badgley, Regional Director

For Further Information: Jean Takekawa, Refuge Manager
Nisqually NWR Complex
100 Brown Farm Road
Olympia, WA 98516
(360) 753-9467

Abstract: Four alternatives, including a Preferred Alternative and a No Action Alternative, are described, compared, and assessed for Nisqually NWR. Alternative A is the No Action Alternative, as required by the National Environmental Policy Act regulations. Selection of this alternative would mean that a Comprehensive Conservation Plan (CCP) would not be finalized and implemented for the Refuge. This would result in continued management of the Refuge as it has been over the past several years, and the existing 1978 Nisqually NWR Conceptual Plan would not be updated. The four alternatives are summarized below:

Alternative A—No Action: Status Quo – This alternative assumes no change from past management programs and is considered the base from which to compare the other alternatives. There would be no changes to the Refuge boundary and no major changes in habitat management or public use programs.

Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration – This alternative would provide for moderate expansion of the Refuge boundary (2,407-acre addition). It places new management emphasis on the restoration of estuarine habitat and improved freshwater wetland management. The current environmental education program would be improved and expanded, to the largest degree of all action alternatives. There would be fewer changes to the trail system than in other action alternatives, and the Refuge would remain closed to waterfowl hunting, with the closure posted and enforced.

Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration – This alternative would provide for the same expansion of the Refuge boundary as in Alternative B (2,407-acre addition). However, it places a stronger emphasis on the restoration of estuarine habitat, while improving freshwater wetland and riparian habitats. The environmental education program would be improved and expanded, although serving fewer students than Alternative B. Moderate changes would occur to the trail system. The largest portion of Refuge acreage would be opened to waterfowl hunting of any alternative. Lands would be consolidated with State lands and waterfowl hunting limited to 3 days per week, if an agreement can be reached with WDFW.

Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration – This alternative would provide for the largest amount of Refuge boundary expansion (3,479-acre addition). It would also maximize estuarine restoration, while improving freshwater wetland and riparian habitats on the Refuge. The environmental education program would be improved and expanded, although not to the highest expansion described in Alternative B. The greatest changes would occur to the trail system of any alternative. A smaller portion of Refuge lands would be opened to waterfowl hunting, 7 days per week, with no changes to hunting on WDFW lands.

Reader's Guide

The U.S. Fish and Wildlife Service will manage the Nisqually National Wildlife Refuge (NWR) in accordance with an approved Comprehensive Conservation Plan (CCP). The CCP provides long-range guidance on Refuge expansion and management through its vision, goals, objectives, and strategies. The CCP also provides a basis for a long-term adaptive management process including implementation, monitoring progress, evaluating and adjusting, and revising plans accordingly. Additional step-down planning will be required prior to implementation of certain programs and projects.

This document combines both a Draft Comprehensive Conservation Plan and Environmental Impact Statement (Draft CCP/EIS). Following public review and comment, we will publish a Final EIS followed by a Record of Decision (ROD) that identifies the alternative selected as the CCP. We will then publish a stand-alone CCP made up of Chapter 1, the selected alternative from Chapter 2, all of Chapters 3, 5, and 6 and the appendices. The four most important Appendices to review include Appendix F: Plan Implementation; Appendix G: Compatibility Determinations; Appendix I: Goals, Objectives, and Strategies; and Appendix K: Land Protection Plan. The following chapter and appendix descriptions are provided to assist readers in locating and understanding the various components of this combined document.

Chapter 1, *Introduction, Purpose and Need, and Issues*, includes the regional context, establishment, and purposes of Nisqually NWR; vision and goals for future management; and the purpose of and need for a comprehensive conservation plan. This chapter also provides background on major planning issues identified by Refuge staff; Federal, tribal, State, and local agencies; and the general public.

Chapter 2, *Alternatives*, describes four management alternatives. Each alternative represents a potential comprehensive conservation plan for Nisqually NWR. Alternative A describes current management on the Refuge. Alternative D, the Preferred Alternative, is the proposed Draft Comprehensive Conservation Plan for Nisqually NWR.

Chapter 3, *Affected Environment*, describes the existing physical and biological environment, public uses, cultural resources, and socioeconomic conditions. They represent baseline conditions for the comparisons made in Chapter 4.

Chapter 4, *Environmental Consequences*, describes the potential impacts of each of the four alternatives on the resources, programs, and conditions outlined in Chapter 3. This is perhaps the most important part of the Environmental Impact Statement component of this document.

Chapter 5, *Relationships to Federal, State, and Local Policies, Plans*, provides a brief description of many national, regional, and local plans that are relevant to the Nisqually Basin. These plans were reviewed and considered in this current planning effort.

Chapter 6, *Compliance, Consultation, and Coordination with Others*, provides details on public involvement, interagency coordination, and tribal consultation during the planning process.

Appendix A, *Glossary of Terms*, contains acronyms, abbreviations, and definitions of terms used in this document.

Appendix B, *Distribution List*, contains the list of Federal, Tribal, State, and local agencies; non-government organizations; academic institutions; and individuals who received planning updates, summaries, and other mailings associated with this planning effort.

Appendix C, *References*, provides bibliographic references for the citations in this document.

Appendix D, *Applicable Laws and Executive Orders*, contains brief descriptions of some of the more pertinent laws and executive orders applicable to management of Nisqually NWR.

Appendix E, *Species Lists*, lists plants and animals that have been observed on Nisqually NWR.

Appendix F, *Plan Implementation*, includes the Refuge Operations Needs (RONS) list, which briefly describes projects and costs associated with the Preferred Alternative; monitoring program; plus current and proposed staffing levels.

Appendix G, *Compatibility Determinations*, describe uses, anticipated impacts, stipulations, and a determination of compatibility or non-compatibility for all existing and proposed public uses on Nisqually NWR.

Appendix H, *List of Preparers*, contains the names, positions, education, and years of experience of persons involved in the preparation of this Draft CCP/EIS.

Appendix I, *Goals, Objectives, and Strategies*, links the mission of the National Wildlife Refuge System and purposes of Nisqually NWR with the alternatives described and analyzed in this document. The goals, objectives, and strategies focus on Alternative D (Preferred Alternative), but include tables to show differences among alternatives.

Appendix J, *Hydrodynamic and Sediment Transport Modeling Summary*, briefly summarizes the methods and results of a hydrodynamic and sediment transport model used to evaluate physical components involved in eight tidal restoration alternatives for Nisqually NWR. The modeling results from these eight alternatives contributed to the development of the four alternatives that are considered in greater detail in this document, and to the selection of the Preferred Alternative.

Appendix K, *Land Protection Plan*, a document prepared during detailed planning that is intended to inform landowners and the interested public of the resource protection needs, the dimensions of the Service's protection proposal, and the land protection priorities.

Appendix L, *Wilderness Review*, lists the criteria used in conducting a wilderness review and describes why Nisqually NWR currently does not meet the criteria.

This page intentionally left blank.

TABLE OF CONTENTS

Abstract
 Reader’s Guide
 Table of Contents i

Chapter 1: Introduction, Purpose and Need, and Issues 1-1

1.1 Introduction 1-1

1.2 Proposed Action 1-1

1.3 Purpose and Need for the Comprehensive Conservation Plan 1-2

1.4 Legal and Policy Guidance 1-7

1.4.1 The U.S. Fish and Wildlife Service 1-7

1.4.2 National Wildlife Refuge System 1-7

1.5 History of Refuge Establishment and Purpose 1-9

1.6 Refuge Vision and Goals 1-11

1.6.1 Vision 1-11

1.6.2 Goals 1-12

1.7 Comprehensive Conservation Planning Process 1-12

1.7.1 The Nisqually NWR CCP Process 1-13

1.7.2 Public Involvement 1-14

1.8 Planning Issues, Concerns, and Opportunities 1-14

Chapter 2: Alternatives 2-1

2.1 Introduction to the Alternatives 2-1

2.1.1 Alternatives Development 2-1

2.2 Similarities Among Alternatives 2-2

2.2.1 Features Common to All Alternatives (A-D) 2-2

2.2.2 Features Common to All Action Alternatives (B-D) 2-5

2.3 Detailed Description of the Alternatives 2-6

2.3.1 Alternative A - No Action (Status Quo) 2-6

2.3.2 Alternative B - Refuge Expansion of 2,407 Acres and
 Minimum Estuarine Restoration 2-9

2.3.3 Alternative C - Refuge Expansion of 2,407 Acres and
 Moderate Estuarine Restoration 2-14

2.3.4 Alternative D - Preferred Alternative: Refuge Expansion of
 3,479 Acres and Maximum Estuarine Restoration 2-19

2.3.5 Comparison of the Alternatives by Issue 2-23

2.4 Alternative Components Considered but Eliminated from Detailed Study 2-23

Chapter 3: Affected Environment 3-1

3.1 Physical Environment 3-1

3.1.1 Climate 3-1

3.1.2 Hydrology 3-1

3.1.3 Geology 3-3

3.1.4 Soils 3-4

3.1.5 Environmental Contaminants 3-5

TABLE OF CONTENTS (continued)

3.2 Vegetation and Habitat Resources 3-8

 3.2.1 Habitats and Vegetation Communities 3-8

 3.2.2 State and Regional Trends for Key Habitats Represented
 at Nisqually NWR 3-24

 3.2.3 Plants, Including Exotic and Invasive Species 3-24

3.3 Fisheries Habitats and Resources 3-29

 3.3.1 Pacific Salmon 3-30

 3.3.2 Forage Fish 3-31

 3.3.3 Other Fishes 3-32

 3.3.4 Threatened and Endangered Fish 3-34

3.4 Wildlife 3-35

 3.4.1 Waterfowl 3-35

 3.4.2 Waterbirds and Seabirds 3-36

 3.4.3 Shorebirds 3-40

 3.4.4 Landbirds 3-40

 3.4.5 Marine Mammals 3-42

 3.4.6 Land Mammals 3-43

 3.4.7 Reptiles and Amphibians 3-43

 3.4.8 Invertebrates 3-44

 3.4.9 Invasive and Exotic Wildlife Species 3-44

 3.4.10 Federally Endangered and Threatened Species 3-45

 3.4.11 State Listed Species 3-45

3.5 Special Uses 3-46

 3.5.1 Haying 3-46

 3.5.2 Scientific Research 3-46

 3.5.3 Tribal Fishing 3-46

3.6 Public Access, Education, and Recreational Opportunities 3-47

 3.6.1 Public Access 3-47

 3.6.2 Recreation 3-47

 3.6.3 Environmental Education 3-54

3.7 Cultural Resources 3-56

 3.7.1 Native American Cultural History and Landscape 3-56

 3.7.2 Euro-American Cultural History 3-57

3.8 Socioeconomics 3-59

 3.8.1 Socioeconomic Setting 3-59

 3.8.2 Environmental Justice 3-63

 3.8.3 Land Use 3-63

 3.8.4 Refuge Management Economics 3-69

 3.8.5 Area Recreation Sector 3-69

 3.8.6 Agricultural Sector 3-71

 3.8.7 Commercial Shellfishing 3-72

TABLE OF CONTENTS (continued)

Chapter 4: Environmental Consequences	4-1
4.1 Effects to the Physical Environment	4-2
4.1.1 Alternative A	4-2
4.1.2 Alternative B	4-4
4.1.3 Alternative C	4-7
4.1.4 Alternative D (Preferred Alternative)	4-9
4.2 Effects to Vegetation and Habitat Resources	4-11
4.2.1 Alternative A	4-11
4.2.2 Alternative B	4-13
4.2.3 Alternative C	4-18
4.2.4 Alternative D (Preferred Alternative)	4-21
4.2.5 Effects to Regional Availability of Wetland Habitats	4-24
4.3 Effects to Fisheries Habitats and Resources	4-26
4.3.1 Alternative A	4-26
4.3.2 Alternative B	4-27
4.3.3 Alternative C	4-29
4.3.4 Alternative D (Preferred Alternative)	4-32
4.3.5 Effects to Threatened and Endangered Species	4-35
4.4 Effects to Wildlife	4-36
4.4.1 Effects to Birds	4-36
4.4.2 Effects to Mammals	4-55
4.4.3 Effects to Reptiles and Amphibians	4-62
4.4.4 Effects to Invertebrates	4-66
4.4.5 Effects to Invasive and Exotic Wildlife Species	4-69
4.4.6 Effects to Endangered and Threatened Species and Selected Birds of Conservation Concern	4-72
4.4.7 Effects to State-Listed Species	4-76
4.5 Effects to Special Uses	4-77
4.5.1 Alternative A	4-77
4.5.2 Alternative B	4-77
4.5.3 Alternative C	4-78
4.5.4 Alternative D (Preferred Alternative)	4-79
4.5.5 Effects to Tribal Fishing	4-80
4.6 Effects to Public Access, Education, and Recreational Opportunities	4-81
4.6.1 Alternative A	4-81
4.6.2 Alternative B	4-84
4.6.3 Alternative C	4-88
4.6.4 Alternative D (Preferred Alternative)	4-91
4.7 Effects to Cultural Resources	4-95
4.7.1 Alternative A	4-95
4.7.2 Alternative B	4-95
4.7.3 Alternative C	4-96
4.7.4 Alternative D (Preferred Alternative)	4-96

TABLE OF CONTENTS (continued)

4.8	Effects to Socioeconomics	4-97
4.8.1	Effects to Environmental Justice	4-97
4.8.2	Effects to Land Use	4-98
4.8.3	Effects of Refuge Management Economics on the Regional Economy	4-102
4.8.4	Effects to Recreation Economics	4-103
4.8.5	Effects to Commercial Shellfishing	4-106
4.9	Summary of Effects	4-107
4.10	Cumulative Effects	4-115
4.11	Irretrievable and Irreversible Commitment of Resources	4-116
4.12	Short-term Uses and Long-Term Productivity	4-116
4.13	Unavoidable Adverse Effects	4-116
Chapter 5:	Relationships to Federal, State, and Local Policies and Plans	5-1
5.1	Federal Government	5-1
5.1.1	Fish and Wildlife Service Plans, Policies, and Programs	5-1
5.1.2	Fort Lewis	5-3
5.2	State of Washington	5-4
5.2.1	Watershed Planning Act	5-4
5.2.2	Growth Management Act	5-4
5.2.3	Shoreline Management Act	5-4
5.3	Nisqually Indian Tribe	5-5
5.3.1	Nisqually Watershed Planning - Nisqually WRIA 11	5-5
5.3.2	Nisqually Chinook Recovery Plan	5-5
5.3.3	Nisqually River Multi-Species Management Plan	5-5
5.3.4	Nisqually Community Vision Plan	5-6
5.4	Resource-Specific Plans	5-6
5.4.1	Nisqually River Management Plan	5-6
5.4.2	Nisqually River Task Force	5-6
5.5	Thurston County	5-7
5.5.1	County-Wide Planning Policies	5-7
5.5.2	Comprehensive Plan	5-7
5.5.3	Shoreline Master Program	5-8
5.5.4	Shellfish Protection Districts	5-8
5.5.5	Nisqually Sub-Area Land Use and Zoning Plan	5-8
5.6	Pierce County	5-9
5.6.1	County-Wide Planning Policies	5-9
5.6.2	Comprehensive Plan	5-9
5.6.3	Shoreline Master Program	5-10
5.6.4	Land Use Regulations	5-10

TABLE OF CONTENTS (continued)

Chapter 6: Compliance, Consultation, and Coordination with Others 6-1

 6.1 Compliance 6-1

 6.2 Consultation and Coordination with Others 6-1

 6.2.1 Public Outreach 6-1

 6.2.2 Interest Group and Other Agency Consultation/Coordination 6-3

 6.2.3 Tribal Consultation/Coordination 6-4

Appendices:

A. Glossary of Terms

B. Distribution List

C. References

D. Applicable Laws and Executive Orders

E. Nisqually NWR Species List

 E.1 Plant List

 E.2 Wildlife List

F. Plan Implementation

G. Compatibility Determinations for Proposed Actions

 G.1 Recreational Boating

 G.2 Recreational Fishing

 G.3 Waterfowl Hunting

 G.4 Environmental Education

 G.5 Wildlife Observation, Photography, and Interpretation

 G.6 Research

 G.7 Agriculture - Haying

H. List of Preparers

I. Goals, Objectives, and Strategies

J. Hydrodynamic and Sediment Transport Modeling Summary

K. Land Protection Plan

L. Wilderness Review

TABLE OF CONTENTS (continued)

Figures:

Figure 1.1-1 Regional Context 1-3

Figure 1.1-2 Current Ownership within the CCP Study Area 1-5

Figure 2.3-1 Alternative A: No Action (Status Quo) 2-7

Figure 2.3-2 Alternative B: Refuge Expansion of 2,407 Acres and Minimum Estuarine
Restoration 2-11

Figure 2.3-3 Alternative C: Refuge Expansion of 2,407 Acres and
Moderate Estuarine Restoration 2-17

Figure 2.3-4 Alternative D: Refuge Expansion of 3,479 Acres and Maximum
Estuarine Restoration 2-21

Figure 3.2-1 Major Habitat Types and Wildlife Typical of the Refuge 3-9

Figure 3.2-2 CCP Study Area Habitat Types 3-11

Figure 3.2-3 National Wetland Inventory of Regional Estuarine Wetlands 3-15

Figure 3.2-4 Historic (1878) and Current Wetlands in the Nisqually Delta 3-17

Figure 3.2-5 Overall Losses in Salt Marsh Acres for Puget Sound River Deltas 3-25

Figure 3.2-6 Distribution of Invasive Reed Canary Grass, 1997 3-27

Figure 3.4-1 Waterfowl Survey Units 3-37

Figure 3.6-1 Current Authorized Public Recreation within the Study Area 3-49

Figure 3.8-1 Special Designated Areas 3-67

Tables:

Table 2.3-1 Comparison of Nisqually NWR Draft CCP/EIS Alternatives by Component . 2-27

Table 3.2-1 Summary of Habitat Types and Acres Within the CCP Study Area 3-8

Table 3.3-1 Species Selected for Evaluating the Likely Effects of CCP Alternatives on Fish
Inhabiting the Estuarine Habitats of the Refuge 3-29

Table 3.8-1 Local Population Trends 3-60

Table 4.0-1 Brief Summary of Alternatives Described in Chapter 2 4-1

Table 4.2-1 Summary of Habitat Restoration Effects to Regional Estuarine and
Freshwater Wetlands 4-25

Table 4.9-1 Summary of Potential Effects of Alternatives A, B, C, and D 4-109

Chapter 1. Introduction, Purpose and Need, and Issues

1.1 Introduction

Nisqually National Wildlife Refuge (NWR or Refuge) is located at the southern end of Puget Sound, Washington in the Nisqually River delta (Figure 1.1-1). The 2,925-acre Refuge, located in Thurston and Pierce counties, is managed by the U.S. Fish and Wildlife Service (Service) and protects one of the few relatively undeveloped large estuaries remaining in Puget Sound. The Refuge has international significance as a staging area, sanctuary, and migration stopover for migratory birds of the Pacific Flyway. The Refuge also has regional importance as migration and rearing habitat for salmon, particularly the Federally listed fall chinook salmon.

This document is a Draft Comprehensive Conservation Plan and Environmental Impact Statement (Draft CCP/EIS) for Nisqually NWR. Once finalized, the CCP will guide management of Refuge operations, habitat restoration, and visitor services for the next 15 years. Guidance within the CCP will be in the form of goals, objectives, strategies (Appendix I), and compatibility determinations (Appendix G). The Final CCP will be based on the Record of Decision (ROD) that will identify the selected alternative. The selected alternative can be one of the alternatives in this Draft CCP/EIS or it can be a new alternative developed from a combination of these draft alternatives. This Draft CCP/EIS evaluates and compares four alternatives containing programs for habitat restoration, Refuge boundary expansion, and related environmental education and recreational opportunities. It also identifies the effects of restoration, Refuge expansion, and visitor use on key physical, biological, social, and cultural resources. The Service's Regional Director in Portland, Oregon is the responsible official for approving the Final CCP/EIS and signing the ROD. The National Director of the Service has final authority on the proposed expansion of Nisqually NWR.

The currently approved Refuge boundary totals 3,936 acres. Figure 1.1-2 identifies the CCP Study Area, which includes areas for potential Refuge expansion. The CCP Study Area totals 9,326 acres and includes the bluffs east of the Refuge and lands south of Interstate 5 (I-5) along approximately 6 miles of the Nisqually River corridor and 2.5 miles up McAllister Creek to its headwaters at McAllister Springs.

1.2 Proposed Action

The Service proposes to adopt and implement a Comprehensive Conservation Plan for Nisqually National Wildlife Refuge. The Service examined a wide range of alternatives for future management at Nisqually NWR; of these alternatives, Alternative D best achieves the Refuge purpose, vision, and goals (see Sections 1.5 and 1.6). Alternative D would provide the largest amount of Refuge boundary expansion, as well as the largest amount of restoration of estuarine

habitat. Alternative D addresses the major issues and relevant mandates identified in the CCP process and is consistent with principles of sound fish and wildlife management. For details on the specific components and actions comprising Alternative D, see Chapter 2.

1.3 Purpose and Need for the Comprehensive Conservation Plan

A new CCP is needed to more effectively address the highest priority natural resource needs in the face of changing conditions since the Nisqually NWR was established in 1974. The Refuge is currently managed under an outdated 1978 Conceptual Plan (CH2M Hill et al. 1978). The purpose of the CCP is to shape the future of the Refuge and provide guidance in achieving management goals and objectives for land protection, habitat restoration, fish and wildlife, special status species, environmental education, and wildlife-dependent recreation. Implementing the CCP would provide the Refuge an opportunity to enhance its critical role in the conservation and management of fish and wildlife resources of the Nisqually River delta and lower watershed and continue developing high quality environmental education and wildlife interpretation for Refuge visitors. The CCP will provide Refuge neighbors, visitors, the public, partners, and government officials with an understanding of the Service's management actions on and around the Refuge. The CCP will also provide a basis for budget requests to support the Refuge's needs for staffing, operations, maintenance, and capital improvements.

The south Puget Sound region, with its rapidly growing urban and suburban development, is undergoing dramatic changes in population and landscape. Some areas within the study area that are currently proposed for development are ecologically inseparable from Refuge habitats. The CCP provides an opportunity to consider whether the Refuge could play a more effective role in habitat protection in the Nisqually delta and lower Nisqually watershed, based on ecological needs.

Eighty percent of estuarine habitat has been lost in Puget Sound in the last 150 years, contributing to the decline of many fish and wildlife that depend on estuaries, including several salmon species (Dean et al. 2000). The Refuge's diked freshwater wetlands were historically estuarine, and habitat quality has declined. The Refuge provides a unique opportunity to consider restoration of an historical tidal system, thereby benefitting many fish and wildlife species.

Located on the I-5 corridor 20 miles from Tacoma and only 8 miles from Olympia, Nisqually NWR has become an urban Refuge easily accessible to outdoor enthusiasts. Visitor use and interest in the Refuge have increased as residential developments expand in the nearby cities of Lacey, DuPont, Olympia, and the Seattle-Tacoma area. Thousands of students and teachers participate in the Refuge's environmental education program. The Refuge is an ideal setting to provide an improved and expanded education program to respond to this growing need. As Refuge use has increased, so have conflicts among visitors and concerns over meeting the needs of fish and wildlife species. Boating, personal watercraft (PWC, i.e., jetskiing), waterfowl hunting, fishing, and shellfishing all occur on the Refuge. Changes are needed to reduce wildlife disturbance;

Figure 1.1-1, Regional Context - 8 ½ x 11, B&W

Figure 1.1-1

BACK SIDE

Figure 1.1-2 Comprehensive Conservation Plan Study Area 8 ½ x 11, color

[Color Figure]

FIGURE 1.1-2

BACK SIDE

provide sufficient wildlife sanctuary; protect the Refuge's Research Natural Area (RNA); reduce overcrowding, visitor conflicts, and unauthorized activities; improve the quality of wildlife-dependent recreation; and allow the Service to accomplish its goals on the Refuge.

1.4 Legal and Policy Guidance

Nisqually NWR and its management and administrative activities are managed as part of the National Wildlife Refuge System (NWRS or System) within a framework provided by legal and policy guidelines. The Refuge is guided by the mission and goals of the NWRS, the purpose of the Refuge as described in its acquisition authority, Service policy, Federal laws and executive orders, and international treaties. Below is a discussion of concepts and guidance for the System covered in the NWRS Administration Act of 1966, the Refuge Recreation Act of 1962, Title 50 of the Code of Federal Regulations (CFR), the Fish and Wildlife Service Manual (USFWS 1981), and, more recently, through the National Wildlife Refuge System Improvement Act of 1997. A list of other laws and executive orders that may affect the CCP for Nisqually NWR or the Service's implementation of the CCP is provided in Appendix D.

1.4.1 The U.S. Fish and Wildlife Service

Nisqually NWR is managed by the U.S. Fish and Wildlife Service within the Department of the Interior. The Service is the primary Federal agency responsible for conserving and enhancing the nation's fish and wildlife populations and their habitats. Although the Service shares this responsibility with other Federal, State, tribal, local, and private entities, the Service has specific trust responsibilities for migratory birds, threatened and endangered species, and certain anadromous fish and marine mammals. The Service also has similar trust responsibilities for the lands and waters it administers to support the conservation and enhancement of fish and wildlife.

1.4.2 National Wildlife Refuge System

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.” (16 U.S.C. 668dd et seq.)

Starting with the first Refuge, Florida's Pelican Island established in 1903 by President Theodore Roosevelt, the NWRS has grown to more than 95 million acres in size, including nearly 540 National Wildlife Refuges. The NWRS is the largest collection of lands specifically managed for fish and wildlife conservation in the nation. The needs of wildlife and their habitats come first on Refuges, in contrast to other public lands which are managed for multiple uses.

The administration, management, and growth of the NWRS are guided by the following goals: (Draft Mission, Goals, and Purposes Policy, January 16, 2001):

- To fulfill our statutory duty to achieve Refuge purpose(s) and further the System mission.
- To conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- To perpetuate migratory bird, interjurisdictional fish, and marine mammal populations.
- To conserve a diversity of fish, wildlife, and plants.
- To conserve and restore where appropriate representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
- To foster understanding and instill appreciation of native fish, wildlife, and plants, and their conservation, by providing the public with safe, high quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

1.4.2.1 National Wildlife Refuge System Improvement Act

The National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) amends the Refuge System Administration Act of 1966 by defining a unifying mission for all Refuges, including a new process for determining compatible uses on Refuges, and requiring that each Refuge be managed under a CCP. The Act expressly states that wildlife conservation is the priority of NWRS lands and that the Secretary of the Interior shall ensure that the biological integrity, diversity, and environmental health of Refuge lands are maintained. Each Refuge must be managed to fulfill the NWRS mission and the specific purposes for which the Refuge was established. The first priority of each Refuge is to conserve, manage, and, if needed, restore fish and wildlife populations and habitats according to its purpose. The Service has statutory authority under the National Wildlife Refuge Administration Act and the Improvement Act to regulate activities that occur on water bodies “within” a Refuge. The Improvement Act requires that a CCP be completed for each Refuge by the year 2012 and that the public have an opportunity for active involvement in plan development and revision. It is Service policy that CCPs are developed in an open public process and that the agency is committed to securing public input throughout the process.

Compatibility Policy

Lands within the NWRS are different from other, multiple-use public lands in that they are closed to all public uses unless specifically and legally opened. No Refuge use may be allowed unless it is determined to be compatible. A compatible use is a use that, in the sound professional judgement of the Refuge Manager, will not materially interfere with or detract from the fulfillment of the mission of the NWRS or the purposes of the Refuge. The Improvement Act identifies six priority wildlife-dependent recreational uses: hunting, fishing, wildlife observation, photography,

environmental education, and interpretation. As priority public uses of the NWRS, they receive priority consideration over other public uses in planning and management.

Biological Integrity, Diversity, and Environmental Health Policy

The Improvement 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 Refuge managers to follow while achieving Refuge purpose(s) and System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on Refuges and associated ecosystems. When evaluating the appropriate management direction for Refuges, Refuge managers will use sound professional judgment to determine their Refuges’ contribution to biological integrity, diversity, and environmental health at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of Refuge resources, Refuge role within an ecosystem, applicable laws, and best available science, including consultation with others both inside and outside the Service.

1.4.2.2 Research Natural Area Policy

Research Natural Areas (RNA) have special status on lands managed by the Service. Guidance for the operation of RNAs is provided in Section 8 RM 10 of the Service’s Refuge Manual. The purposes of RNAs are:

- (1) “...to preserve adequate examples of all major ecosystem types or other outstanding physical or biological phenomena;”
- (2) “To provide research and educational opportunities for scientists and others in the observation, study, and monitoring of the environment;” and
- (3) “...to preserve a full range of genetic and behavioral diversity for native plants and animals, including endangered or threatened species..”

According to the Manual:

“activities on RNAs are limited to research, study, observation, monitoring, and educational activities that are non-destructive, non-manipulative, and maintain unmodified conditions. Picnicking, camping, collecting plants, gathering nuts and herbs, picking berries, hunting, fishing, trapping, and other public uses which contribute to modification of a Research Natural Area should be discontinued or expressly prohibited if such uses threaten serious impairment of research and education values.” (USFWS 1981)

1.5 History of Refuge Establishment and Purpose

The Nisqually River delta is located approximately 20 miles southwest of Tacoma and 8 miles northeast of Olympia, Washington, in Pierce and Thurston counties. The proximity to these two

major urban centers has exposed the delta to numerous development threats over the years. In 1965, the Port of Tacoma proposed developing 1,100 acres of the Nisqually River Estuary as a deepwater port facility. Largely as a result of citizen efforts led by conservationist and teacher Margaret McKenny and the Nisqually Delta Association, the proposal was denied (Burg 1984). In 1967, the Port of Olympia proposed development of an aluminum mill on the delta (Stevenson 1998). In 1966 and 1967, to further stave off development, the Washington State Department of Game (now the Washington Department of Fish and Wildlife [WDFW]) purchased holdings of approximately 616 acres of delta tidelands and salt marshes (USFWS 1977; Guth 1998).

In 1970, the Nisqually River Task Force (see Section 5.4.2) was created to assist in preserving and protecting the river and delta. In 1971, in recognition of the significance of the area as a natural estuarine and aquatic ecosystem, the U.S. Department of the Interior designated the estuarine portion of the Nisqually River delta as a National Natural Landmark (see Figure 1.1-2). The Nisqually River Task Force recommended in 1972 that the delta be set aside as a National Wildlife Refuge.

In February 1974, in recognition of the area's unique fish and wildlife resources, the Brown Farm property and tidelands were acquired for inclusion in the NWRS as Nisqually NWR. In total, 1,285 acres of diked grasslands, freshwater marshes, and tidelands were initially purchased with funds approved by the Migratory Bird Conservation Commission under authority of the Migratory Bird Conservation Act and subsequently placed under the management of the Service (Hesselbart 1977a). Revenue received from Duck Stamps is the primary source of funding for those lands purchased under the Migratory Bird Conservation Act. However, three additional funding sources include appropriations authorized by the Wetlands Loan Act; import duties collected on arms and ammunition; and receipts from the sale of Refuge admission permits. Nisqually NWR was established with the following purposes:

“for use as an inviolate sanctuary, or for any other management purpose, for migratory birds” (16 U.S.C. ss 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) ... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude” ... 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)

In 1977, an Environmental Assessment (EA) was completed in order to expand the Refuge boundary and authorize the acquisition of approximately 3,780 acres of delta lands (USFWS 1977). One year later, a Conceptual Plan and associated Environmental Assessment were developed for the Refuge (CH2M Hill et al. 1978). These documents provided initial direction for managing wildlife, habitat, and public use. The Conceptual Plan designated a Research Natural Area (RNA) in the northeast corner and habitat management, surface water control, and haying within the diked interior to provide forage and cover for waterfowl.

In 1996, the Service acquired a 107-acre parcel on the top of the West Bluff. Funding for this parcel came from the Land and Water Conservation Fund, which is supported by proceeds from off-shore oil and gas development. A total of 516 acres of tidelands was also transferred from the Department of Army to the Refuge.

The Service has acquired 76% (or 2,925 acres) within the approved Refuge boundary. These lands consist primarily of the Nisqually River, the delta estuary, McAllister Creek, diked freshwater wetlands and grasslands, and upland bluffs to the west. The diked area includes approximately 1,000 acres of Refuge lands between the Nisqually River and McAllister Creek. Refuge buildings, roads, parking lots, and an old orchard are located at the southeast corner of the Refuge, near the river.

In November 2000, Congress appropriated an additional \$2 million of Land and Water Conservation Funds which was earmarked for a land purchase on the East Bluff of the delta. Operation and maintenance funding is provided in an annual appropriation to the Department of the Interior from the United States Congress.

1.6 Refuge Vision and Goals

1.6.1 Vision

Nisqually National Wildlife Refuge is a landmark in the Pacific Northwest, located where the freshwater of the Nisqually River flows into Puget Sound. The estuary created by this mixing of fresh and saltwater is the richest kind of habitat known. Because of its biological significance, the Nisqually delta was registered as a National Natural Landmark. More than 275 species of migratory birds, many runs of salmon, and numerous other species come to rest, feed, nest, spawn, and grow. More than 100,000 visitors also come to view this special place each year, to enjoy and learn about these fish and wildlife and their habitats, and to share in the experiences of the delta.

The Service has a unique opportunity to restore Nisqually NWR as an historic tidal system, thereby benefitting many fish and wildlife species that depend on estuaries, including several salmon species and a wide variety of migratory birds. This restoration effort will contribute significantly to Puget Sound, where 80% of estuarine habitat has been lost in the last 150 years. Many migratory fish and wildlife move across the Refuge boundary into the lower Nisqually River watershed on a daily basis. Expanded land protection will be based on ecological needs to allow the Refuge to more effectively protect and restore the Nisqually delta, freshwater wetlands, and riparian forests critical to these fish and wildlife.

Nisqually NWR is located within 100 miles of more than 4 million people, providing tremendous opportunities for many to learn about and experience the diverse habitats, fish and wildlife, and restoration of an historic system. A model environmental education program will reach a diverse group of tomorrow's stewards and leaders, to help them learn about and participate in the protection and care of our natural areas. Quality wildlife-dependent recreation will be provided to thousands of people so they can enjoy the abundance of fish and wildlife in a diversity of habitats. New, accessible Refuge headquarters facilities provide an ideal venue for these opportunities.

Through strong partnerships and innovative outreach efforts, the Refuge will provide a unique opportunity to develop a model National Wildlife Refuge, providing leadership in habitat restoration and management, land protection, environmental education, and quality wildlife-dependent recreation. With the support of partners and the community, the Refuge will provide a focal point in the Nisqually River watershed and throughout Puget Sound to demonstrate sound land stewardship and restoration of native habitats on a large scale to benefit salmon and migratory birds. This is an unparalleled opportunity for people to learn about and help build the future of Nisqually National Wildlife Refuge.

1.6.2 Goals

The following goals provide guiding principles for Nisqually NWR. They are consistent with Refuge purposes, Refuge System goals, the Improvement Act, Service policy, and international treaties. These goals apply to all alternatives in the Draft CCP/EIS.

- Goal 1: Conserve, manage, restore, and enhance native habitats and associated plant and wildlife species representative of the Puget Sound lowlands, with a special emphasis on migratory birds and salmonids.*
- Goal 2: Support recovery and protection efforts for Federal and State threatened and endangered species, species of concern, and their habitats.*
- Goal 3: Provide quality environmental education opportunities focusing on the fish, wildlife, and habitats of the Nisqually River delta and watershed.*
- Goal 4: Provide quality wildlife-dependent recreation, interpretation, and outreach opportunities to enhance public appreciation, understanding, and enjoyment of fish, wildlife, habitats, and cultural resources of the Nisqually River delta and watershed.*

1.7 Comprehensive Conservation Planning Process

This Draft CCP/EIS for Nisqually NWR is intended to meet the dual requirements of compliance with the Improvement Act and the National Environmental Policy Act (NEPA). NEPA and the Improvement Act require the Service to actively seek public involvement in the preparation of environmental documents. NEPA also requires the Service to seriously consider all reasonable alternatives to its Preferred Alternative including the “No Action” alternative, which represents continuation of current conditions and management practices. Chapter 2 presents the alternatives for Refuge management.

Key steps in the CCP/EIS process include:

1. Form the Planning Team and conduct pre-planning
2. Initiate public involvement and scoping
3. Identify issues and develop vision and goal statements

4. Develop alternatives and assess their environmental effects
5. Identify the Preferred Alternative
6. Publish the Draft CCP and NEPA Document
7. Revise the Draft CCP and Publish a Final Plan
8. Implement the CCP

1.7.1 The Nisqually NWR CCP Process

During the summer of 1995, Nisqually NWR staff initiated preliminary habitat management planning. Interest was based on a desire to reevaluate how habitat was managed and to guide improvements for areas of deteriorating habitat quality. After the Refuge experienced severe flooding in 1996, comprehensive planning was initiated, and public scoping meetings were held during 1996 and 1997 to gather comments on issues to be addressed in the CCP. The CCP process is guided by the Refuge Planning Chapter of the Fish and Wildlife Service Manual (Part 602 FW2.1, Draft November 1996 and Final, June 2000).

In 1997, a core team of Refuge and Regional Office staff was established to prepare the CCP. An internal Service technical work group was also formed to advise on the technical aspects and management strategies of the plan. This technical work group met five times during the planning process to review and comment on the progress of the plan. The list of preparers as well as other participants can be found in Chapters 6 and Appendix H.

During 1997, the Refuge also established a cooperative management agreement with Ducks Unlimited (DU) to assist with the CCP and provide technical support on habitat management and restoration. In early 1998, the Service and DU hired ENSR, a Redmond, Washington-based consulting firm, to prepare a hydrodynamic and sediment transport model to assess restoration alternatives on the Nisqually River delta. The model and evaluation of restoration alternatives were presented in a technical report completed by ENSR in May 1999. A summary of this report can be found in Appendix J.

In this same month, an analysis in support of the CCP, titled “The Regional Context of Intertidal Habitat Restoration in the Nisqually River Delta” was produced by Curtis Tanner (1999). Also, a “Characterization of Fishes in the Nisqually River, Estuary, and Reach” was developed by Carrie Cook-Tabor (1999) in support of the planning process. In September 2000, the Service hired EDAW, Inc., an environmental consulting firm, to assist the agency in completing the CCP/EIS and assist with public involvement.

Coordination and cooperation among participating stakeholders was a fundamental element of the Draft CCP/EIS. The Planning Team consulted with and considered the interests of many agencies and organizations. Chapter 6 provides additional details on coordination with the following groups:

- U.S. Fish and Wildlife Service
- Washington Department of Fish and Wildlife (WDFW)
- Nisqually Indian Tribe

- Nisqually River Council
- Friends and Volunteers of Nisqually NWR
- City of Olympia
- Thurston County Planning
- Pierce County Planning
- Fort Lewis Military Reservation
- Weyerhaeuser Corporation
- National Marine Fisheries Service (NMFS)

1.7.2 Public Involvement

Public involvement is an important component of Federal planning and was given considerable attention in the Nisqually NWR CCP process. Public involvement began with a preliminary scoping meeting on July 25, 1996. To date, Refuge staff have given more than 50 presentations to a variety of groups. Tools used to encourage public involvement included public meetings, planning update newsletters, workbooks, workshops, presentations, web pages, and Federal Register notices. Chapter 6 provides more details on public involvement activities.

1.8 Planning Issues, Concerns, and Opportunities

Issues, concerns, and opportunities were identified through discussions with key contacts, workshop participants, and through the public scoping process. The following section summarizes issues, concerns, and opportunities from all public input received throughout the planning scoping efforts. Eight major issues were identified, as listed and described below.

Issue 1: Refuge Boundary Expansion

Should the Service play a larger role in protecting the lower Nisqually watershed and expand its Refuge boundary and, if so, what areas should be included?

Nisqually NWR currently consists of just under 3,000 acres. If all the lands within the currently approved Refuge boundary were acquired, the Refuge would consist of 3,936 acres. When the Refuge was established, protection was focused on the part of the delta that was imminently threatened with development. This CCP provides an opportunity to consider whether the original boundary is sufficient to make the Refuge ecologically whole and meet today's vision and goals for the Refuge, or whether additional lands beyond the approved Refuge boundary should be protected and included within an expanded Refuge boundary. These considerations include whether expansion is needed to protect all the habitat components necessary to sustain habitat quality in the delta and whether additional protection is needed for wetlands and riparian habitat used by Refuge wildlife in the lower Nisqually watershed.

For example, should the Refuge expand its boundary onto lands along the East Bluff of the delta? If these lands were acquired and added to the Refuge, they would receive greater protection and management. Under Refuge management, the East Bluff would provide greater protection for

wildlife by providing an almost continuous (except for the railroad tracks) corridor of habitats from wetlands to forested uplands, as well as improve habitat quality and protection of the watershed. This corridor would help protect the stability of the steep bluff, reducing erosion and sedimentation, and contributing to improved water quality. A visual buffer would also help preserve the character of the delta for years to come. A similar corridor has been acquired on the West Bluff, including forested uplands along the slope, crest, and top of the bluff. Properties on the East Bluff of the delta are privately owned; major development is currently proposed, including bluff-top lands.

The current Refuge and the adjacent habitats of the Nisqually Valley on the south side of I-5 and along the Nisqually River and McAllister Creek are ecologically inseparable. Many migratory birds move between these areas on a daily basis to feed and roost. Salmon migrate through the Refuge into the rivers and creeks of the Nisqually Valley. These areas have high wetland and riparian restoration potential to recreate freshwater wetlands and improve the river corridor. Freshwater wetland restoration in the lower watershed could also offset the potential conversion of diked freshwater wetlands back to estuary. Public comments have indicated widespread support for Refuge expansion, including on the East Bluff.

Issue 2: Habitat Restoration and Management of the Diked Area

Should Nisqually NWR restore historical estuarine habitat and, if so, to what extent should this occur?

This issue focuses primarily on the 1,000 acres of former estuarine habitat within the Brown Farm Dike. This area was historically a major part of the Nisqually delta estuary but was diked for farming in the late 1800s. This habitat is currently managed by the Service as a mosaic of freshwater wetlands and non-native grasslands to benefit a variety of migratory waterfowl and other migratory birds. Many species of ducks, geese, shorebirds, waterbirds, songbirds, raptors, invertebrates, and mammals use this area. The dike trails allow easy access to portions of these habitats, providing excellent wildlife viewing, photography, and educational opportunities.

Since Refuge establishment, frequent and costly breaching of the dike has occurred. In 1973, the northwest section of the dike along McAllister Creek breached and was quickly repaired (Klotz et al. 1978). On December 4, 1975, excessive river flood waters, high tide on the sound, and debris in the flooding river caused the dike again to breach approximately 1½ miles north of I-5 on the Nisqually River. Approximately 150 linear feet of the dike were destroyed, 400 feet severely undercut, and another 100 feet were damaged. Repairs to the dike were made in 1975. In 1979, material was added to the top and sides of the dike to raise its level to 12.5 feet on the Nisqually side and 12 feet on the McAllister side. New tide gates were also installed (Stevenson 1998). Major winter storms and high Nisqually River flows during November 1995 eroded riparian forest along the river and damaged the Nisqually River dike. Repairs using riprap (bank stabilization material) occurred in December 1995 and January 1996. In February 1996, a severe flood inundated most of the Refuge. Flooding and high river flows created two breaches and severe erosion along the Nisqually River dike. At the south end of the Refuge, overflow channels from the Nisqually River and McAllister Creek were also a major source of flood waters. Ninety-five

percent of the diked interior flooded, damaging buildings, water control structures, boardwalks, and trails. The diked interior was flooded with up to 4 feet of water for days and in some places for weeks. Emergency dike repairs were conducted as a temporary measure until planning could be completed. Headquarters facilities replacement was largely completed in 1999.

In late 1996, subsequent flooding, heavy snowfall, ice, and high winds once again caused damage to the dike adjacent to the riprap repair of the previous year. Emergency repairs were completed by February 1997. Approximately \$400,000 was spent on emergency dike repairs in 1996 and 1997. Flooding and the effects of riprap repairs, which deflected erosive energy to the north, resulted in the erosion of about 400 feet of riparian habitat as well. A 1998 engineering survey recommended extensive repairs on much of the dike along McAllister Creek. The February 28, 2001 Nisqually Earthquake also caused extensive damage to much of the dike system, which is still being assessed. The entire dike system would require major repairs to bring it up to today's safety and structural standards.

During the past 20 years, management of the diked area has become increasingly difficult, and habitat quality has declined for the following reasons:

- Reed canary grass, a highly invasive exotic plant, is rapidly spreading throughout much of the area and now occupies more than a third of the total acreage.
- Water level management capabilities are extremely limited, and portions of the diked area are becoming too wet to easily manage.
- Plant succession has been allowed to occur in large sections of the diked area, allowing wetlands and grasslands to gradually convert to shrub habitats, reducing the value for waterfowl, shorebirds, and waterbirds.
- The 100-year-old dike system has required major repairs in 1973, 1975, 1979, 1996, and 1997 and currently needs major repair work. Saltwater seepage occurs along substantial portions of the dike.

This diked habitat, now isolated from tidal influence, was historically part of the Nisqually Estuary. The footprint of this salt marsh system is still visible within the dike in the form of a network of sloughs and channels that spread across the land. Estuaries, and their associated mudflats, salt marshes, tidal channels, and open waters, are one of the most productive habitats on earth. However, the location of estuaries has made them vulnerable to development. In Puget Sound alone, 80% of estuarine habitat has been lost to diking, filling, and development (Dean et. al. 2000). Even more has been lost throughout the West Coast. As estuarine habitat has diminished, associated fish and wildlife have also declined. For example, many salmon species and runs have declined severely in the Puget Sound area.

Through public scoping, the Refuge has learned that some people would like the entire diked area to be restored as historical estuarine habitat to maximize the recovery of anadromous (migratory) fish and benefit migratory birds; to restore a type of habitat now rare in Puget Sound; to bring back an historic, more natural system; and to potentially reduce the costs of future flooding and

dike repairs. Others believe that only a portion of the diked area should be restored to contribute to estuarine, wildlife, and fish recovery, with the remaining area managed as freshwater and grassland habitat. Still others believe that the area should be retained and improved as freshwater and grassland habitats with no tidal restoration, so that the existing mixture of habitats is retained and the trail system is left in its current condition.

Issue 3: Environmental Education

Should the Refuge expand its environmental education program and facilities to serve the growing urban community?

Environmental education is a priority use of the NWRS and a high priority use for urban Refuges like Nisqually NWR. The Refuge is ideally located to reach a diverse group of students in the growing urban community surrounding the Refuge. Public scoping identified environmental education as a highly valued purpose and activity of Nisqually NWR. For all these reasons, Refuge staff consider environmental education to be one of the highest and best public uses on the Refuge. As many as 5,000 students and teachers from King, Pierce, Thurston, and Mason counties participate annually in the Refuge's limited environmental education program. The Refuge provides educators and youth professionals with volunteer support, indoor and outdoor facilities, and limited equipment. Demand by school groups is growing throughout the year, with the highest use period from early April through mid-June and a growing demand in the summer months as well. The current environmental education program and facilities and programs are inadequate to meet the current and projected future demands for environmental education opportunities. The Twin Barns Education Center served as a temporary education facility. Safety concerns from the recent earthquake required moving the education program out of the Twin Barns and into a trailer by the maintenance shop. The Refuge is currently seeking funding to build a new education center with greatly improved facilities and to resolve this safety issue and support an enlarged, high quality program.

A focus group of educators identified several opportunities for improving the Refuge's education program. These included a watershed stewardship theme; having additional trained staff and volunteers; providing interpretation for all important ecological features of the Refuge; participation in restoration and research as a means to educate; and user-friendly facilities, gear, and equipment.

The private, non-profit Nisqually Reach Nature Center at Luhr Beach is located within the CCP Study Area and doubles as a wildlife interpretation center and an educational center for school children ranging from 3rd to 12th grades, supporting up to 2000 students per year. The educational focus at the Nature Center is on the marine environment. The Service sees an opportunity to develop and strengthen a partnership with the Nisqually Reach Nature Center to provide a coordinated environmental education program in the Nisqually delta area.

Issue 4: Wildlife Observation, Hiking, and Trail Configuration

What areas of the Refuge will be accessed by trails and available to visitors if estuarine restoration occurs?

The Refuge supports 7 miles of trails, including the 5½-mile Brown Farm Dike Trail and the 1-mile Twin Barns Loop Trail. The Twin Barns Loop Trail was improved in 1999, is fully accessible, and provides interpretive and educational information. The use and location of the Twin Barns Loop Trail will not change based on decisions in this CCP/EIS. Three miles of the Brown Farm Dike Trail closes annually during the waterfowl hunting season to provide increased sanctuary for waterfowl and other birds and to ensure visitor safety due to the waterfowl hunting occurring on adjacent WDFW lands. Changes to the Brown Farm Dike Trail would be necessary under all estuarine restoration alternatives. In some cases, the length of the trail would be greatly reduced. Effects of these changes could be reduced through the construction of new trails in other locations or construction of boardwalk trails in estuarine areas. Many hiking groups and birdwatchers have provided comments on this topic. Many people commented that whatever the configuration of the trail system, for example, if the 5½-mile loop is reduced, access should be provided so that visitors can see wildlife and the variety of habitats on the Refuge and learn about estuarine and freshwater habitat management and restoration. Some people feel that trails should not be reduced or changed. Others believe that if breaches are created in the dikes, the breaches should be bridged if possible, and the Brown Farm Dike should be retained in its current state to support the existing loop trail. Numerous comments suggested new trail options, including building boardwalks into restored estuarine areas. Many commentors expressed discontent with seasonal trail closures due to hunting. The majority of respondents did support seasonal closures if needed to protect wildlife. The majority of commentors also said that fish and wildlife and habitat needs should take priority in making trail and restoration decisions.

Issue 5: Waterfowl Hunting on Nisqually NWR

How can unauthorized hunting on the Refuge be resolved? Is sufficient wildlife sanctuary currently provided within the Refuge? Should waterfowl hunting occur on Nisqually NWR? Would consolidation of hunting on Refuge and State lands in the tideflats provide the best location for a hunting area? Should the Service in cooperation with the WDFW take a more direct role in managing the waterfowl hunting program?

Since its establishment, Nisqually NWR has never been formally opened to waterfowl hunting. However, waterfowl hunting is a popular State-managed activity that occurs in the delta, October through January each year. Estimated use ranges from 1,100 to 2,100 hunter visits per season (USFWS data). Waterfowl hunting is permitted on three parcels (inholdings within the Refuge boundary) owned by WDFW. These parcels have irregular boundaries and are not distinguished from Refuge lands by boundary markers, so hunters often hunt on Refuge lands. Except in limited areas where some posting has been done, the Refuge has not enforced the hunting closure. Unauthorized hunting is occurring on large portions of Refuge tideflats, providing insufficient sanctuary for migratory birds.

The Research Natural Area (RNA) is also hunted in the eastern half of the tideflats. This area should remain closed to hunting as a sanctuary area since, by policy, hunting and other consumptive uses are not allowed in RNAs. Restoration proposals to remove the north and west dikes associated with tidal restoration could remove a visual landmark out in the delta. This physical change could lead to further confusion and “encroachment” by hunters on Refuge lands.

The original 1918 Migratory Bird Treaty Act required that all Refuges be inviolate sanctuaries and deemed that Refuges’ primary purposes were as breeding grounds and habitat for migratory birds. Migratory bird hunting was prohibited. The 1938 amendment to the Act gave Refuge managers the authority to decide if, when, and how bird hunting would be allowed. The subsequent 1949 Duck Stamp Act allowed waterfowl hunting on all Refuges but restricted the percentage of each Refuge open to hunting. No more than 40% of the area purchased with Migratory Bird dollars may be opened at one time for hunting of migratory game birds or resident species of birds.

Many public comments have been received for and against waterfowl hunting. Some commentators believe that the Refuge should be open to waterfowl hunting to improve public hunting opportunities in south Puget Sound. Others specifically requested walk-in and accessible hunting opportunities. Many commentators requested that the current confusion be resolved and the program be managed consistently throughout the delta. Many believe that if hunting is allowed on the Refuge, additional restrictions are needed to ensure that waterfowl hunting is a high quality and safe experience, and sufficient wildlife sanctuary is provided on the Refuge. Others feel if hunting is allowed on the Refuge, it should not conflict with other users, including trail users and kayakers. Seasonal trail closures, required because of the lack of separation between uses, are a source of considerable conflict for many Refuge visitors, and many commentators expressed discontent with these closures. Many commentators believe that the Refuge should not be open to waterfowl hunting and that the Refuge tideflats should provide sanctuary. Hunting programs typically require a sizable effort to ensure a high quality experience and sufficient resource protection, including administrative effort, law enforcement, education, posting, writing and distributing literature, presentations, public contact, and monitoring. Additional staff would be required, and the hunting program could reduce resources and labor available for other high priority programs, such as environmental education.

The CCP process provides an opportunity to reevaluate waterfowl hunting in the delta and consider implementation, consolidation, or enforcement of closure of a waterfowl hunting program on Refuge lands to resolve the current unauthorized hunting on a closed Refuge. Resolution of this issue requires close coordination with WDFW because they control the hunting access at Luhr Beach, and they own the land and waters where the primary hunting occurs. If a decision is made to open parts of the Refuge to hunting, the Service would need to prepare a Hunting Plan consistent with the CCP and stipulations in the compatibility determination (Appendix G.4), and formally open the Refuge to waterfowl hunting.

Issue 6: Fishing and Shellfishing

What opportunities should the Refuge provide for bank fishing, boat fishing, and shellfishing?

The Refuge offers fishing for salmon, steelhead, and cutthroat trout in McAllister Creek and the Nisqually River, and for shellfish and bottomfish in the tideflats. No fishing is allowed inside the dike. Some fishing and shellfishing occur within the RNA although this is not allowed by Service policy. Public comments identified concerns over limited access and opportunities for bank fishing, increases in use and crowding, conflicts with other users, and the need for fishing facilities accessible to people with disabilities. One group suggested additional opportunities for youth fishing, such as constructing a pond on the Refuge. Refuge concerns include the challenges of enforcing wildlife sanctuary areas from human disturbance, providing quality fishing and shellfishing opportunities with both boat and foot access, potential loss of current foot access (McAllister bankfishing), and construction and maintenance costs of sites that are accessible to people with disabilities. Concerns have been raised about the effects of shellfishing, particularly foot access in the Luhr Beach area, on sensitive tideflat habitats, shellfish, and wildlife, caused by trampling, harvesting, and human disturbance. If a decision is made to change the current fishing program, the Service would need to prepare a Fishing Plan consistent with the CCP and stipulations in the compatibility determination (Appendix G.3).

Issue 7: Boating

Is boating a compatible use and, if so, what restrictions are necessary?

Limited launch sites, shallow water conditions, and narrow boating corridors along the Nisqually River and McAllister Creek currently limit the amount of boat traffic in the Refuge. However, boat use, estimated at 6,700 visits per year for motorized and non-motorized use, is increasing. General power boating is not a priority activity of the NWRS. This use is distinguished from boating associated with fishing or other priority public uses. High speeds and erosion caused by boat wakes, pollution, and wildlife disturbance are the primary management concerns. Luhr Beach is the only public water access site in the Nisqually delta. Visitors from this site enter the Refuge or cross Refuge waters to recreate primarily on the Refuge or on State lands within the Refuge. Luhr Beach is managed by WDFW. Under current conditions, the State and Nature Center staff have control over public access for water-based activities on the Refuge, including waterfowl hunting, kayaking, small craft motorized boating, personal watercraft, and shellfishing. However, no public information about the Refuge is available to visitors at this site. A public parking area provides visitors with convenient foot access to Refuge tideflats, shorelines, and bank fishing sites. Other launch sites in south Puget Sound are also potential sources. Lack of access control, disturbance to Refuge wildlife, conflicts with other Refuge visitors, and the absence of educational materials at launch sites are Refuge management concerns. The potential for dike removal has also raised new concerns over wildlife disturbance by boaters in areas that are currently closed. Under Thurston County regulations, all watercraft are restricted to a speed of 5 mph within 200 feet of any shoreline; however, it is minimally enforced. If portions of the dike are removed for tidal restoration, this speed restriction regulation becomes less effective in the Nisqually delta because shoreline locations would be altered.

Chapter 2. Alternatives

2.1 Introduction to the Alternatives

This chapter describes the process used to develop alternatives to the Proposed Action (i.e., development and implementation of a CCP), similarities among the alternatives, a detailed description of each alternative, and a summary comparison of the alternatives by each of the primary issues. The Proposed Action and the primary issues are described in Chapter 1, Sections 1.2 and 1.8, respectively. Appendix G includes Compatibility Determinations for each secondary use proposed, which is required to ensure that all uses are compatible with Refuge purposes.

2.1.1 Alternatives Development

NEPA requires Federal agencies to evaluate a full range of reasonable alternatives to a Proposed Action. The alternatives should meet the purpose and need of the proposal while minimizing or avoiding detrimental environmental effects. The NEPA alternative development process allows the Service to work with the public, stakeholders, interested agencies, and tribes to formulate alternatives that respond to identified issues. This Draft CCP/EIS documents the Service's planning and decision process for the CCP.

Eight preliminary habitat restoration alternatives were developed and presented to the public in an Issues Workbook at two public meetings in 1997. Comments received on the preliminary set of alternatives and throughout the public scoping process, as well as input from a series of scientific and public use workshops, ultimately resulted in the four draft management alternatives presented in this Draft CCP/EIS. These include a "no action" alternative (as required under NEPA) and three "action" alternatives, each of which describes several options for managing Nisqually NWR over the next 15 years and would ultimately result in different future conditions at the Refuge. Each alternative describes a combination of habitat and public use management prescriptions designed to achieve the Refuge purpose, goals, and vision. These alternatives provide different ways to address and respond to major public issues, management concerns, and opportunities identified during the planning process. All of the major issues, activities, and management concerns were evaluated and addressed for each alternative. The four alternatives are listed below and described in detail in Section 2.3.

- **Alternative A—No Action: Status Quo** – This alternative assumes no change from past management programs and is considered the base from which to compare the other alternatives. There would be no changes to the Refuge boundary and no major changes in habitat management or public use programs.
- **Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration** – This alternative would provide for moderate expansion of the Refuge boundary (2,407-acre addition). It places new management emphasis on the restoration of estuarine habitat and improved freshwater wetland management. The current environmental education program

would be improved and expanded, to the largest degree of all action alternatives. There would be fewer changes to the trail system than in other action alternatives, and the Refuge would remain closed to waterfowl hunting, with the closure posted and enforced.

- **Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration** – This alternative would provide for the same expansion of the Refuge boundary as in Alternative B (2,407-acre addition). However, it places a stronger emphasis on the restoration of estuarine habitat, while improving freshwater wetland and riparian habitats. The environmental education program would be improved and expanded, although serving fewer students than described in Alternative B. Moderate changes would occur to the trail system. The largest portion of Refuge acreage would be opened to waterfowl hunting of any alternative, consolidated with State lands, and limited to 3 days per week, if an agreement can be reached with the WDFW.
- **Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration** – This alternative would provide for the largest amount of Refuge boundary expansion (3,479-acre addition). It also maximizes estuarine restoration, while improving freshwater wetland and riparian habitats on the Refuge. The environmental education program would be improved and expanded, although not to the highest expansion described in Alternative B. The greatest changes would occur to the trail system of any alternative. A smaller portion of Refuge lands would be opened to hunting, 7 days per week, with no changes to hunting on WDFW lands.

These four alternatives are described in more detail below, starting with a summary of similarities among the alternatives, followed by a detailed description of each alternative.

2.2 Similarities Among Alternatives

Although the alternatives differ in many ways, there are similarities (i.e., shared features or management components) among them as well. Following is a description of: (1) the features common to all alternatives; and (2) features common to all action alternatives.

2.2.1 Features Common to All Alternatives (A-D)

All alternatives contain some common features. These are listed below to reduce the length and redundancy of the individual alternative descriptions.

- *Complete Land Acquisitions within Current Approved Refuge Boundary* - Interests would continue to be acquired in the remaining 1,011 acres within the existing approved Refuge boundary, either through fee acquisition or other land protection measures.
- *Extensive Repairs to Brown Farm Dike (Exterior Dikes)* - The Brown Farm Dike (exterior dikes) have severely deteriorated and would require extensive repairs to prevent dike failure and continued seepage. The Brown Farm Dike was additionally damaged by the magnitude

6.8 Nisqually Earthquake on February 28, 2001. The epicenter was located in the Nisqually delta. It resulted in thousands of feet of linear cracks in the dike, with the largest amount of damage along McAllister Creek and secondarily along the Nisqually River. Repairs are needed, and geologists and engineers have indicated that the dikes do not meet accepted safety or structural standards. Any portions of the Brown Farm Dike that would remain in Alternatives A-D would require extensive repairs.

- *Resource Monitoring* - Existing and new fish, wildlife, and vegetation monitoring programs would be conducted by Refuge staff, volunteers, or cooperators to support adaptive management. Monitoring programs would include monitoring and evaluation of habitat management and restoration activities, sensitive species, and public uses.
- *Restoration of West Bluff Parcel* - Restoration of the West Bluff parcel of the Refuge (formerly the Meek property) would continue under all alternatives. The long-term goals of restoring this deforested parcel is to create a native conifer forest with Douglas-fir as the primary species to provide a continuous forested corridor, improve watershed protection, and create an effective buffer for nesting bald eagles and other migratory birds.
- *Improved Protection of West Side of McAllister Creek* - Wildlife disturbance caused by illegal foot access on the west side of McAllister Creek would be reduced by signing the west shoreline from Luhr Beach south along McAllister Creek. A new visitor contact station with interpretive information at Luhr Beach and increased visitor contact to educate visitors about these restrictions would also reduce trespass in this area. These efforts would benefit nesting great blue herons and bald eagles, as well as other migratory birds.
- *Management of Minor Non-Wildlife Dependent Recreational Uses (such as Apple, Berry, and Mushroom Picking)* - Certain non-wildlife dependent recreational activities occur occasionally on the Refuge. Apple and blackberry collection for off-site consumption would no longer be allowed. Picking would be restricted to trails only and for consumption only while on the Refuge. Other plant material and mushroom picking would continue to be prohibited to protect sensitive wildlife habitat and maintain established wildlife sanctuary areas closed to public entry.
- *Visitor Center, Boardwalk, and Public Parking* - The Visitor Center, 1-mile accessible boardwalk loop trail, and 100-space public parking lot would remain unchanged under all alternatives. The Visitor Center offers excellent education and interpretive opportunities for the public. The boardwalk trail with interpretive panels allows visitors to observe and learn about wildlife in a diversity of habitats.
- *Protection and Management of Cultural Resources* - Under all alternatives, the Service would continue to manage cultural resources in accordance with public law and agency policy. The Service is required to consider the effects of its actions on archeological and historic properties. Small projects require a "Request for Cultural Resource Compliance" form to be completed in conformance with the Programmatic Agreement among the Service, the Advisory Council on Historic Preservation (ACHP), and the State of Washington Historic Preservation

Officer (SHPO). Additional consultation, surveys, and clearance would be required when large projects are sponsored by the Service.

- *Management of Tribal Lands East of the Nisqually River as Part of Nisqually NWR* - The Nisqually Indian Tribe recently purchased the Braget farm east of the Nisqually River, including two lowland parcels that fall within the approved Refuge boundary. Congress passed Public Law 106-291, which authorized \$850,000 to be granted to the Nisqually Indian Tribe for part of the purchase, and stated that the lowlands be managed as part of the Refuge through a 25-year Cooperative Agreement/renewable lease, and that the lands be managed for Refuge purposes in perpetuity. These lowland parcels would be managed by the Service as part of Nisqually NWR, under a Cooperative Agreement with the Nisqually Indian Tribe. Life tenant uses on these tribal lands retained by Kenneth Braget (the previous landowner) include agriculture and a private hunt club.
- *Estuarine Restoration on Tribal Lands East of the Nisqually River* - The Nisqually Indian Tribe, in cooperation with the Service, is in the process of designing and implementing an estuarine restoration program on approximately 300 acres of lowland portions of the tribe's property east of the Nisqually River. Although this would occur on land within the approved Refuge boundary, the specific restoration project would proceed independent of the Nisqually NWR CCP and associated EIS. Compliance requirements for the tribe's restoration plan would be addressed through the permit process.

The restoration of salt marsh and other estuarine habitats is envisioned by removing dikes and reconnecting diked fields to Red Salmon Slough, a tidal channel between the Nisqually River and the East Bluff. A phased approach to restoration has been developed (Wiltermood Associates, Inc. 2000) and the tribe initiated restoration in 2002, beginning in areas to the north and working south.

- *Treaty Rights* - Tribal fishing, hunting, and gathering rights as reserved in Article 3 of the Treaty of Medicine Creek of 1854 (10 Stat. 1132) are common to all alternatives.
- *Public Access Restricted to Trails Only* - Foot access by the public would continue to be restricted to trails only. Exceptions would include special study areas identified for environmental education groups and research activities permitted under special use permit.
- *Primitive Trail in Surge Plain* - A half-mile primitive trail would be established in the forested surge plain habitat, a tidally influenced riparian forest along the Nisqually River. It would connect to the existing boardwalk spur in the surge plain to provide a longer experience in this unique habitat. It would be minimally maintained and would not be fully accessible. Portions may be flooded by higher tides and storm events.
- *Replacement of Twin Barns Environmental Education Center* - The Twin Barns Environmental Education Center was severely damaged by the February 2001 Nisqually Earthquake, and it was permanently closed to the public for safety reasons. The Environmental Education Center has been temporarily moved to a trailer near the

maintenance compound. A new facility is required to upgrade facilities and ensure a safe, quality experience for school children participating in the program.

- *Shellfishing Allowed According to County and State Regulations* - Recreational shellfishing would continue to be allowed in tidal habitats according to County and State regulations. However, the Luhr Beach area has been closed since summer 2000 because of high levels of fecal coliform contamination. Commercial geoduck harvest would continue under State regulation in waters in or adjacent to the Refuge.

2.2.2 Features Common to All Action Alternatives (B-D)

These features are common to Alternatives B, C, and D but would not be implemented as part of the No Action Alternative.

- *Protection of Estuarine Restoration Areas for Research and Monitoring* - Public access would be restricted in restored estuarine areas within the Brown Farm Dike. Restored areas would be closed to public access to provide wildlife sanctuary and a research study area to document processes of estuarine restoration and fish and wildlife responses with minimal human disturbance. This closure would also maximize wildlife viewing opportunities for those restricted to trails. New boardwalk trails would be allowed in limited areas at the edges of restored areas to provide new wildlife viewing opportunities in estuarine habitats.
- *Improved Fishing Opportunities* - Improved quality bank fishing would be provided on the east bank of the Nisqually River (Trotter's Woods area) south of I-5, if areas are successfully acquired or through a cooperative management agreement with Fort Lewis (U.S. Army), the current landowner. Cooperative efforts with Fort Lewis could also involve key partners, including the Nisqually Indian Tribe.
- *New Walk-in Hunting Opportunities* - Walk-in waterfowl hunting with set blinds would be considered if sufficient lands are acquired south of I-5, which would provide adequate wildlife sanctuary and minimal conflict with other priority public uses.
- *Research Natural Area (RNA) Closures Enforced* - The RNA in the northeastern part of the Refuge would be retained, and requirements to keep this designated area closed to consumptive uses would be enforced. However, Alternatives C and D propose to modify the current RNA boundary (reducing the area by approximately 166 and 80 acres, respectively) to provide a high quality hunting area at the mouth of the river and create a clearly delineated proposed hunting area that can be posted. The RNA would be posted and fishing, shellfishing, and waterfowl hunting would be prohibited.
- *Speed Restrictions and Seasonal Closures for Boats* - A speed limit of 5 mph would be established for watercraft in all Refuge waters. This would broaden the current 5 mph speed restriction for all watercraft within 200 feet of any shoreline by Thurston County regulation. The RNA would be closed to all boating from October 1 to March 31 to provide a seasonal sanctuary for migratory birds and other wildlife.

- *Future Boating Restrictions* - Boating activity and its potential effects on wildlife would continue to be monitored to ensure that boating remains compatible with Refuge purposes and that new boating restrictions provide sufficient wildlife protection. Future closures or additional restrictions would be considered if undue wildlife disturbance occurs.
- *Management of Luhr Beach Area and Nisqually Reach Nature Center* - The Refuge would develop a cooperative management agreement with the WDFW to cooperatively manage the Luhr Beach boat ramp area, including the Nisqually Reach Nature Center. Boating, waterfowl hunting, fishing, and Refuge regulations and general Refuge and wildlife information would be provided at a new Visitor Contact Station. The Refuge would also work cooperatively with the Nisqually Reach Nature Center to conduct a cooperative education program to provide an even stronger environmental and public education program on the marine resources of the Nisqually delta.

2.3 Detailed Description of the Alternatives

2.3.1 Alternative A—No Action (Status Quo)

This alternative assumes no change from past management programs and is considered the base from which to compare the other alternatives (Figure 2.3-1).

The Refuge would continue to complete land acquisition within the approved Refuge boundary (3,936 acres), but no expansion would occur.

The area within the Brown Farm Dike, approximately 1,000 acres, would be retained and managed as freshwater wetlands and grasslands. Some limited improvements would be made to the current habitat management program to improve habitat quality. Attempts to enhance freshwater habitats would be investigated but can include installing pumps for existing artesian wells or drilling new wells to increase the source of freshwater. Water control structures, including culverts and risers, would be replaced or installed to make minor improvements in the ability to control water levels and reduce the effects of beaver activity. The extent of ponds and seasonal marshes would be increased by sculpting and excavating larger wetlands. Limited reed canary grass control would be conducted where conditions allow, including a combination of mowing, discing, and herbicide application. The current haying and mowing program would continue (see section 3.5.1). No new internal dikes or management units would be created, but external dikes (28,000 linear feet) would need extensive repairs and continued maintenance. Some native riparian plantings would occur north of the headquarters building and along slough systems within the diked area to mimic native riparian habitat historically found in the delta. Since these areas are not directly connected to a system with natural hydrology, they would not function as native riparian systems.

The Service would continue to provide a limited environmental education program, serving up to 5,000 students each year. The program includes a reservation system, trails, and field trip assistance by Refuge volunteers.

Figure 2.3-1 Alternative A: No Action (Status Quo)

8 ½ x 11 color

Back of Figure 2.3-1
Alternative A: No Action (Status Quo)

To provide opportunities for wildlife observation, interpretation, and wildlife photography, the Service would continue to provide 7 miles of trails (primarily using the existing dike system), including the accessible 1-mile loop boardwalk trail with interpretive panels. As described in Section 2.2.1, an unimproved, primitive ½-mile trail would be developed in the Nisqually River surge plain forest, connected to the existing boardwalk spur. This trail would be minimally maintained and would not be fully accessible. Public facilities would continue to be provided, including the Visitor Center, with interpretive displays focusing on existing habitats and wildlife. Nisqually NWR would continue to be closed to waterfowl hunting. The current waterfowl hunting on Refuge lands is unauthorized since the Refuge has not been officially opened to hunting. Unsigned areas would continue to be administratively uncontrollable, and closures in these areas would not be enforced. Waterfowl hunting would continue to provide insufficient wildlife sanctuary, occurring on large portions of Refuge tideflats, in McAllister Creek, and in portions of the RNA. The area within the Brown Farm Dike would continue to be closed to waterfowl hunting. The 5½-mile loop trail would continue to be closed seasonally during the waterfowl hunting season to ensure visitor safety and provide wildlife sanctuary. No new wildlife sanctuary areas would be established. WDFW would continue to have jurisdiction and management responsibility over WDFW lands.

Fishing would continue to be allowed by boat, following State regulations. Bank fishing at the McAllister Creek fishing area, which is accessible by foot or boat, would continue to be allowed. A portion would still be seasonally closed during the waterfowl hunting season. RNA closures to consumptive uses would not be enforced. The area within the Brown Farm Dike would continue to be closed to fishing. No new fishing opportunities would be developed.

As described in Section 2.2.1, Features Common to all Alternatives, recreational shellfishing would continue to be allowed according to County and State regulations. Commercial geoduck harvest would continue under State regulations in waters in or adjacent to the Refuge.

As described in Section 2.2.1, Features Common to all Alternatives, boat access would continue to be allowed in the tideflats and river/creek systems. PWC use would continue to be allowed. Thurston County regulations would apply, requiring a speed limit for all watercraft of 5 mph within 200 feet of any shoreline, but this regulation would continue to be minimally enforced.

2.3.2 Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration

As shown in Figure 2.3-2, Alternative B would expand the Refuge boundary by 2,407 acres, for a total authorized Refuge boundary encompassing 6,343 acres. The proposed addition would include 512 acres of upland habitat and 1,891 acres of floodplain, riparian, and wetland habitat. Expansion would provide improved habitat protection along portions of the East Bluff north of I-5, including a 200-foot wide forested corridor along the crest of the bluff. New areas south of I-5 would include floodplain, riparian, forested, and freshwater habitats, consisting of portions of the Nisqually Valley floodplain areas, creeks and sloughs, and portions of the forested bluffs along McAllister Creek. This alternative is distinguished from expansion in Alternative D (the Preferred Alternative) by protecting only a small part of the Nisqually River corridor (325 acres), including

the Trotter's Woods area just south of I-5, and 386 acres less of floodplain and forested habitat in the Nisqually Valley. A variety of techniques would be used to improve habitat protection including cooperative management agreements, leases, easements, fee title acquisition, and strengthening cooperative efforts with partners. Cooperative efforts with Fort Lewis could also involve key partners, including the Nisqually Indian Tribe. Efforts would continue to complete acquisition or protection within the existing Refuge boundary, including the development of a cooperative management agreement with the State to allow consolidated management of the Luhr Beach area.

Habitat management and restoration in the diked interior would include a combination of 30% muted estuarine habitat (restored area created by maintaining dikes with selected breach locations for tidal water influence), 15% full estuarine restoration (restored area created by breaching dikes in slough channel locations and shaving remaining dikes down to grade), and improved freshwater wetland management in the remaining diked area. Essentially, this alternative would restore some estuarine habitat but would retain dikes to minimize the effect of estuarine restoration on existing trails.

Approximately 318 acres (30%) of the diked interior would be restored to muted estuarine habitat by creating bridged breaches and retaining dikes. Muted estuarine habitat would be created by breaching the dike in five locations to reconnect several historical slough systems with the waters of Puget Sound. Breaches would be large to maximize tidal volume and flow, varying in width from 150 to 350 feet depending on the size of the slough being restored. Tides would fully penetrate the diked unit, but the tide cycle would be slightly delayed, and some ponding would occur inside the diked tidal area due to the restrictions caused by limited breaches and the barrier caused by dikes. This would produce a muted, or less than fully functional, estuarine system (ENSR 1999). Material removed from the dike breaches would be used for interior dike construction. Heavy armoring, including steel reinforced wing walls and riprap, would be installed to stabilize breaches and keep them from eroding or becoming enlarged. Bridges would be built to span the breaches, capable of supporting heavy equipment to allow regular dike maintenance and repair. A borrow ditch (created when material was "borrowed" to build the dikes) parallels the dike. The borrow ditch would not be filled in the muted tidal impoundment because the costs to import sufficient material are prohibitive. Consequently, the borrow ditch would also pond and channel tidal waters in the area restored to muted tidal circulation.

To prevent failure and continued seepage, exterior dikes would require extensive repairs due to their severely deteriorated condition and damage sustained during the February 2001 Nisqually Earthquake. New dike armoring, including riprap, would be needed to protect dikes from erosion caused by tidal waters and wave action inside and outside the restored area. This alternative would require the construction of 9,700 linear feet of new exterior dike between the restored estuarine areas (muted and full) and the diked freshwater habitat and 13,200 linear feet of a new interior dike system. New internal and external dikes would be planted with vegetation to stabilize banks, prevent erosion, and provide screening and habitat. Dikes would continue to be maintained with periodic resurfacing (graveling), mowing, brushing, and other techniques. A total of 33,800 linear feet of exterior dike would need to be maintained.

Figure 2.3-2 Alternative B: Moderate Refuge Expansion and Minimum Estuarine Restoration

11 x 17 color

Back of Figure 2.3-2 Alternative B: Moderate Refuge Expansion and Minimum Estuarine Restoration

Approximately 140 acres (15%) of diked habitat would be restored to fully functional estuarine habitat in the northern half of the Shannon Slough system along McAllister Creek, by removing 0.75 mile of dike to grade and filling the adjacent borrow ditch. Removal of some of the artificial bench of sediments that have built up along the outside of the dike may be needed to allow full tidal circulation in the restored area.

Management of 542 acres of freshwater and grassland habitats would be improved in the remaining diked area by creating a higher proportion of freshwater habitat through conversion of some grasslands to seasonal freshwater wetlands and ponds. The freshwater area would be subdivided into five management units by new internal dikes to allow much more intensive management, thereby improving habitat quality and controlling reed canary grass. However, due to the large size of management units and freshwater supply limitations, the effectiveness of management actions may be limited, including the ability to flood large areas to depths sufficient for invasive vegetation control. A new exterior dike on the north side of the management units would be placed along the highest contour line to separate the muted estuarine restoration area from the management habitat. A large amount of material would be required for the new dike due to this area's relatively low elevation. The material, at least in part, would be borrowed from units where pastureland would be converted to freshwater ponds. This would increase the overall length of exterior dike by approximately 1.25 miles.

Small permanent ponds would be created and seasonal wetlands enlarged by excavating and sculpting higher areas. Permanent ponds would need to be relatively small because of the limited water sources currently on the Refuge and to allow more efficient water movement. New water control structures and pumps would be installed between units to allow water movement and to provide the ability to drain and flood individual units. Units and ponds would be designed to allow flooding in selected areas at least 3 feet deep for up to 3 to 4 months to improve reed canary grass control.

A more intensive management regime would be implemented to keep freshwater wetlands and grasslands in high quality condition. Management techniques would include a rotating cycle of draining, mowing, discing, scraping, herbicide application, and flooding to control reed canary grass, prevent brush invasion, and halt succession in these habitats. Management of any remaining grassland areas would include regular mowing. Fertilization and seeding in grasslands would also be conducted to enhance the quality for fall and winter waterfowl browse. The water delivery system would be periodically maintained, including the excavation or cleaning of sloughs, ditches, and water control structures.

As in Alternative A, some riparian plantings would occur north of the headquarters building and along slough systems in the southern portion of the remaining diked area to widen the corridor of riparian habitat, mimicking native riparian habitat historically found in the delta.

The environmental education program would be improved to provide for the largest expansion of the program, serving up to 20,000 students each year. The program would include development of site-specific materials and curricula, provide teacher training and field trip support, develop and strengthen partnerships in the area, and serve as a model for other programs. This alternative

would require the highest level of applicable staff to support this program. As described in Section 2.2.2, for all action alternatives, the Luhr Beach area (Nature Center and boat landing) would be managed under cooperative management agreement, and use of the Nisqually Reach Nature Center would be coordinated with the Refuge environmental education program.

Of the action alternatives, Alternative B provides the smallest change in trail configuration. The existing 5½-mile dike loop trail would be roughly the same length, although in a revised configuration around the Shannon Slough system. A large portion of the trail would continue to be closed during the waterfowl hunting season to ensure visitor safety and provide improved waterfowl sanctuary. Interpretation would focus on existing habitats, estuarine restoration, improved management, and wildlife.

A waterfowl hunting program would not be implemented on the Refuge, and the Refuge boundary would be clearly signed to delineate Refuge lands from WDFW property where hunting is allowed. Regulations would be enforced, eliminating the unauthorized hunting that has previously occurred in unsigned portions of the Refuge. WDFW would continue to have jurisdiction and management responsibility over WDFW lands.

The McAllister Creek bank fishing area, accessible by foot or boat, would continue to be provided. A portion of the bank fishing area would continue to be closed during the waterfowl hunting season to ensure visitor safety. The Trotter's Woods area south of I-5, if acquired or under a cooperative management agreement, would be managed to provide a high quality bank fishing area along the Nisqually River while providing improved habitat protection. The boat ramp in the Trotter's Woods area would remain available for use by the Nisqually Indian Tribe. An accessible fishing site at Luhr Beach would be provided, if feasible, following development of a cooperative management agreement with WDFW.

Boating and shellfishing are described above in Section 2.2.1, Features Common to All Alternatives (A-D), and Section 2.2.2, Features Common to all Action Alternatives.

2.3.3 Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration

As shown in Figure 2.3-3, expansion of the Refuge boundary under Alternative C would be the same as described under Alternative B (i.e., 2,407 acres, including 512 acres of upland habitat and 1,891 acres of floodplain, riparian, and wetland habitat).

This alternative would restore approximately 515 acres (50%) of the diked interior to estuarine habitat. Dikes would be breached at major sloughs, remaining dikes would be lowered to grade, and the material from dike removal would be used to fill in the borrow ditch to allow unimpeded tidal circulation in the restoration area. Some of the artificial bench of sediments that have accumulated along the outside edge of the dike may be removed to allow full tidal circulation. Small sections of the exterior dike would be left in place to reduce the loss of the largest deciduous trees along the Nisqually River. A new cross dike, approximately 1 mile long, would be built to enclose the remaining freshwater habitat. Dike armoring would be required on this

new feature to protect exterior banks from erosion from tidal waters and wave action. New dike material would be borrowed from freshwater wetland enhancement sites, dikes to be removed, and adjacent areas. This alternative would retain the Shannon Slough system along McAllister Creek as diked freshwater habitat. All remaining exterior dikes would require extensive repairs to prevent seepage and failure. Dikes would continue to be maintained with periodic resurfacing (graveling), mowing, brushing, and other techniques.

This alternative would allow a new portion of the Nisqually River to flow unrestricted, including during storm and flood events. Riparian habitat would be enhanced along the Nisqually River by replanting a 38-acre area north of the Twin Barns to restore forested, surge plain habitat. It would be protected by constructing a berm to the northwest but would still receive saltwater influence periodically. The berm would be designed to prevent fish entrapment through the design of berm height and grading.

Management of the remaining 447 acres of freshwater and grassland habitats would be improved, with a higher proportion of freshwater habitat created by converting some grasslands to seasonal freshwater wetlands and ponds. However, due to the large size of management units and freshwater supply limitations, the effectiveness of management actions may be limited, including the ability to flood large areas to depths sufficient for vegetation control. The freshwater area would be subdivided into five units by new internal dikes to allow more intensive management to improve habitat quality and control reed canary grass. This alternative would require the construction of 4,600 linear feet of new exterior dike between the restored estuarine area and the diked habitat (along the northern boundary) and 13,000 linear feet of a new interior dike system. New internal and external dikes would be planted with vegetation to stabilize banks, prevent erosion, and provide screening and habitat. Dikes would continue to be maintained with periodic resurfacing (graveling), mowing, brushing, and other techniques. A total of 15,600 linear feet of exterior dike would need to be maintained. A much more intensive freshwater wetland, grassland, and riparian habitat management regime would be implemented in the remaining diked habitat, similar to that described in Alternative B except within a smaller area. Some riparian plantings would occur north of the headquarters building and along slough systems within the diked area to mimic native riparian habitat historically found in the delta.

This alternative would provide an improved and expanded environmental education programs similar to Alternative B, except that it would serve up to 15,000 students instead of 20,000 each year. Refuge staff would have to be diverted to operate a waterfowl hunt program in this alternative, reducing the effort available for the education program. Improvements would include development of site-specific materials and curricula; providing teacher training, field trip support, and enhanced facilities; developing and strengthening partnerships with others to coordinate programs in the area; and serving as a model for other programs. Increased staff support would be required to perform at this improved/expanded level. As in Alternative B, the Luhr Beach area (Nature Center and boat landing) would be managed under a cooperative management agreement, and use of the Nisqually Reach Nature Center would be coordinated with the Refuge environmental education program.

As part of this alternative, the existing 5½-mile dike trail would be reduced to a 3¾-mile round trip, including a loop with a boardwalk extension. No seasonal trail closure would be required because waterfowl hunting would no longer occur along McAllister Creek. An approximately 2½-mile loop trail would be developed on tribal and Refuge property east of the Nisqually River, with temporary seasonal closures instituted during the waterfowl hunting season to avoid conflict with the private hunt club. This closure would no longer be necessary when the hunt club ceases operation. This trail would provide new wildlife viewing opportunities and would also require construction of a new parking area and visitor contact station. A bridge would be needed across Red Salmon Creek to support a loop configuration. The specific design of this trail would be developed during implementation of the CCP. Interpretation would focus on existing habitats, estuarine restoration, improved management, and wildlife. If lands are acquired, other new trail options would include trails on the East Bluff to link with planned Pierce County trails.

A consolidated waterfowl hunting area consisting of both Refuge and WDFW lands (1,170 acres total) would be managed by the Service. More of the Refuge (713 acres) would be open to waterfowl hunting than in Alternative D. The hunting area would include Refuge tideflats west of the Nisqually River and north of the current Brown Farm Dike and WDFW lands north and northeast of the Brown Farm Dike. The WDFW tract in McAllister Creek would be closed to hunting. The RNA boundary would be modified to provide a high quality hunting area at the mouth of the river and create a clear delineation (straight boundary line) of the hunting area, reducing it by 166 acres to 671 acres. The area within the Brown Farm Dike, including the estuarine restoration area, would remain closed to hunting. The Service would be responsible for waterfowl hunting management on the newly consolidated hunting area through a cooperative management agreement with WDFW. Luhr Beach facilities would also be managed by the Service through a cooperative management agreement. Restrictions to ensure a high quality hunting experience would include instituting a 3 day/week, 25-shell limit. There would be no limits placed on numbers of hunters and no designated blind sites. WDFW concurrence would be required. If an agreement could not be reached by December 2004, the Refuge would follow Alternative B and officially close to hunting, be posted and enforced, thereby eliminating the unauthorized hunting on the Refuge.

The McAllister Creek bank fishing area, accessible by foot or boat, would continue to be provided. No seasonal closure would be required during the waterfowl hunting season. Two new fishing areas along the Nisqually River would also be provided, including the Trotter's Woods area (as described in Alternative B) south of I-5, and an area off a new loop trail east of the Nisqually River north of I-5 on tribal and Refuge properties. Fishing access on tribal and Refuge property east of the Nisqually River would be associated with the development of the trail, parking area, and visitor contact station, as described above. Accessible fishing access at Luhr Beach would be provided, if feasible, following development of a cooperative management agreement. The RNA would be closed to fishing, with the closure enforced. The area within the Brown Farm Dike and any tidal restoration area would be closed to fishing.

Boating and shellfishing are described above in Section 2.2.1, Features Common to All Alternatives (A-D), and Section 2.2.2, Features Common to All Action Alternatives.

Figure 2.3-3 Alternative C: Moderate Refuge Expansion and Estuarine Restoration with Limited Housing

11 x 17 color

Back of Figure 2.3-3 Alternative C: Moderate Refuge Expansion and Estuarine Restoration with Limited Housing

2.3.4 Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration

As shown in Figure 2.3-4, Alternative D would provide for the largest expansion of the Refuge boundary, adding an additional 3,479 acres for a total authorized boundary of 7,415 acres. The proposed expansion would include 512 acres of upland habitat and 2,963 acres of floodplain, riparian, and wetland habitat. The boundary would increase habitat protection on the East Bluff north of I-5 to include a forested corridor, as described in Alternatives B and C. It would also extend the boundary south of I-5 to include floodplain, bluff, wetland, and upland forested habitats along the Nisqually River and McAllister Creek. The main difference between the expansion in this alternative and Alternatives B and C is the enlarged protection it would provide to the Nisqually River corridor and the Nisqually Valley, by improving protection of the riparian forested river corridor, including a portion of the proposed RNA on Fort Lewis property, as well as greater protection in the floodplain and forested habitat in the Nisqually Valley. This alternative would provide the greatest protection of bluffs, floodplain wetlands, and the river corridor south of I-5.

This alternative maximizes estuarine restoration while still providing freshwater wetland and riparian habitat on the Refuge. Under Alternative D, 699 acres (70%) of the diked area would be restored to estuarine habitat. This alternative component is based on the results of a scientific workshop hosted by the Service in June 1998. The restored area would reconnect a majority of the historic slough systems in the Nisqually delta to Puget Sound, creating a more complete and functional estuarine system than any other alternative. This would require breaching the existing Brown Farm Dike in specific locations and removing much of the dike down to grade. Material from the dike would be used to fill in the associated borrow ditch. Some of the artificial bench of sediments that have accumulated along the outside edge of the dike may be removed to allow full tidal circulation. Small sections of the exterior dike would be left in place to reduce the loss of the largest deciduous trees along the Nisqually River. A new exterior dike would be built to protect the remaining freshwater habitat. Alternative D would require the construction of 12,000 linear feet of new exterior dike and 10,500 linear feet of a new interior dike system. New internal and external dikes would be planted with vegetation to stabilize banks, prevent erosion, and provide screening and habitat. Dikes would continue to be maintained with periodic resurfacing (graveling), mowing, brushing, and other techniques. A total of 15,000 linear feet of exterior dike would need to be maintained.

The remaining 263-acre area within the dike would be managed primarily as freshwater wetlands and riparian habitat. As described in Alternatives B and C, a much more intensive freshwater wetland, grassland, and riparian habitat management regime would be implemented in the remaining diked habitat, except within a smaller area. Internal dikes would be built to create five management units. Grassland habitat would be managed as a smaller component of a mosaic of freshwater wetland habitats, scattered in patches and along the edges of freshwater wetlands. As in Alternatives B and C, some riparian plantings would occur north of the headquarters building and along slough systems within the diked area to mimic native riparian habitat historically found in the delta.

As described under Alternative C, 38 acres of riparian/surge plain habitat would also be created to increase the acreage of this important habitat along the Nisqually River.

The environmental education program under the Preferred Alternative would be the same as Alternative C, serving up to 15,000 students annually.

This alternative would have the largest effect on the existing trail system. The existing 5½-mile loop trail would be reduced to provide an approximately 3½-mile round trip trail by combining the Twin Barns Boardwalk Loop Trail (1 mile), existing and new exterior dike, and a new boardwalk trail extension into the estuary. The trail would no longer be configured in a loop. The boardwalk extension would help offset changes in the trail and improve wildlife viewing opportunities in estuarine habitat. The boardwalk extension along McAllister Creek would be seasonally closed to prevent conflicts with waterfowl hunters on WDFW property. As in all alternatives, a primitive ½-mile loop trail would be provided in the surge plain habitat. Similar to Alternative C, an approximately 2½-mile loop trail would be developed on tribal and Refuge property east of the Nisqually River, with temporary seasonal closures during the waterfowl hunting season until the private hunt club is discontinued on tribal lands. This trail would provide new wildlife viewing opportunities. A bridge would be needed across Red Salmon Creek to support a loop configuration. The specific design of this trail would be developed during implementation of the CCP. Interpretation would focus on existing habitats, estuarine restoration, improved management, and wildlife. Other new trail options would include trails on the East Bluff as part of a larger Pierce County trail system.

Under the Preferred Alternative, the Service would open 191 acres of Refuge lands to a 7 day/week hunting program during the waterfowl hunting season. These lands are located adjacent to the WDFW parcel north of the Brown Farm Dike. The RNA would be reduced by 73 acres to 764 acres and the RNA boundary moved to the east to provide a high quality hunting area at the mouth of the river. By opening 191 acres of the Refuge to waterfowl hunting, the hunting area north of the Brown Farm Dike would be configured in a single rectangular block, reducing confusing boundary issues. Areas designated as “No Hunting Areas” would be posted and enforced, eliminating the unauthorized hunting that has occurred previously on the Refuge.

Waterfowl hunting would continue on all WDFW lands. A 25-shell limit would be instituted on Refuge and WDFW lands. WDFW would maintain jurisdiction and management responsibility over WDFW lands, and the Service would manage the hunting program on Refuge lands. Refuge outreach, education, and enforcement programs would benefit hunting programs on State lands as well. The area within the Brown Farm Dike, including the estuarine restoration area, would be closed to hunting.

The bank fishing area along McAllister Creek would no longer be available due to dike removal. However, the closure of the McAllister Creek Hatchery (July 2002) is expected to reduce fishing opportunity dramatically, lessening the effect of this change. Bank fishing access along McAllister Creek south of I-5 would be provided in the future if acquisition or land protection occurs in appropriate locations. Fishing alternatives on the Nisqually River and at Luhr Beach would be the same as described in Alternative C. An additional accessible fishing access only

Figure 2.3-4 Alternative D: Maximum Estuarine Restoration with Consolidated Hunt Program
Managed by Refuge

11 x 17 color

Back of Figure 2.3-4 Alternative D: Maximum Estuarine Restoration with Consolidated Hunt Program Managed by Refuge

area at the Nisqually River Overlook off the Twin Barns Loop Boardwalk Trail would also be investigated to determine if a stable fishing platform can be maintained along that portion of the river. The RNA would be closed to fishing with closures enforced. The area within the Brown Farm Dike and any tidal restoration area would be closed to fishing.

Boating and shellfishing are described above in Section 2.2.1, Features Common to All Alternatives (A-D), and Section 2.2.2, Features Common to All Action Alternatives.

2.3.5 Comparison of the Alternatives by Issue

Table 2.3-1 (at the end of this chapter) presents an issue-by-issue comparison of the four alternatives selected for detailed analysis.

2.4 Alternative Components Considered but Eliminated from Detailed Study

The alternatives development process under NEPA and the Improvement Act is designed to allow consideration of the widest possible range of issues and potential management approaches. During the alternatives development process, many different solutions were considered. The following alternative components were considered but not selected for detailed study in this Draft CCP/EIS for the reason(s) described.

- *Larger Refuge Expansion Along the Nisqually River* - A larger boundary expansion was considered along the Nisqually River south of I-5, which would have increased expansion to 5,133 acres (1,654 acres more than Alternative D). This larger expansion was based on a proposed RNA on Fort Lewis lands and the 100-year flood line. It was not selected because it overlapped with the Nisqually Indian Tribe's established reservation boundary. If lands within that recognized boundary were to become available, the tribe would pursue interests in them.
- *Estuarine Restoration to I-5 Boundary* - Maximum estuarine restoration would have encompassed the entire 1,000 acres of diked habitat. This alternative was not selected because it would severely restrict opportunities for wildlife-dependent public uses such as wildlife observation, interpretation, and environmental education, which are considered priority public uses on National Wildlife Refuges. In addition, it would not provide a diversity of freshwater habitat types to support the variety of wildlife populations that currently occur on the Refuge.
- *Intensive Freshwater Management Within Diked Area With No Estuarine Restoration* - Under this component, no estuarine restoration would be undertaken. The diked area would be retained, and the habitat would be managed much more intensively to improve the quality of freshwater and grassland habitats. Because of the difficulty in maintaining non-native grassland areas that have become progressively wetter each year, reed canary grass has spread rapidly and dominates more than 30% of the diked area. In addition, there has been an

increase in scrub-shrub habitat because equipment access is limited in these wet areas. The Brown Farm Dike would need extensive repairs and replacement. An extensive internal dike system would have to be built to provide the water management capabilities needed for effective reed canary grass control and freshwater wetland management. Habitat management within the diked area would require an intensive, regularly rotating regime of draining, mowing, discing, application of herbicides, and flooding. Existing water sources would need to be supplemented with more pumping and additional water sources. Current freshwater sources might be insufficient to provide the volume of water needed for reed canary grass control. This alternative component would not meet Refuge goals of restoring native habitats and associated plant and wildlife species, or restoring endangered and threatened species.

- *85% Estuarine Restoration* - Originally considered as part of eight preliminary habitat restoration alternatives during the public scoping process, 85% estuarine restoration would reduce freshwater habitats on the Refuge to approximately 150 acres. This alternative component would limit foot access by the public to a small area. This would make it very difficult to provide a high quality visitor experience while providing sufficient wildlife sanctuary areas in freshwater wetland habitat. In addition, the remaining amount of diked area would provide a limited quantity of freshwater wetland and riparian habitats for freshwater-dependent species.
- *50% Estuarine Restoration in a Different Configuration* - This alternative component would have restored 50% of the diked area to estuary, with a new cross-dike in a different configuration (as compared with Alternative C), angling from the northeast along the Nisqually River, south of the ring dike, down to the southwest, south of Shannon Slough. This would retain more of the Nisqually River dike. This alternative component was not selected because it would only allow a limited water exchange between the restoration area and the Nisqually River, reducing the opportunities for fish, invertebrates, and other wildlife to pass freely. In addition, it would reduce the ability of sediment to reach the restoration area from the major sediment source, the Nisqually River. It would also increase the amount of new cross-dike needed, which would affect the deposition of sediments and salinity patterns in the restoration area (ENSR 1999). It would also have eliminated the riparian restoration zone along the Nisqually River that is part of Alternatives C and D. This dike configuration would have been less effective than Alternative C in restoring estuarine habitat, allowing the Nisqually River to move or flow more naturally, and reducing the need to repair and maintain the dike along the Nisqually River.
- *Acquire State Lands and Close to Waterfowl Hunting* - Acquisition of State lands and closing the Refuge to waterfowl hunting was considered but eliminated because it would have eliminated public waterfowl hunting opportunities in the delta, which is one of the priority public uses on Refuges; in addition, it would not have met WDFW goals and objectives for their lands.
- *Waterfowl Hunting on the East Side of the Nisqually River* - Walk-in waterfowl hunting east of the Nisqually River was considered but not included as an alternative component. This area consists of approximately 400 acres of Refuge and tribal lands, including estuarine and diked habitats. Diked areas will be restored to estuarine and riparian habitats in a phased approach

over the next several years, led by the Nisqually Indian Tribe. A loop trail, including bank fishing access, is proposed in Alternatives C and D to offset the trail reduction on the west side of the Nisqually River. The east side parcel is too small to zone or separate multiple uses and provide sufficient wildlife sanctuary and a high quality visitor experience. Certain basic criteria were used to design all alternatives that were not met by this option, including providing sufficient wildlife sanctuary, a 200-yard buffer between hunt areas and trails, and no seasonal trail closures.

- *Waterfowl Hunting Across Entire Tidelands* - An alternative was initially considered that would have created a waterfowl hunting area from bluff to bluff (approximately 924 acres), extending from the western shore of the delta at the Luhr Beach boat ramp east through the entire delta to the eastern boundary of the Refuge. This alternative was not selected for several reasons, including: (1) the large hunting area would have stretched across the entire delta east to west, leaving very little intertidal/salt marsh habitat as undisturbed sanctuary areas for waterfowl; (2) the hunting area would have extended into portions of the estuarine restoration area, conflicting with the common provision in all action alternatives to maintain restoration areas as closed to public access to provide wildlife sanctuary and a research study area, to document processes of estuarine restoration and fish and wildlife responses with minimal human disturbance; and (3) hunting would be an open access, 7 day/week program, in keeping with WDFW lands; this level of hunting activity, in addition to the enlarged hunt area, would provide insufficient waterfowl sanctuary.
- *Waterfowl Hunting in Multiple Sites* - An alternative was considered but not selected that would have retained hunting in all three WDFW parcels and opened more of the Refuge to hunting. It would have included 3 to 4 set blinds and a one-month delayed opening on the McAllister Creek tract, opening the northeastern section of the RNA and the northeastern portion of the restored area to hunting, opening Refuge and tribal lands east of the river for 4 to 6 hunting blinds, requiring seasonal trail closures east of the river. This alternative was eliminated because it would provide insufficient wildlife sanctuary, compromise the RNA to a great degree including areas where wigeon concentrate to rest and feed, conflict with the provision to maintain restored areas as sanctuary and research areas, and would have created a direct conflict with the proposed east side trail, thereby requiring a seasonal trail closure and eliminating zoning or separation of uses.
- *Boardwalk Loop Options in Restored Estuarine Area within Brown Farm Dike* - Boardwalk loops were not included as an alternative component in restored estuarine areas because: (1) loop configurations would affect the quality of the experience by being fully visible from other parts of the boardwalk, interrupting the visual landscape, and affecting wildlife use patterns, thereby decreasing wildlife viewing opportunities for visitors on other portions of the boardwalk; (2) the trail would disturb wildlife in newly restored estuarine areas and fragment restored estuarine habitats; and (3) the logistical difficulties and costs associated with installing and maintaining extensive boardwalks would have been prohibitive in an open, fully tidal system subject to high tides and storms.

- *West Bluff Trail* - The establishment of a new trail on the 100-acre West Bluff parcel was considered. It was not selected as an alternative component because of its proximity to a bald eagle nest. The Recovery Plan recommends an 800-meter buffer (line of sight) from active eagle nests. The trail would have been well within this buffer area. Further, the trail would have been at or above the level of the nest in the nest tree, greatly increasing the potential for human disturbance to nesting or roosting bald eagles. The majority of the parcel was logged in the early 1990s and has since become dominated by Scot's broom. The Service is reforesting the tract, which would greatly increase its value as a corridor for wildlife and a buffer to nesting bald eagles and great blue herons. In addition, public access would have required establishment of a parking area within the reforestation area and access off a very busy main road, Meridian Drive. Reforestation and wildlife protection were considered the highest priorities for this tract.
- *East Shore Trail* - To provide additional trail linkages within the local area, a new east shore trail was considered along the shoreline below the East Bluff, in the vicinity of the jetty, west of the railroad bed. This trail would have the potential to link up with trails in DuPont. However, further analysis showed that the shoreline was commonly inundated during high tides and was heavily riprapped and extremely steep, making the installation of a trail logistically infeasible. Additionally, the active railroad track would have been very difficult to cross safely to gain access to a trail along the shoreline.
- *Full Study Area Boundary Expansion* - A larger Refuge expansion (5,390 additional acres) was considered but not included because of conflicts with other land uses, high costs, and because some areas were judged to be lower priority for Refuge protection.

Table 2.3-1. Comparison of Nisqually NWR Draft CCP/EIS Alternatives by Component.				
Plan Features	Alternative A— No Action: Status Quo	Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration	Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration	Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration
REFUGE EXPANSION				
Refuge Boundary	No change in existing approved Refuge boundary. Continue to complete the Refuge, acquiring or protecting lands within the boundary. Improve priority habitat protection in the watershed through strengthened partnerships outside of the Refuge boundary.	Continue to complete the Refuge as in Alternative A, including cooperative management agreement for Luhr Beach area. Expand Refuge boundary (listed below). Strengthen partnerships within the watershed to improve priority habitat protection.	Same as Alternative B.	Continue to complete the Refuge as in Alternative B, but with larger boundary expansion (listed below). Strengthen partnerships within the watershed to improve priority habitat protection.
Acres	No change.	Additional 2,407 acres.	Same as Alternative B.	Additional 3,479 acres.
East Bluff	No proposed acquisition.	Protect 512 acres of a forested corridor along the East Bluff, north of I-5.	Same as Alternative B.	Same as Alternative B.
Nisqually River Valley	No proposed acquisition.	Protect 1,566 acres of freshwater wetland, riparian, and forested habitat.	Same as Alternative B.	Same as Alternative B, but with a total of 1,952 acres protected.
Nisqually River Corridor	No proposed acquisition.	Protect 325 acres of the Nisqually River corridor south of I-5.	Same as Alternative B.	Same as Alternative B, but with a total of 1,011 acres protected.
HABITAT RESTORATION				
Estuarine Habitat	No restoration.	30% muted (318 acres) 15% full (140 acres; Shannon Slough system).	50% full (515 acres) Allow Nisqually River to follow more natural flow.	70% full (699 acres) Allow Nisqually River and McAllister Creek to follow more natural flow.
Freshwater Habitat	1,000 acres Limited management improvements.	542 acres Improved management with 5 new interior management units.	447 acres Retain Shannon Slough system; improved management with 5 new interior management units.	263 acres Improved management with 5 new interior management units.

Table 2.3-1. Comparison of Nisqually NWR Draft CCP/EIS Alternatives by Component.				
Plan Features	Alternative A— No Action: Status Quo	Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration	Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration	Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration
Riparian Habitat	Limited riparian plantings north of headquarters and along sloughs within diked areas.	Same as Alternative A.	Same as Alternative A with additional 38 acres of riparian/surge plain restoration along the Nisqually River.	Same as Alternative C.
Exterior Dike (linear feet remaining)	28,000 feet Extensive dike repairs and long-term maintenance required.	A total of 33,800 feet (retain 24,100 feet, new 9,700 feet) Extensive dike repairs and long-term maintenance required. Dike breached and bridged in 5 locations with no filling of borrow ditch.	A total of 15,600 feet (retain 11,000 feet, new 4,600 feet) Extensive dike repairs and long-term maintenance required. Breach and remove dike to grade; fill borrow ditch.	A total of 15,000 feet (retain 3,000 feet, new 12,000 feet) Breach and remove dike to grade; fill borrow ditch.
Interior Dike System	No changes.	13,200 feet 5 diked, freshwater units.	13,000 feet 5 diked, freshwater units.	10,500 feet 5 diked, freshwater units.
Nisqually Tribal Land, east of River	Estuarine restoration on portions of 330 acres, managed by the Refuge under Cooperative Agreement.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
ENVIRONMENTAL EDUCATION				
On-site Program	Continue to provide limited program: (1) reservation system for school groups; (2) trails; and (3) field trip assistance by Refuge volunteers.	Greatly expand and improve program. Develop site-specific materials and curricula, provide teacher training, provide increased field trip support, and serve as a model for other programs.	Expand and improve program. Same program components as Alternative B, but for fewer students.	Same as Alternative C.
Students Served	5,000	20,000	15,000	15,000
Facility(ies)	Replace Environmental Education Center.	Acquire or manage Luhr Beach under cooperative management agreement, including Nisqually Reach Nature Center. Replace Environmental Education Center.	Same as Alternative B.	Same as Alternative B.

Table 2.3-1. Comparison of Nisqually NWR Draft CCP/EIS Alternatives by Component.				
Plan Features	Alternative A— No Action: Status Quo	Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration	Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration	Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration
Off-site Program	No changes.	Develop and strengthen partnerships in the area.	Same as Alternative B.	Same as Alternative B.
Staffing Needs	No changes	Provide increased staff support.	Same as Alternative B.	Same as Alternative B.
WILDLIFE OBSERVATION, HIKING, AND TRAIL CONFIGURATION				
Dike (main) Trail	Existing 5½-mile dike trail loop would remain.	Existing 5½-mile dike trail loop roughly the same length although revised in configuration around the Shannon Slough system.	Existing dike trail would be reduced to approx. 3¾-mile round trip, including a loop with a boardwalk extension.	3½-mile round-trip trail, including a boardwalk extension into the estuary; no loop configuration.
Twin Barns Boardwalk Loop Trail	Accessible loop trail (1 mile) with interpretive panels remains.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
New Trails	Unimproved, primitive ½-mile trail in Nisqually River surge plain forest.	Same as Alternative A.	Same as Alternative A. Also, new 2½-mile loop trail on tribal and Refuge lands east of the Nisqually River. Possible new trail option on the East Bluff, if acquired.	Same as Alternative C.
Facilities	Visitor Center and interpretive displays, focusing on existing habitats and wildlife.	Same as Alternative A but with additional interpretation on estuarine restoration. A new Visitor Contact Station at Luhr Beach.	Same as Alternative B, plus new Visitor Contact Station and parking on the east side of the Nisqually River.	Same as Alternative C.
Seasonal Closures	Portion of the 5½-mile loop trail would continue to be closed seasonally during waterfowl hunting season.	Same as Alternative A.	No seasonal closures on main trail. New eastside trail seasonally closed during waterfowl hunting season for the duration of private duck club operation.	A portion of main trail would be closed seasonally during waterfowl hunting season. New eastside trail seasonally closed during waterfowl hunting season for the duration of private duck club operation.

Table 2.3-1. Comparison of Nisqually NWR Draft CCP/EIS Alternatives by Component.				
Plan Features	Alternative A— No Action: Status Quo	Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration	Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration	Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration
WATERFOWL HUNTING				
Refuge Open to Waterfowl Hunting	No, but unsigned areas administratively uncontrollable. Some hunting occurs on Refuge tidelands, McAllister Creek, and RNA.	No; sign boundaries to delineate Refuge from WDFW lands and enforcement to prevent hunting from occurring on Refuge lands.	Yes; quality hunting on 1,170 acres of Refuge and WDFW lands north of Brown Farm Dike and west of Nisqually River. Quality hunt provisions include 3 days/week; 25-shell limit; no limit on number of hunters and no designated blind sites.	Yes; Refuge will open 191 acres of Refuge lands to a 7 day/week hunt program, creating a single block area with WDFW lands north of the Brown Farm Dike. Quality hunt provision of 25-shell limit on all lands. No limit on number of hunters. Total area available for hunting, including WDFW lands, would be 808 acres.
WDFW Lands	Hunting occurs on 617 acres of WDFW lands; management responsibility by WDFW.	Same as Alternative A.	WDFW and Refuge lands, including Luhr Beach, consolidated and managed by Refuge preferably through a cooperative management agreement. If agreement cannot be reached by Dec. 2004, same as Alternative B.	Same as Alternative A, with quality hunt provision of 25-shell limit.
Acreage Changes	None	None	Refuge opens 713 acres to hunting and WDFW closes 72 huntable acres along McAllister Creek. Reduce RNA by 166 acres.	Refuge opens 191 acres to hunting. Reduce RNA by 73 acres.
Sanctuary	No new sanctuary provided.	Largest amount of sanctuary.	Moderate increase in sanctuary, including McAllister Creek.	Moderate increase in sanctuary.
Luhr Beach Hunter Access	Hunting and hunter access managed by WDFW.	Same as Alternative A	Hunting and hunter access managed by the Service.	Hunting on Refuge lands managed by the Service; hunting on WDFW lands managed by WDFW.
Staffing Needs	No changes.	Provide increased staff support for enforcement.	Provide maximum increased staff support for management of hunting program and enforcement.	Same as Alternative C.

Table 2.3-1. Comparison of Nisqually NWR Draft CCP/EIS Alternatives by Component.				
Plan Features	Alternative A— No Action: Status Quo	Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration	Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration	Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration
FISHING				
General Regulations	Fishing would be allowed by boat, following State regulations, in all Refuge waters outside of the dike. The area within the Brown Farm Dike would continue to be closed to fishing.	Fishing would be allowed by boat, following State regulations, in all Refuge waters outside of the dike, except that the RNA fishing closures would be enforced and any tidal restoration area would be closed to fishing.	Same as Alternative B.	Same as Alternative B.
McAllister Creek bank fishing area	No change in area but continued seasonal closures in portions during waterfowl hunting season.	Same as Alternative A.	Same as Alternative A, except no seasonal closures.	Bank fishing along McAllister Creek would no longer be available due to dike removal.
RNA closures	RNA closures would not be enforced.	The RNA would be closed to fishing and closures enforced.	Same as Alternative B.	Same as Alternative B.
New fishing opportunities	None	An improved Nisqually River bank fishing area, if acquired, located south of I-5 (Trotter's Woods area) would be provided. Accessible fishing site at Luhr Beach would be provided if feasible under cooperative management agreement.	Same as Alternative B but with an additional potential bank fishing area along the Nisqually River north of I-5 (on tribal and Refuge lands east of the river).	Same as Alternatives B and C, but an additional option for accessible fishing site at the Nisqually River Overlook from the Twin Barns Loop Trail would be investigated, and new fishing opportunities on McAllister Creek would be explored in expansion areas if acquired.

Table 2.3-1. Comparison of Nisqually NWR Draft CCP/EIS Alternatives by Component.				
Plan Features	Alternative A— No Action: Status Quo	Alternative B—Refuge Expansion of 2,407 Acres and Minimum Estuarine Restoration	Alternative C—Refuge Expansion of 2,407 Acres and Moderate Estuarine Restoration	Alternative D—Preferred Alternative: Refuge Expansion of 3,479 Acres and Maximum Estuarine Restoration
BOATING				
General Regulations	No restrictions.	A speed limit of 5 mph would be established in all Refuge waters.	Same as Alternative B.	Same as Alternative B.
RNA closures	RNA closures would not be enforced.	All consumptive uses, including associated boating, would be prohibited in the RNA. In addition, the RNA would be closed to all boating from October 1 to March 31 to provide a seasonal sanctuary for migratory birds and other wildlife.	Same as Alternative B.	Same as Alternative B.
Luhr Beach Boat Ramp Area	None	Manage through a cooperative management agreement to enhance Refuge outreach efforts and provide Refuge boating regulations and general Refuge and wildlife information at a Visitor Contact Station.	Same as Alternative B.	Same as Alternative B.

Chapter 3. Affected Environment

This chapter describes the environment that may be affected by land acquisition and management activities of Nisqually NWR. The affected environment includes important portions of the Nisqually delta and lower reaches of the Nisqually River watershed. For this document, the affected environment includes the CCP Study Area, which includes the lands within the currently approved Refuge boundary (3,936 acres) and the potential Refuge expansion areas (5,390 acres). The study area (Figure 1.1-2) includes four distinct areas: McAllister Springs and Creek area, Nisqually River corridor, Nisqually agricultural lands and floodplain, and East Bluff. The McAllister Springs and Creek area, Nisqually River corridor, and Nisqually agricultural lands and floodplain are located south of the current Refuge and are bordered on the north by I-5, on the east and west by bluffs, and on the south by a combination of railroad tracks, bluffs, and property boundaries of residential housing developments. The East Bluff area is east of the Refuge and is bordered on the north by Sequelitchew Creek, on the west by Puget Sound, on the south by I-5, and the eastern boundary follows property lines, including most of the forested habitat west of Fort Lewis.

3.1 Physical Environment

Elements of the physical environment considered include climate, hydrology, geology, soils, and contaminants.

3.1.1 Climate

Maritime air masses have a moderating effect in south Puget Sound year round, creating a modified Mediterranean climate. Air quality is generally high due to climate, location, and few industries that produce particulates. Average annual rainfall is 53 inches in nearby Olympia. During the fall and spring seasons, the climate of the Nisqually delta is relatively mild. Winters are usually wet and mild, with intermittent moderate to heavy rain rather than snow. Summers are generally cool and dry.

The Olympic coast and Cascade ranges protect south Puget Sound from strong south-southwest prevailing winds associated with winter storms. Average fall and winter daytime temperatures range from 40°F to the low 50s. Winds are northeasterly during the summer and fair-weather periods. July, August, and September temperatures average 60 to 70°F, exceeding 90°F on approximately six days each summer. The average growing season is 250 days, depending on elevation and distance from Puget Sound (D. Weaver, pers. comm.; USFWS 1978; Thurston County Advance Planning and Historical Preservation 1994).

3.1.2 Hydrology

3.1.2.1 Freshwater

Freshwater sources on the CCP Study Area include the Nisqually River, McAllister and Red Salmon creeks, Medicine Creek, McAllister Springs, and groundwater aquifers and artesian

wells. Surface drainage primarily enters the delta from the Nisqually River, McAllister Creek, and Red Salmon Creek (USFWS 1978). A subsurface aquifer is located 175 feet below the delta (USFWS 1977, 1978).

Originating on the south slope of Mount Rainier, the Nisqually River is 78 miles long and has a 712 square mile drainage basin. Flow volumes in the upper half of the Nisqually River result from runoff and snow melt into the tributaries (Canning 1986). Located at river mile 44.2 and 42.5 are Tacoma City Light's Alder and LaGrande hydroelectric dams, respectively. These dams and their reservoirs have altered the natural flow regime by regulating downstream discharge (Whiley and Walter 1998). From the town of Yelm to the delta, the floodplain width broadens to 1 mile, bordered by bluffs on both sides rising 200 feet. Peak flows on the Nisqually River occur during winter (December through February) and late spring (May and June). Low flow periods occur in August and September. Low flows of about 1,000 cubic feet per second (cfs) usually occur in June through October in the watershed; wet season flow values are typically around 2,000 cfs (ENSR 1999). Flood flows of about 13,000 cfs were recorded in December 1995. River discharges over 18,000 cfs can overflow onto the riverbanks (Consoer et al. 1974; USFWS 1977).

McAllister Creek originates at McAllister Springs in the lower Nisqually River Valley at 6.7 feet above mean sea level. Numerous small springs and seeps also feed into the creek near its headwaters (Thurston County Department of Water and Waste Management 1993). McAllister Springs is the source for the municipal water supply for the City of Olympia (Consoer et al. 1974). A wellhead protection plan was developed and implemented in 1995 to decrease the possibility of contamination of the drinking water supply and to provide reaction time for a town to find another water source or install a treatment system in the event of water contamination (City of Olympia 1995).

McAllister Creek flows north through the study area and Refuge for 6 miles to the Nisqually Reach in Puget Sound. A very low stream gradient allows the tide to influence the creek all the way to its source, and creek salinity varies with the tide. The streambed changes to sand, peat, and muck downstream toward the delta. Medicine Creek is the longest tributary to McAllister Creek, originating near the Nisqually River and flowing 3½ miles, joining McAllister Creek at river mile 4.1. Another tributary to McAllister Creek is Little McAllister Creek. In wetlands above McAllister bluff, Little McAllister Creek travels through a steep ravine into agricultural ditches that outfall into McAllister Creek (Thurston County Dept. of Water and Waste Management 1993).

Red Salmon Creek originates in the eastern uplands above the delta as a shallow gradient creek that courses through marshes to the east delta bluffs, where it enters the Nisqually River (USFWS 1978).

Groundwater aquifers and several artesian wells are located within the study area. Generally, groundwater flows toward Puget Sound and major drainages, but patterns can vary locally. Groundwater of the Nisqually River watershed occurs mostly in the glacially deposited unconsolidated sand and gravel aquifers. Infiltrated precipitation recharges the central and western portions of the watershed (Emmett 1995). A 500 square mile south-central Pierce County aquifer extends north and east to the Puyallup River and Ohop Creek, bordering the

Nisqually River and Puget Sound to the south and west. The U.S. Environmental Protection Agency (EPA) has designated this aquifer as a sole source aquifer and is a primary drinking source for Pierce County (Emmett 1995; Moulton 1994; White 1997).

Population growth in the watershed is increasing the demand for water. Currently, 225,000 people live in the watershed, with 169,000 using the Pierce County aquifer as their sole source for drinking water (which supplies on the average of 42 million gallons of drinking water per day) (Emmett 1995). The City of Olympia withdraws 7 to 15 million gallons of water per day from McAllister Springs to serve approximately 40,000 customers (V. Decillo, pers. comm.). Groundwater withdrawals within all the drainages have the potential to adversely affect critical flows (Emmett 1995).

3.1.2.2 Estuary

The Nisqually River provides the majority of the freshwater to the estuary. The tidally driven reach currents distribute the turbid plume of river waters and sediment into a crescent-shaped pattern across the delta front (Thom et al. 1985). McAllister Creek also opens into a broad, tidally influenced estuary with a silt and muck streambed, braided distributaries, and mudflats at Nisqually Reach (Thurston County Dept. of Water and Waste Management 1993).

The delta undergoes two daily high and low tides. The mean higher high water (MHHW) line in the Nisqually Reach is 13.5 feet, and the maximum yearly tide is 18.7 feet (J.G. Dunbar, pers. comm.). Tidal influence extends upstream of the Nisqually River to about river mile 3.3 (Canning 1986). Very low tidal cycles (below Mean Low Low Water [MLLW]) usually occur twice a month, and the lowest tides occur during the spring and summer (-3.5 feet MLLW) (Wisseman et al. 1978).

3.1.3 Geology

The Nisqually delta is one of several river-mouth estuaries within the greater fjord-type estuary of Puget Sound. The delta is located in the Puget Trough, a broad structural and topographic depression formed at the time of the final uplift of the Cascade and Coast Range mountains, 11 million years ago (Burg 1984). Areas of volcanic activity raised large volcanic cones such as Rainier and Baker. Sedimentation, glaciation, and pressure between plates all worked to form the Puget Sound lowlands (White 1997).

After erosion, deposition, and plate tectonics worked on 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). When the last glacier receded about 14,000 years ago, the valleys were flooded with sea water and became the major basins and numerous smaller inlets of Puget Sound (Burg 1984). In lowland areas around the sound, retreating glaciers left behind a thick mantle of lacustrine and outwash sediments over the bedrock as far south as Chehalis, Washington (Burg

1984). The Nisqually River carved a deep valley into its floodplain, building the present-day delta when sea level reached its present condition 5,000 years ago. Sediments deposited at the mouth of the river built the delta northward a distance of at least 2.4 km until an equilibrium was reached between the river's deposition and tidal current erosion in the Nisqually Reach. The delta achieved its unique crescent shape during the final stages of development when more extensive outward growth occurred along the east and west margins where tidal currents were weaker (Burg 1984).

3.1.4 Soils

Refuge soils vary widely, from the hydric soils of tidal marshes to the sandy and gravelly soils of the adjacent uplands. The delta is composed of alluvial layers of sand, silt, and clay to a depth of 138 feet (CH2M Hill et al. 1978). Tidal soils are very deep, poorly drained soils on which salt-tolerant vegetation grows (Pringle 1982; Burg 1984). Surface sediments of the main river channel are composed of silt mixed with sand, clay, and organic matter (Caicco 1989b).

Soils of the high marsh and sloughs are generally organic with silt, sand, or clay (Caicco 1989b). Sediments of the delta marsh and mudflats have been largely derived from glacial material, which historically and currently have been carried by the Nisqually River from its glacial source on Mount Rainier. The construction of LaGrande Dam in 1910-1912 and completion of Alder Dam midway up the river in 1945 reduced the amount of sediment carried to the delta by the Nisqually River.

Pilchuck loamy sand underlies an area known as the surge plain (see Section 3.2, Vegetation and Habitat Resources) and is then covered by sandy alluvial deposits of the Nisqually River floodplain.

Soils within the diked interior are silt loams of the Pilchuck, Puget, Puyallup, Sultan, and Tacoma series. These soils are compressible, tend toward wetness, and have a high organic content, low strength, and slow permeability (CH2M Hill et al. 1978).

The West Bluff in the Refuge consists of well-drained very gravelly sandy soils on 60 to 90% slopes. The East Bluff is composed of similar soils, moderately to excessively well-drained on 45 to 70% slopes, and are formed in sandy and gravelly outwash (Pringle 1982). In the uplands above East Bluff, known as the Hoffman Hill area, the Kitsap formation is associated with a significant risk of slope failure. In areas of groundwater seepage, steep slopes tend to break off in large blocks (URS Company 1979).

The McAllister Springs basin soils are found in six or so layers of silt, sand, and gravel. Soils consist of glacial till, outwash, and drift, some with peat layers deposited before the Vashon glacier advanced. Soils south of I-5 in the agricultural area are primarily Puyallup silt loams, a dark brown loamy fine sand, and sandy loam. This moderately rapidly draining soil developed in the alluvium, forming floodplain soils. Large pockets of Puget silt loam, a deep, poorly drained soil, are found within depressions in the floodplain soils (Pringle 1982).

3.1.5 Environmental Contaminants

Between 1985 and 1988, the Service conducted four contaminant investigations on the Refuge. As a result of their findings, the Refuge was classified as Category C, which requires reconnaissance monitoring for metals. The justification for the classification was based on the Refuge's proximity to urban areas and a dead bald eagle containing extremely high levels of polychlorinated biphenyls (PCBs) found on the Refuge in 1982 (Momot 1993).

The diked interior along I-5, the orchard, Shannon Slough, and McAllister Creek on the Refuge were documented as areas of potential concern due to elevated levels of arsenic, lead, and mercury. Mice from the Twin Barns contained high levels of lead. Elevated levels of mercury were found at McAllister Creek at I-5, Shannon Slough, and the "red-tailed hawk" pump (Momot 1993). In 1997 and 1998, amphipod tissue studies conducted in the delta detected measurable quantities of heavy metals, especially copper, zinc, and butyltins, in the tissues of amphipods (Davis et al. 1997). However heavy metals detected were below what are considered levels of concern for these organisms. In 1999, the Washington State Department of Ecology tested soils collected from the old orchard area for the presence of arsenic, cadmium, and lead. Results detected no presence of cadmium and very low levels of arsenic and lead (J. Mercuri, pers. comm.).

On the Nisqually Reach, vanadium and aromatic hydrocarbons were found in clams and oysters, and low levels of PCBs were found in ghost shrimp. Elevated concentrations exceeding National Oceanic and Atmospheric Administration (NOAA) standards were also documented for zinc, copper, nickel, and manganese (Momot 1993). Heavy metals and chemicals were found in 1987 and 1992 in sediment chemistry of the Nisqually River delta and reach by the Puget Sound Water Quality Authority. They included aromatic hydrocarbons, PCBs, arsenic, copper, cadmium, mercury, lead, zinc, and total organic carbon (Evans-Hamilton and D.R. Systems 1987; Puget Sound Water Quality Authority 1992). A 1985 study in Puget Sound revealed high levels of contaminants in fish, marine mammals, and marine birds. Great blue heron eggshells from the heronry in the Nisqually River delta were found to be significantly thinner than a pre-1947 mean, likely due to contamination by Dichlorodiphenyltrichloroethane (DDT) or its derivative, DDE (Calambokidis et al. 1985). Aquatic plants, such as eelgrass, appear to concentrate metals without being affected, allowing metals to move through the food web (Phillips 1984).

Since the study area is located in the vicinity of I-5, industrial and commercial operations (such as the gravel mine and gas stations), and residential developments, non-point sources of environmental contaminants exist. In addition, hazardous materials may be transported on I-5, the railroad, or by ship in Puget Sound and have potential for accidental spills, which would affect Refuge lands and waters.

3.1.5.1 Water Quality

The Nisqually River, from its headwaters on Mount Rainier to Alder Dam (river mile 44), is listed by the Department of Ecology as Class AA, which means that its waters are expected to meet criteria characteristic of extraordinary quality water (Emmett 1995). From Alder Dam to

the delta, the river is listed as Class A, with expected criteria characteristic of good and fair quality waters. Water analyses of monitoring stations indicate that significantly higher fecal coliform concentrations occur below river mile 34 (within the mainstem Nisqually River) in comparison to upriver locations, particularly during storm events (Whiley and Walter 1998). This increase is linked to both an increase in nonpoint source fecal coliform loading and to decreased dilution. While significant increases in fecal coliform concentrations were observed for the lower portion of the river, those increases were well within the Washington State Water Quality Standard. The trend in fecal coliform for the lower river indicates that concentrations have reduced over the past 19 years from a median level of 33 colony-forming units (cfu)/100 ml to a present median of 10 cfu/100 ml (Whiley and Walter 1998).

McAllister Creek provides the most continuous source of fecal coliform to the marine areas of the Nisqually Reach (Whiley and Walter 1998). A positive correlation was detected between fecal coliform concentrations within the creek during storm events to corresponding increases in bacterial levels found over shellfish growing areas. In 1992, the Washington State Department of Health reclassified 2,130 acres of commercial and recreational shellfish beds in the Nisqually Reach from “approved” to “conditionally open” after finding elevated levels of fecal coliform bacteria in the reach following storm events (Whiley and Walter 1996; Emmett 1995). Following further evaluation, the shellfish beds were closed to harvest in spring 2000 (W. Clifford, pers. comm.). Water testing is conducted regularly to monitor contaminant levels.

The Nisqually River regularly experiences high turbidity or cloudiness during the summer due to its glacial source. Summer fluvial flows in all rivers and creeks within the CCP Study Area are extremely low and are not supporting existing water rights or fish populations, nor are they reducing the effects of pollutants or providing for recreation. The sand and gravel outwash deposits throughout the aquifer are susceptible to contamination from surface sources, such as land application of wastes (Emmett 1995).

River temperatures on the Nisqually River vary seasonally, with maximums greater than 60.8°F observed in August or September (at the gaging station at river mile 3.4). Minimum temperatures at this station are observed in January or February with values below 42.8°F (ENSR 1999).

Salinity profiles were sampled in 1977 in the Nisqually Reach during low slack water and flood tide (ENSR 1999). Freshwater in this area flows over the marine water in a very thin layer, estimated at 3 to 5 cm. Salinity measurements varied from 0 to 30 parts per thousand (ppt), with the most stratified conditions occurring near the Nisqually mudflats. The Nisqually Reach water is replaced every 8 days and is considered well flushed (ENSR 1999). Saltwater and tidal influence have been observed from the mouth of Nisqually River to the old US Hwy 99 bridge (river mile 0.0-3.3) (Canning 1986). Salinity ranged from 0 to 6.3 ppt at McAllister Creek from October 1984 to May 1985 (ENSR 1999).

3.1.5.2 Air Quality

The delta is susceptible to localized low level inversions, which can entrap both gaseous and particulate pollutants (Hesselbart 1977b). Stationary sources of air pollution in south Puget

Sound include pulp mills, lumber mills, veneer dryers, and sand and gravel companies. North to Seattle and Snohomish County, stationary sources also include steel plants, flour mills, cement plants, aluminum smelters, sawmills, and grain elevators (Washington State Department of Ecology 1991). Deteriorating air quality in the local area is necessitating burn bans of increasing duration and area.

3.2 Vegetation and Habitat Resources

The Nisqually NWR represents an important regional wildlife habitat resource. Information is presented below on important habitats and plant species (including exotic and invasive species) present on the Refuge and in the entire study area. Habitats in the study area include estuarine, freshwater wetland, riverine and riparian, and upland. Figure 3.2-1 is a graphic representation of the habitat types and wildlife typical of the Refuge. This section ends with a discussion of regional trends for important habitats.

3.2.1 Habitats and Vegetation Communities

A habitat type map covering the approved Refuge as well as the entire study area was created based on analysis of a 1997 Landsat Thematic Mapper (TM) image. The amounts of each habitat type present within the approved Refuge boundary, the study area outside the approved Refuge boundary, and within the total study area are presented in Table 3.2-1 and shown in Figure 3.2-2.

Habitat	Acres		
	Approved Refuge Boundary	Study Area Outside of Refuge Boundary	Total Study Area
Open Water, Salt	393	43	436
Open Water, Fresh	142	244	386
Unconsolidated Shore	1,115	64	1,179
Aquatic Bed	295	0	295
Vegetated Intertidal	623	10	633
Freshwater Wetland	623	48	671
Riparian and Forested Wetland	259	1,913	2,172
Upland Forest	71	1,262	1,333
Grassland	434	305	739
Agriculture	93	1,108	1,201
Bare Land	0	89	89
Developed	5	304	309
TOTAL ACRES	4,053	5,390	9,443

Source: USFWS data, Ducks Unlimited, and National Wetlands Inventories.

Includes State, Nisqually Indian Tribe, and Private lands. Acres presented in this table were calculated from GIS database; variations in the GIS cover type data result in slight discrepancies in acreage totals presented elsewhere in this CCP/EIS.

Figure 3.2-1 Nisqually National Wildlife Refuge

11 x 17 cross section

Back of Figure 3.2-1

Figure 3.2-2 Refuge Habitats

[color figure]

Figure 3.2-2
Back side of figure

3.2.1.1 Estuarine Habitat

The Nisqually River Estuary, one of the most extensive and productive estuaries in Puget Sound, is one of the few remaining vegetated nearshore estuarine habitats in the sound (Copping 1990). Estuarine habitat includes open water, aquatic bed, unconsolidated shore, and vegetated intertidal areas (Figure 3.2-3). The estuary is a complex and highly integrated system that serves as important habitat for migrating waterbirds, waterfowl, shorebirds, raptors, and salmon populations (Thom et al. 1985; URS Company 1979). Estuarine habitats attract a diversity and abundance of wildlife species and provide nursery areas for juvenile salmon and other fish. Many species of plants and animals depend on the delta for one or more phases of their life cycles (Canning 1986).

Historically, the Nisqually delta supported 6,207 acres of intertidal estuarine habitat (Figure 3.2-4). Currently, 5,016 acres of this habitat remains, which represents a loss of 1,191 acres or 19%. Especially significant is the loss of vegetated intertidal habitat or salt marsh, which has decreased from 1,458 acres to 674 acres (a loss of 784 acres or 54%) because of diking, channel migration and straightening, and land filling around I-5 (Tanner 1999). The landward extent of the historical salt marsh, depicted on a 1878 topographic survey map (Bortleson et al. 1980; Figure 3.2-4), reached southwest to Martin Way, just south of I-5. Tidal channels crossed the forested lowland. Since 1878, the Nisqually River channel shifted laterally and straightened from the I-5 crossing to the river mouth (Burg 1984). At the turn of the century, the Brown Farm Dike was constructed and converted estuarine habitat to approximately 1,000 acres of freshwater wetlands and non-native grasslands in the current Refuge boundary (USFWS 1978). The construction of the dike also significantly reduced the amount of shoreline by cutting off the upper reaches of tidal channels and former river distributaries.

The dike is a barrier preventing nutrients, produced in the freshwater wetlands it encompasses, from being released into the estuary. Once an energy and nutrient source to the estuary, the diked interior is now interrupting the physical, chemical, and biological processes of the estuarine system. The alteration of estuarine wetlands to freshwater wetlands by diking has removed habitat for waterfowl, salmon, and other estuarine-dependent species, resulting in detrimental effects (Burg 1984).

The construction of two dams on the Nisqually River reduced the amount of sediment carried to the delta, which may have altered the equilibrium between erosion and deposition toward erosion and recession. The river discharges about 105,000 tons¹ of sediment annually, nearly all of which is currently deposited in Alder Lake (Nelson 1974). The dike may also have caused tidal velocities to increase, resulting in erosion of the mudflats (Consoer et al. 1974; USFWS 1977; Burg 1984; Canning 1986).

¹ Sediment load averages between 250,000 and 300,000 tons annually (USFWS 1977).

Estuarine Vegetation Community Descriptions

Estuarine habitat surrounds the diked area in the delta. Below are described three general categories of estuarine habitat—aquatic bed, unconsolidated shore, and vegetated intertidal—and their distinct vegetation communities (Figure 3.2-2).

Aquatic Bed

Aquatic bed refers to wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season (Cowardin et al. 1979). One of the most important vegetation communities of the aquatic bed in the Nisqually delta is eelgrass beds. Eelgrass provides shelter for fish and invertebrates and is an important source of food for shorebirds, waterfowl, benthic invertebrates, and a large number of other animals. Eelgrass is restricted to habitats where erosion and sedimentation are in equilibrium because its rhizomes tend to grow horizontally (Phillips 1984). The Nisqually River delta is the southern-most source of eelgrass in Puget Sound (T. Mumford, pers. comm.).

Eelgrass beds covering about 49 acres in 1978 were found to occur from the County line northeast to the sandspit on the eastern shore (Wisseman et al. 1978), and covered about 25% of the RNA in the Nisqually Reach (Caicco 1989a). The northeast eelgrass meadows are in the lower intertidal and shallow subtidal areas (Wisseman et al. 1978). The delta front, from the County line to McAllister Creek, is devoid of eelgrass, presumably due to strong tidal scouring action in the reach. High concentrations of eelgrass (22 acres) were found in the McAllister Creek channel in 1978, extending well into the creek mouth and reach (Wisseman et al. 1978). The eelgrass beds in this area are sparsely distributed and less dense than eelgrass beds in other parts of Puget Sound (A. Sewell, pers. comm.).

Unconsolidated Shore (Saltwater)

Unconsolidated shore areas consist of mudflats, sandflats, and rocky shores characterized by a lack of vegetation, except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce these landforms (Cowardin et al. 1979). These areas attract many wildlife species including shellfish and other invertebrates, shorebirds, and mammals. The delta mudflats and unconsolidated substrate harbor microalgae and over 80 seaweed species. Microalgae, which attaches to sediment, is a possible source of carbon to the detritus-based food web, which plays a primary role in estuarine production (Thom et al. 1985). Sparse mudflat vegetation includes Lyngby's sedge, seashore saltgrass, seaside arrowgrass, fleshy jaumea, and pickleweed (Kunze 1984; Burg et al. 1980). The sparsely vegetated mudflats transition into the more abundant vegetation and dense drainage channels of the low salt marsh (see Vegetated Intertidal, below).

Vegetated Intertidal (Estuarine Emergent)

Vegetated intertidal or estuarine emergent areas are better known as salt marshes. These areas can be further subdivided into low, middle, and high salt marsh communities based on salinity patterns, elevation, and other factors such as substrate, wave energy, marsh age, sedimentation,

Figure 3.2-3 National Wetland Inventory Regional Estuarine Wetlands

color, 8 ½ x 11

Back of Figure 3.2-3

Figure 3.2-4 Historic and Current Estuarine Wetlands

Back of Figure 3.2-4

and erosion. Low salt marsh generally occurs between the lowest margin of the marsh and mean high water (MHW). Middle salt marsh occurs between MHW and MHHW. High salt marsh occurs between MHHW and the highest margin of the marsh. High salt marsh vegetation typically mixes with upland plant species in the marsh/upland zone (Figure 3.2-1).

Low salt marshes are found on low terraces where the Nisqually River and McAllister Creek meet the reach and in sandy intertidal marsh areas along the outer fringe of the Brown Farm Dike. The topography is hummocky with a diffuse drainage pattern and attracts an abundance of migrating waterfowl species, rails, and bitterns. In the delta toward the reach, low salt marshes are of moderate salinity, with silty and sandy soils. Low to intermediate salt marsh plant communities are dominated by pickleweed, Lyngby's sedge, gumweed, tufted hairgrass, seaside arrowgrass, seashore saltgrass, fleshy jaumea, halberd-leaf saltbush, and scattered patches of Baltic rush (Burg 1984, Burg et al. 1980, Mason et al. 1974). In sandy, low intertidal marsh areas, plant communities include seashore saltgrass and pickleweed (Kunze 1984; WNHP 1998).

The broad, relatively level vegetated areas of the high salt marsh, separated by wide drainage channels up to 6 feet deep were formed by distributaries of the Nisqually River prior to diking (Klotz et al. 1978; Burg 1984). Migrating waterfowl, particularly dabbling ducks, utilize the rich food sources available in these areas. The high salt marsh is composed of plant communities that tolerate low and moderate salinity. Along the river, communities include tufted hairgrass, Baltic rush, Pacific silverweed, Lyngby's sedge, and red fescue (Burg et al. 1980; Burg 1984). Quackgrass, redtop, velvetgrass, and orchardgrass are found high on the banks of McAllister Creek.



D.J. Smith

Salt marsh communities are a primary source of productivity in the estuary.

Salt marsh productivity is dependent upon the health of its vegetation (URS Company 1979). Nisqually salt marsh studies in 1980 showed a production weight recorded for Lyngby's sedge that is among the highest rates recorded for salt marshes in the Pacific Northwest (Thom et al. 1985). Lyngby's sedge, covering roughly 20 acres in the delta, was the most productive plant type at both high and low elevations (Burg et al. 1980).

3.2.1.2 Freshwater Wetland Habitat (Palustrine Emergent)

Freshwater wetlands in the CCP Study Area include permanent and seasonal ponds, marshes, wet meadows, and scrub-shrub habitats. These are also known as palustrine emergent wetlands.

Riverine and riparian wetlands are other types of freshwater wetlands, discussed separately below. Freshwater wetlands provide habitat for a variety of waterfowl (especially dabbling ducks), herons and other waterbirds, shorebirds, landbirds, mammals, amphibians, and invertebrate species.

Since the mid-1800s, a loss of wetlands in the Nisqually River delta and watershed has occurred, not only in estuarine but also in freshwater wetlands (Canning 1986). Freshwater wetland losses have been caused by draining, filling, and diking of lands. Losses are also due to competing activities and practices such as agriculture, grazing, forestry, and recreation (Canning 1986).

When the dike was built in the late 1800s, estuarine habitat was converted to freshwater habitat, increasing freshwater habitat in the delta by 610% (Tanner 1999). With the cessation of agricultural practices, the diked area became progressively wetter. Since Refuge establishment, the diked area has been managed as freshwater wetlands and non-native grasslands.

Freshwater wetlands within the current Refuge boundary are found primarily within the diked area and include permanent and seasonal wetlands, wet meadows, marshes, and scrub-shrub habitats. These wetlands are fed by several artesian wells and rainfall and are found around artesian wells, in low lying depressions, along historically tidal slough channels, and borrow ditches. During high flood conditions, freshwater also flows into the diked area through two overflow channels from the Nisqually River. Normally, there is no direct flow from the Nisqually River or McAllister Creek into the diked area. Saltwater seepage through the dike occurs frequently, allowing both freshwater and brackish vegetation to grow in the borrow ditch and sloughs. Interspersed within the dike's emergent wetlands and seasonally flooded freshwater depressions are non-native grasslands (see Upland Habitat, below).

Vegetation dominating wet meadows commonly includes rushes, cattails, sedges, and grasses. Scrub-shrub vegetation scattered through the marsh areas includes mixed grasses and forbs and is dominated by native shrubs. Aquatic vegetation found in permanent ponds includes pondweeds, smartweeds, knotweeds, bulrushes, sedges, and grasses (Burg 1984).

During the past 20 years, the habitat quality of the diked interior freshwater wetlands at Nisqually has declined. Reed canary grass, a highly invasive exotic plant, is rapidly spreading throughout much of the area and now occupies more than 30% of the total acreage. Water level management has become increasingly limited, and portions of the diked area are becoming too wet to easily manage. Plant succession has been allowed to occur in large sections of the diked area, allowing wetlands and grasslands to gradually convert to scrub-shrub habitats.

Approximately 48 acres of freshwater emergent wetlands occur in the study area outside of the currently approved Refuge boundary. All of these wetlands are found south of I-5. The majority of them occur in the McAllister Creek basin in potholes and upland depressions. Wetland vegetation ranges from sedge stands to cattails, bulrushes, willows, salmonberry, and skunk cabbage (Thurston County Dept. of Water and Waste Management 1993). Other freshwater wetland locations are also found along the Nisqually River and adjacent floodplains.

3.2.1.3 Riverine and Riparian Habitats

This group of habitats includes riverine, freshwater unconsolidated shore, riparian, and forested wetlands areas in the CCP study area. They are found within and alongside the Nisqually River, McAllister Creek, and Red Salmon Creek. Natural riverine and riparian corridors are diverse, dynamic, and complex habitats supporting a wide variety of fish and wildlife. Although riparian areas constitute a small portion of the surface landscape, they are very productive, and approximately 85% of Washington's wildlife species have been known to use riparian habitat associated with rivers and streams (Knutsen and Naef 1997). Habitat for many upland species is also directly enhanced by the presence of adjacent riparian and riverine habitat.

Most of the Nisqually River floodplain in the study area is comprised of riparian vegetation (Canning 1986). The original extent, and subsequent loss to conversions, of the riparian forests is unknown. Historically, losses occurred primarily due to timber harvest, livestock grazing, road construction, and reservoir impoundments (Canning 1986). On the Refuge, agricultural fields, roads, and building sites are located on historical riparian and bottomland habitat along the Nisqually River. These disturbed areas have been colonized mainly by non-native grasses and forbs (Klotz et al. 1978).

Riverine and Unconsolidated Shore

Riverine habitat is home to some aquatic plants but is dominated by open water. Unconsolidated shore includes sandflats containing pioneering plants that are periodically disturbed by floods and other erosive events. The Nisqually River provides good wintering habitat for bald eagles (URS Company 1979). A peak count of 200 eagles on the Nisqually River has been observed (Stalmaster 2001). Other species that use the riverine habitat in the study area include several anadromous (migratory) salmonids, such as chinook and chum salmon, and a variety of amphibians, reptiles, and mammals.



L. Gillespie

The riverine and riparian habitats in the Nisqually River are important for a variety of migratory birds and fish.

Riparian and Forested Wetland (Deciduous and Mixed)

Riparian forests in the study area are typically deciduous or mixed forests along the Nisqually River and McAllister Creek. Deciduous riparian forests are dominated by big-leaf maple, black cottonwood, and red alder. In areas in which coniferous tree species are present (mixed forests), Douglas-fir or western red cedar are typical. Understory vegetation includes salmonberry, snowberry, Indian plum, and red-osier dogwood. Riparian vegetation along the upper McAllister Creek grows in a broad wetland with some saltwater intrusion. Vegetation consists of willows, red elderberry, ninebark, and Indian plum. From the middle reach of the creek to the estuary, agricultural dikes and lawns with scattered wetland plants occur, as well as riparian

habitat limited to narrow bands along the streambanks (Thurston County Dept. of Water and Waste Management 1993). Riparian areas provide habitat for more bird species, including passerines, woodpeckers, waterfowl, and raptors, than all other habitat types combined (Knopf et al. 1988; Kirby et al. 1992).

Within the Refuge, a high quality example of a surge plain—a high energy, high nutrient, tidal freshwater forested wetland—can be found along the Nisqually River. The approximately 70-acre forested wetland community is regularly influenced by tidal waters. The surge plain is flooded during high tides and freshwater storm events. Between inundating floods and high tides, the forested wetlands remain wet to saturated by slightly brackish water and freshwater, and the water table is near the surface (Washington Natural Heritage Program [WNHP] 1998; Caicco 1989a). The surge plain consists primarily of deciduous forests with small pockets of mixed canopy. The deciduous stands are dominated by black cottonwood, big-leaf maple, red alder, with a very dense shrub layer (Caicco 1989a). The shrub layer consists of two communities—one dominated by common snowberry and the other by salmonberry (Klotz et al. 1978; Caicco 1989a). Other plants found in the understory include various willow species, vine maple, red-osier dogwood, Oregon ash, and red elderberry (Caicco 1989a; URS Company 1979).

3.2.1.4 Upland Habitat

Upland habitat consists of lands not inundated by water except during catastrophic events. Upland habitat in the CCP Study Area includes upland forest, grassland, and agricultural land. Most of the upland areas within the approved Refuge boundary are in the southwestern portions of the diked area, on the western property above the bluffs, the eastern hillside near Mounts Road, and the area around the Refuge administrative buildings and parking lot. Upland areas within the study area outside the Refuge boundary include the bluffs along the Nisqually River, McAllister Creek and along the eastern boundary of the Refuge, and agricultural lands in the valley. Upland forest habitats support a variety of nesting birds, including the bald eagle, red-tailed hawk, great blue heron, woodpeckers, and passerines, as well as mammals and amphibians. Agricultural lands and grasslands, depending on specific management regime, can be good foraging areas for some landbirds, shorebirds, and waterfowl.

Within the Refuge, upland forests were formerly highly diverse and probably contained western hemlock, western red cedar, and Douglas-fir, which flourished in openings created by fire, wind, drought, insect damage, and disease (Thurston County Dept. of Water and Waste Management 1993). By the mid-1800s, the upland forests were cleared as settlers created fields for cultivation amidst transitional freshwater wetlands (Burg 1984). Forests throughout the Puget Sound lowlands, including the Nisqually River watershed, have been heavily affected by logging (Cassidy 1998). Red alder, which was much less common before settlement and logging of the delta, is now more abundant (URS Company 1979). The overall reduction in structure and complexity of forests in the watershed compared to their historical counterparts may offer less stormwater protection and habitat diversity (Thurston County Dept. of Water and Waste Management 1993).

Soil map analysis of the study area suggests that prior to European settlement, forested uplands and riparian forested bottomlands grew adjacent to the estuarine wetlands of the delta. Native grasslands were, at that time, restricted to uplands and prairies south and east of the delta.

Upland Forest

The Refuge and study area lie entirely within the Puget Sound Douglas-fir ecoregion/vegetation zone, adjacent to the Woodland/Prairie Mosaic zone on Fort Lewis. Forests cover about 87 acres of the Nisqually delta and bluffs (Klotz et al. 1978). The delta bluffs are dominated by mixed coniferous-deciduous upland forests (USFWS 1977). Forests along the west delta bluffs are mixed deciduous-conifer species. Douglas-fir is predominant, mixed with big-leaf maple, western hemlock, and red alder at lower levels on the bluffs. The upland area adjacent to the West Bluff between Meridian Road and the top of the bluff was historically a dense forest of Douglas-fir, western hemlock, and some western red cedar. Most of the trees were clearcut from the southern two-thirds of the property in the early 1990s, before the 110-acre tract was purchased in 1996 by the Service. The parcel has since reverted to a field of Scot's broom with some occurrences of natural revegetation. The uplands were acquired by the Refuge as a wildlife corridor to the West Bluff and to stabilize the slope above the creek and protect the biological and aesthetic integrity of the Refuge. Reforestation efforts were initiated in the late 1990s.

Forests in the remainder of the study area are comprised of second-growth coniferous and mixed forests (Thurston County Dept. of Water and Waste Management 1993). The bluff along the eastern boundary of the Refuge and along McAllister Creek south of I-5 is dominated by coniferous trees, primarily Douglas-fir. Mixed deciduous forests are scattered along the Nisqually Valley lowlands.

Grassland

Approximately 230 acres of the diked interior are former pastures that were historically extensively cultivated and heavily grazed. Today, pasture grasses that dominate these areas and elevations of these former pasture lands fluctuate slightly with distinct vegetation changes, creating a mixture of non-native grasslands and wet meadows. In lower depressional areas of the diked interior, non-native grasses, such as creeping bentgrass and common velvetgrass, and occasional stands of rushes are found (Mason et al. 1974). Reed canary grass dominates the transition zone between former pasture land and wet meadows, comprising more than 30% of the diked interior.

Since 1974, between 75 and 450 acres have been mowed or hayed each year each to control reed canary grass and provide fall browse vegetation for waterfowl, particularly American wigeon. The area mowed or hayed varies from year to year, depending on rainfall. Currently, approximately 300 to 350 acres are mowed or hayed each year.

Agriculture

With over 1,100 acres in crops and pasture in the CCP Study Area outside of the Refuge boundary, agriculture is one of the predominant land uses south of I-5. The principal crops grown in this area include hay, corn, and Christmas tree farms. To maintain the existing rural environment of the Nisqually Valley, agricultural lands in this area became part of Thurston County's Purchase of Development Rights (PDR) program since 1994 (S. Morrison, pers. comm.; Thurston County Planning Department 1992). The PDR program permanently preserves farmland while supporting the farming community.

3.2.2 State and Regional Trends for Key Habitats Represented at Nisqually NWR

Historically, presettlement wetland acreage in Washington ranged from 1.17 to 1.53 million acres (Lane and Taylor 1996). Estimates of wetland loss in Washington range from 20 to as great as 50% decline during the past 200 years due to dredging, filling, diking, and industrial and residential development (Lane and Taylor 1996). The Puget Sound area has experienced even greater losses of up to 70 to 100% of historic wetlands in some urbanized areas (White 1997; Lane and Taylor 1996). Freshwater wetlands throughout the state were subject to a high rate of loss until the 1940s. Since then, the trend of wetland loss has slowed considerably since fewer wetlands remain to be converted, particularly in urbanized areas (Boule et al. 1983; Lane and Taylor 1996). Of the estimated 900,000 acres of wetlands currently in Washington State, about 22% are estuarine and 78% are freshwater (also known as palustrine) (Boule et al. 1983; Lane and Taylor 1996).

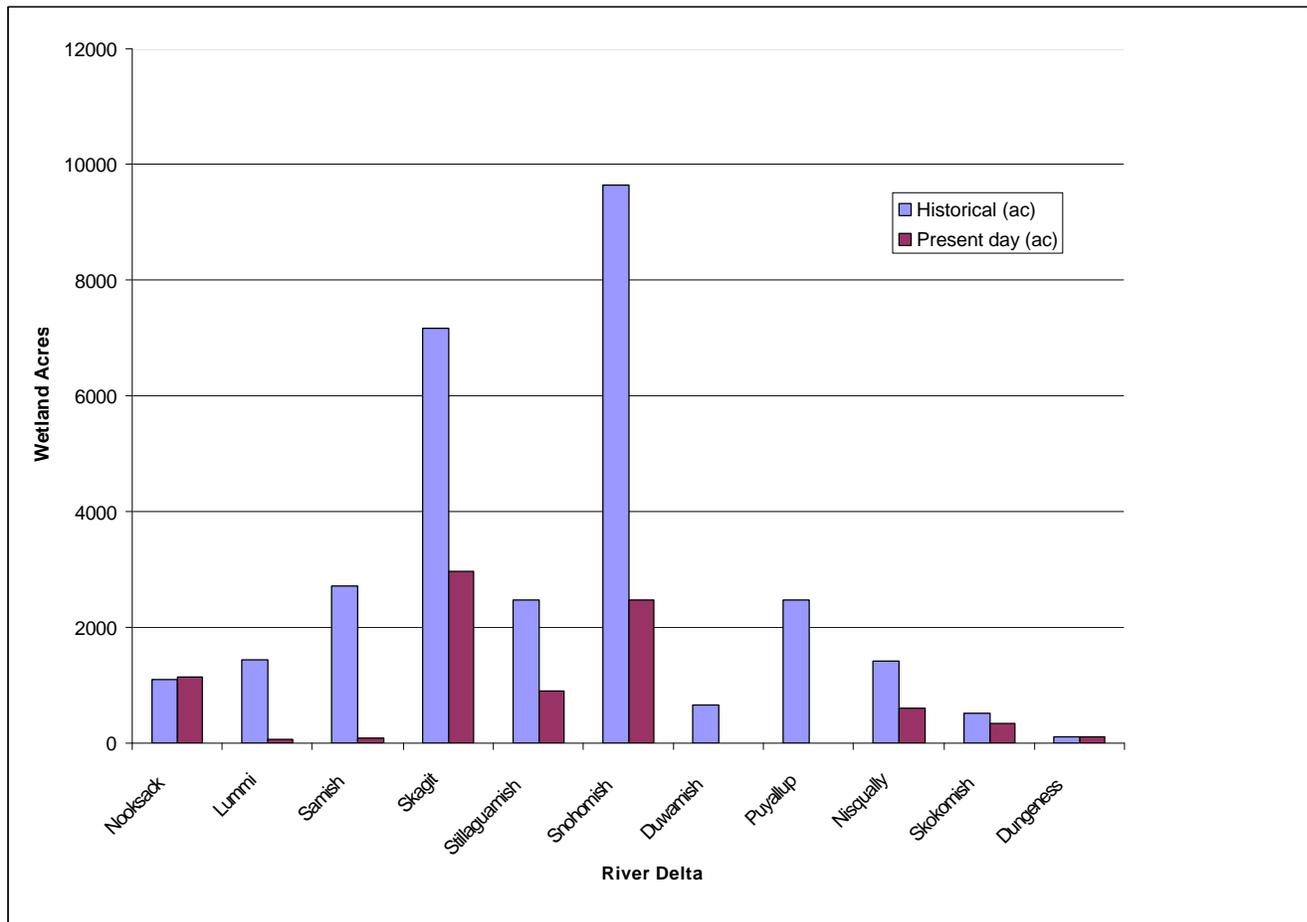
Over 80% of estuarine wetlands in Puget Sound, and up to 33% of its eelgrass beds, have been lost (White 1997; Lane and Taylor 1996; Dean et al. 2000). In south Puget Sound, estuarine intertidal areas comprise only 6% of wetland areas and are dominated by vast expanses of shoreline (Tanner 1999). Figure 3.2-5 shows large overall losses in salt marsh acreage for 11 major river deltas in Puget Sound. Currently, salt marsh habitat is one of the smallest wetland components, comprising just 0.3% or approximately 1,529 acres of wetland and deepwater resources in the south Puget Sound region (Tanner 1999).

Roughly 500 to 1,000 acres of freshwater wetlands are filled each year in western Washington (White 1997). Current loss and degradation of freshwater wetlands in western Washington are due to urban expansion, forestry and agricultural practices, industrial development, and invasive or exotic plants and animals (Lane and Taylor 1996). Currently, freshwater wetlands comprise a significant component (18%) of wetlands in the south Puget Sound region (Tanner 1999). Freshwater wetlands in the region are dominated by vegetated wetland classes, with emergent wetlands comprising 35% of all freshwater wetlands found in this region (Tanner 1999).

3.2.3 Plants, Including Exotic and Invasive Species

A list of plant species found on the Refuge is located in Appendix E.1. There are no rare plants inhabiting the Refuge or study area. As many as 437 species of plants have been recorded on the Refuge (USFWS data). These include a variety of forbs, trees, shrubs, grasses, and sedges. The most abundant group of plants are forbs, with over 200 species. Shrubs are the next most

Figure 3.2-5. Overall losses in salt marsh acres for Puget Sound river deltas.



abundant, with 60 species. The number of species of grasses and trees is similar, with about 35 species each. An inventory of plants within the study area has not been conducted. See Habitats and Vegetation Communities, above, for examples of plant species found in various habitat types.

Nisqually NWR has numerous invasive weed species that compete aggressively with native plant communities. One species in particular, reed canary grass, has invaded most non-forested freshwater wetlands. Figure 3.2-6 displays the best available data showing the distribution of reed canary grass on the Refuge.

Canary grass grows under a variety of moisture conditions; however, optimal growth occurs on moist or wet soils, particularly in wetlands. Canary grass infestations establish quickly and expand rapidly. Because canary grass is highly competitive, it poses a major threat to native wetland vegetation. Many wetlands throughout the Pacific Northwest have become infested with dense, monotypic stands of canary grass, resulting in decreased diversity of flora and fauna.

In 1997, reed canary grass dominated at least 30% of the diked interior and it continues to spread rapidly. Effective control is extremely difficult and costly, requiring an intensive combination of mowing, discing, prolonged and deep flooding, and herbicide application.

Other weed species are monitored and controlled annually to prevent them from taking over Refuge habitats. Scot's broom was introduced to the Pacific coast as a garden ornamental by early settlers. Scot's broom aggressively grows into dense, pure stands eliminating native forbs, grasses, or young trees. In Washington, this plant interferes with re-establishment of conifer seedlings on harvested lands. Other pest species include common reed, poison hemlock, rush skeletonweed, gorse, Canada thistle, and tansy ragwort. The Refuge is surveyed throughout the year for the presence of these species, and plants are removed manually. The non-native Himalayan blackberry is an aggressive invader of pastures and seasonal freshwater wetlands, forming dense monotypic stands. Control requires aggressive measures including mowing, discing, scraping, hand removal, and herbicide application.

Figure 3.2-6: Invasive Reed Canary Grass

[Color Figure]

Back of Figure 3.2-6

3.3 Fisheries Habitats and Resources

As many as 94 species of fishes from 30 different families have been observed in the Nisqually Basin, Estuary, and Reach (Cook-Tabor 1999). These species include salmonids, lamprey, herring, smelt, cods, sculpins, rockfish, surfperches, pricklebacks, gobies, sandlances, flounders, and flatfishes. There are few freshwater species residing in the Nisqually River, McAllister Creek, and associated tributaries that would be affected by this plan. To simplify and focus the discussion of the effects of the CCP alternatives on fish (presented in Chapter 4), this description focuses on the selected species listed in Table 3.3-1 below (see Wildlife Species List, Appendix E.2). All of these species are considered indicators of estuarine environmental health and are meant to represent the broader set of fish species using estuarine habitats of the Refuge and study area (Emmett et al. 1991). The species listed in the following table are described below by species group, with potential effects addressed in Chapter 4.

Table 3.3-1. Species Selected for Evaluating the Likely Effects of CCP Alternatives on Fish Inhabiting the Estuarine Habitats of the Refuge.	
Species Group	Family
1. Pacific Salmon	
Chinook salmon (<i>Oncorhynchus tshawytscha</i>)	Salmonidae, trouts
Chum salmon (<i>O. keta</i>)	Salmonidae, trouts
Coho salmon (<i>O. kisutch</i>)	Salmonidae, trouts
2. Forage Fish	
Pacific herring (<i>Clupea harengus</i>)	Clupeidae, herrings
Surf smelt (<i>Hypomesus pretiosus</i>)	Osmeridae, smelts
Pacific sand lance (<i>Ammodytes hexapterus</i>)	Ammodytidae, sand lances
3. Other Fishes	
White sturgeon (<i>Acipenser transmontanus</i>)	Acipenseridae
Bull trout (<i>Salvelinus confluentus</i>)	Salmonidae, trouts
Pacific tomcod (<i>Microgadus proximus</i>)	Gadidae, cods
Pacific staghorn sculpin (<i>Leptocottus armatus</i>)	Cottidae, sculpins
Shiner perch (<i>Cymatogaster aggregata</i>)	Embiotocidae, surfperches
Arrow goby (<i>Clevelandia ios</i>)	Gobiidae, gobies
Starry flounder (<i>Platichthys stellatus</i>)	Pleuronectidae, righteye flounders
English sole (<i>P. vetulus</i>)	Pleuronectidae, righteye flounders

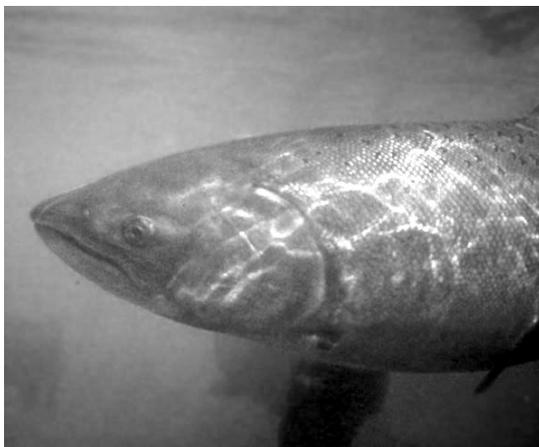
3.3.1 Pacific Salmon

Salmonids are probably the most abundant fishes in the Nisqually River Basin, with ten species found in the Nisqually River and Estuary, McAllister Creek, and independent tributaries. Six of the salmonids observed in the Nisqually Basin are Pacific salmon. Pacific salmon are an integral component of the Pacific Northwest, supporting industry, recreation, and culture (Nehlsen et al. 1991). The Pacific salmon runs present in the Nisqually River include summer/fall chinook, winter chum, coho, and pink salmon, and cutthroat and winter steelhead. Chum salmon are the most abundant species, followed by coho salmon, pink salmon, steelhead, and chinook salmon. Due to high numbers of releases of hatchery fish in the Nisqually River Basin, the summer/fall chinook and coho salmon runs are considered to be of mixed hatchery/native origin. All other Pacific salmon runs are of native origin.

Extensive losses of salmonid populations throughout the Pacific have occurred over the last 150 years. Adverse effects of habitat alterations, dams, and hatchery operations are widely recognized as major contributors to the decline of salmon in the region. Nehlsen et al. (1991) associate these activities with over 90% of the documented stock extinctions or declines. The importance of habitat is underscored in coastal watersheds with declining salmon populations.

The generalized life history of Pacific salmon includes spawning in freshwater, migration through estuaries to the ocean, and subsequent maturation and migration back to freshwater for spawning. Juveniles migrate from the river to the estuary primarily during spring and early summer, and the occurrence of juvenile salmon within different estuarine habitats varies by time, species, and size, with species residing in estuaries from a few days to many months. Of the Pacific salmon found in the Nisqually River, chinook salmon are the most dependent on estuaries to complete their life cycle, followed by chum, pink, and coho salmon, and coastal cutthroat trout (Aitkin 1998).

Estuaries provide important habitat for foraging, predator avoidance, and for the physiological transition from fresh to saltwater (Healey 1982; Simenstad et al. 1982; Iwata and Komatsu 1984). Juvenile anadromous salmonids use intertidal and shallow subtidal sloughs and tidal channels during the critical transition from spawning habitats in freshwater to the marine feeding grounds of the north Pacific Ocean (Simenstad et al. 1992). Juvenile salmonids congregate in areas where estuary morphology favors detritus retention, such as weed beds and channels with braided and meandering morphology (Healey 1982).



D. Vogel

Chinook salmon are the largest of the Pacific salmon and are highly dependent on estuaries.

Chinook salmon, also known as king salmon, are the largest of the Pacific salmon. Nisqually River chinook salmon are included, with 27 other distinct stocks, in the Puget Sound evolutionarily significant unit (ESU) determined by NMFS (Myers et al. 1998; Stout et al. 2001). Abundance of native chinook salmon in this ESU has declined substantially; NMFS has determined this ESU to be

at risk of becoming endangered within the foreseeable future and listed this ESU as threatened under the Endangered Species Act (ESA) in 1999 (63 FR 11482).

Chinook salmon have the most diverse life history strategies of the Pacific salmon (Myers et al. 1998) and remain at sea commonly from 2 to 4 years, with some proportion remaining as little as 2 or 3 months or as long as 6 years (Gilbert 1912; Mullen et al. 1992). The majority of juvenile chinook salmon out-migration to the estuary has been found to occur between mid-February and early June (Williams et al. 1975). The principal prey items eaten by juvenile chinook salmon in the estuary were insects (primarily dipteran flies) as well as spiders, decapod zoea, harpacticoid copepods, amphipods, and fish (Pearce et al. 1982). The highest growth rates for juvenile chinook salmon have been recorded in estuaries (Simenstad et al. 1982). Results of studies in the Sacramento River and Skagit River systems suggest that juvenile chinook salmon reared in estuaries grow faster than chinook salmon reared in upper river habitat, and this may increase their marine survival (Kjelson et al. 1982; Congleton et al. 1982). Tag recovery data from hatchery fish indicate that juvenile chinook salmon originating from other river systems in south Puget Sound utilize the Nisqually Estuary (Pearce et al. 1982).

Winter chum salmon in the Nisqually River are considered native in origin. The main prey of juvenile chum salmon in the Nisqually River Estuary was found to shift over the period of out-migration from bottom-dwelling prey, primarily harpacticoid copepods and gammarid amphipods, to prey found in shallow waters, such as calanoid copepods, crustacea larvae, and hyperiid amphipods (Fresh et al. 1979; Pearce et al. 1982).

Nisqually River coho salmon were included in the Puget Sound/Strait of Georgia ESU determined by NMFS in their status review of coho salmon stocks of Washington, Oregon, and California (Weitkamp et al. 1995). This ESU is under consideration for listing (candidate species) under the ESA due to the continuing loss of habitat, high artificial production rates, high harvest rates, and a severe decline in average size of spawners. Coho salmon juveniles remain in the system for more than 1 year, rearing in the accessible length and tributaries of the Nisqually River, the independent tributaries of the south shore of the Nisqually Reach, and McAllister Creek (Williams et al. 1975). The majority of out-migration to saltwater occurs between late February and early June. Juvenile coho salmon located in shallow sublittoral (water zone to about 600 feet) habitat in the Nisqually Reach feed primarily upon bottom-dwelling organisms, such as gammarid amphipods, harpacticoid copepods, cumaceans, isopods, and mysids, as well as sand lance and surface drift insects (Fresh et al. 1979; Pearce et al. 1982).

3.3.2 Forage Fish

Herring species observed in the Nisqually River, Estuary, and Reach include American shad, a non-native species, and Pacific herring (Fresh et al. 1979; Pearce et al. 1982). Pacific herring are a significant part of the prey base of finfish, marine mammals, and sea birds of Puget Sound (Lemberg et al. 1997; Stewart 1977; West 1997). The herring found utilizing the Nisqually Reach and Estuary is the Squaxin Pass stock, the southernmost stock in Puget Sound (Lemberg et al. 1997). A Biological Review Team (BRT) from NMFS reviewed the declining status of Pacific herring in Puget Sound and concluded that it is neither at risk of extinction, nor likely to

become so. However, the report also found that there is evidence pointing to the potential for human-caused factors to be disrupting the Puget Sound ecosystem (Stout et al. 2001).

Prior to spawning, adult herring hold in the Nisqually Reach and, once ready, spawn in south Puget Sound from mid-January to mid-April (Lemberg et al. 1997). Herring usually deposit eggs on intertidal and shallow subtidal eelgrass and marine algae. Juveniles remain in nearshore shallow-water areas until fall, when most disperse to deeper off-shore waters. Alterations of water quality, prey species, spawning substrate, and habitat can also affect populations. Puget Sound herring reside in an increasingly urbanized and threatened environment and are particularly susceptible to influences of shoreline development (O'Tool et al. 2000). The maintenance of these stocks is dependent upon protection of their critical habitats—intertidal and shallow subtidal locations.

Surf smelt in all life stages are found in estuarine and marine waters (Emmett et al. 1991). They are a significant part of the total Puget Sound forage base (Lemberg et al. 1997). Surf smelt spawn in 2.5 to 5 cm of water in the upper intertidal zone, depositing eggs that stick to sand (Emmett et al. 1991). Surf smelt spawning habitat has been documented in the Nisqually Estuary (Lemberg et al. 1997). Due to its strict spawning habitat requirements, this species is considered an indicator of environmental health (Emmett et al. 1991).

Pacific sand lance have been observed in very large numbers in the Nisqually Reach and Estuary (Fresh et al. 1979; Pearce et al. 1982). Sand lance spawn within the upper intertidal zone (Emmett et al. 1991; Lemberg et al. 1997). Sand lance can be an important component of sea birds and salmon prey bases, with reports of 19 to 53% of the diet of coho, sockeye, and chinook salmon consisting of sand lance (Beacham 1986; Manzer 1969; Pearce et al. 1982). Due to their importance as prey for many species of marine vertebrates and sensitivity to oil-contaminated sediments, Pacific sand lance are considered an indicator species of environmental stress (Emmett et al. 1991).

3.3.3 Other Fishes

White sturgeon are anadromous, spawning in large rivers and residing in both marine and fresh water. This species tolerates a wide range of saltwater concentrations and is common in estuaries of large rivers of the Pacific coast. Larvae and very young juveniles are riverine, while older juveniles and adults are found in riverine, estuarine, and marine habitats. White sturgeon are not usually found in intertidal areas, although they may feed on intertidal flats at high tide. Juvenile and adult white sturgeon are primarily carnivorous benthic feeders. This species is considered an indicator of environmental stress because it is long-lived and may concentrate contaminants. White sturgeon are considered to be a priority species for conservation and management by WDFW.

Pacific tomcod spawn from late winter to spring in Washington in marine coastal waters (Emmett et al. 1991; Walters 1984). Larvae and small juveniles are pelagic (i.e., free swimming in open water) occurring in nearshore marine waters and estuaries, while adults and juveniles are demersal (i.e., near the bottom of the ocean) in salinities above 18 ppt. Pacific tomcod larvae are

consumed by many fishes, while juveniles and adults are eaten by large fishes, harbor seals, and other marine mammals (Emmett et al. 1991).

Sculpin are small to moderate-sized bottom-dwelling fishes (Hart 1973). Twenty-two freshwater, marine, and estuarine species of sculpin have been observed in the Nisqually River, Estuary, and Reach (Cook-Tabor 1999). Of these species, the Pacific staghorn sculpin is considered an indicator species of environmental health and is usually found in shallow water (<50 m) in the sand or mud (Emmett et al. 1991; Love 1991). Large numbers of Pacific staghorn sculpin have been found in the Nisqually Reach and Estuary (Fresh et al. 1979; Pearce et al. 1982). Pacific staghorn sculpin feed at high tide on mudflats (Love 1991) and are eaten by large fishes, birds, and mammals.

Most surfperches inhabit shallow intertidal locations along sandy or muddy shores (Lamb and Edgell 1986). Unlike most fish, they bear large and fully developed young. Shiner perch, striped seaperch, and pile perch have been found in the Nisqually Estuary and Reach with shiner perch in large numbers (Fresh et al. 1979; Perce et al. 1982). Shiner perch are considered an indicator species of environmental health. They are commonly associated with docks and pilings and aquatic vegetation (eelgrass) in nearshore intertidal and subtidal areas with depths of less than 50 feet (Emmett et al. 1991; Love 1991). Shiner perch move into shallow bays and estuaries in spring and summer, and offshore into deeper water in fall and winter (Emmett et al. 1991) and are eaten by large marine fishes, marine mammals, and fish-eating birds.

Most gobies live in shallow to moderately deep coastal waters and prefer sandy, silty bays and tideflats (Lamb and Edgell 1986). Gobies are active bottom-dwelling and small-sized fish. The arrow goby is considered to be an indicator of environmental stress because it depends on estuaries (Emmett et al. 1991). They spawn year round on intertidal mudflats or sand flats of estuaries. Arrow gobies are eaten by birds and other fish (Lamb and Edgell 1986).

Nine righteye flounder species occur in the Nisqually Estuary and Reach (Cook-Tabor 1999). Of those species, Dover sole, rock sole, butter sole, English sole, and sand sole are considered common or of economic importance by WDFW (Palsson et al. 1997). Very large numbers (~10,000) of starry flounders have been captured in the Nisqually Estuary and Reach (Fresh et al. 1979; Pearce et al. 1982). Puget Sound stocks spawn between February and April near river mouths and sloughs in shallow water (Emmett et al. 1991). Juveniles most commonly live in estuaries in shallow water and are also found in sandy, intertidal, and freshwater areas. Starry flounder are preyed upon by marine mammals and fish-eating birds (Emmett et al. 1991; Love 1991).

English sole in Puget Sound spawn from January to April over soft-bottom substrates at depths of 50 to 70 m (Emmett et al. 1991). Larvae are transported to nearshore nursery areas (primarily estuaries) by tidal currents, feed on plankton, and metamorphose into juveniles in spring and early summer. Due to its reliance on estuaries for rearing, alterations and pollution of estuarine habitats adversely affect English sole (Gunderson et al. 1990). English sole are eaten by larger fishes, marine mammals, and fish-eating birds.

3.3.4 Threatened and Endangered Fish

Threatened and endangered fish species present in the Nisqually Basin include chinook salmon, coho salmon (a Candidate species), as well as bull trout. Information regarding chinook and coho salmon is presented in Section 3.3.1.

Bull trout have historically occurred in the Nisqually River watershed. Bull trout are closely related to Dolly Varden. Bull trout populations are threatened by habitat degradation, dams and diversion, and predation by non-native fish. The anadromous form of bull trout is the least understood and documented of the four life history forms (resident, fluvial, adfluvial, and anadromous) (USFWS 1998). Adult fish have been occasionally seen in lower sections of Puget Sound rivers, Grays Harbor, and Skagit River estuaries and are presumed to be anadromous forms (Brix et al. 1974; Kraemer 1994; WDFW 1998).

Habitat is available in the Nisqually River for all life history forms: anadromous, fluvial, adfluvial, and resident. Not much is known about the native char in the Nisqually River system. Bull trout/Dolly Varden were described as entering the Nisqually River in "vast numbers" in historical accounts (Suckley and Cooper 1860), but little is known about the current status of the population (WDFW 1998). The anadromous form of bull trout, if present in the Nisqually River, is likely only in small numbers (J. Michaels, pers. comm.).

Bull trout within the Coastal/Puget Sound Distinct Population Segment (DPS) were listed as threatened under the Endangered Species Act on 1 November 1999 (64 FR 58909). Based on their geographic distribution, WDFW classified Nisqually River bull trout as "distinct" from other Puget Sound char stocks in their Salmonid Stock Inventory (WDFW 1998). Due to insufficient information, the stock status was classified as "unknown."

Bull trout generally spawn from August through November in small tributaries and headwater streams. Because bull trout eggs incubate about 7 months in loose, clean gravel, they are especially vulnerable to fine sediments and water quality degradation (Fraley and Shepard 1989). Hatching occurs in late winter or early spring (Rieman and McIntyre 1993). Anadromous bull trout juveniles typically spend 2 to 3 years rearing in tributary streams before migrating to sea. Bull trout eat aquatic and terrestrial insects, macrozooplankton, mysids, and fish (Shepard et al. 1984). Large bull trout may feed almost exclusively on fish (Fraley and Shepard 1989; Shepard et al. 1984).

Bull trout distribution has been reduced by an estimated 40 to 60% since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors. In general, bull trout need habitat providing cold water, complex cover, stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity (Fraley and Shepard 1989; Rieman and McIntyre 1993; USFWS 1998). Bull trout also readily interbreed with non-native brook trout, causing genetic introgression. Brook trout may also exclude bull trout from native habitats (USFWS 1998). In addition, native char are easily caught and are highly susceptible to fishing pressure (Fraley and Shepard 1989).

3.4 Wildlife

The mosaic of saltwater estuary, freshwater wetlands, riparian, and open or forested upland habitats at Nisqually NWR results in a diversity of more than 300 species of birds, mammals, reptiles, and amphibians (see Wildlife Species List, Appendix E.2). The Nisqually delta is an important non-coastal resting and feeding area for migrating waterfowl and shorebirds between the Skagit Flats and the Columbia River within the Pacific Flyway. Eelgrass beds and tidal mudflats provide feeding and roosting areas for migrating waterfowl and shorebirds. Some birds in the estuarine and freshwater ecosystem are year-round residents, or remain for the summer or winter season at the end of their migrations. The Nisqually Estuary is rich in microorganisms and invertebrates that support a variety of wildlife including waterfowl, shorebirds, waterbirds, marine mammals, and shellfish. Located in the lower Nisqually River watershed, the larger study area also provides freshwater, riparian, and upland habitats for a variety of wildlife.

3.4.1 Waterfowl

Waterfowl migrating in the Pacific Flyway begin arriving on the Nisqually delta in late September, with many remaining through the winter. While some birds may use the area only for short periods of time during migration, they are dependent upon the area and its rich food sources. Other birds remain for the winter on the delta, traveling between the estuary and flooded agricultural or grass fields and wetlands on or off the Refuge. Off-Refuge sites are primarily found south of I-5. Nisqually NWR staff have been conducting aerial surveys to monitor waterfowl population numbers on the Refuge since 1975. Since 1984, waterfowl data were collected in association with five distinct survey units (Figure 3.4-1): (1) McAllister Creek, (2) Nisqually tideflats, (3) diked area, (4) Nisqually River and east side estuarine habitats, and (5) northwest shoreline to Johnson Point.

Dabbling ducks comprise more than 90% of all Refuge waterfowl sightings. Peak population numbers were observed during October or November with an average of 5,125 birds observed

annually (1984-2000). The highest annual average was 9,641 in 1994 and the lowest was 1,630 in 1997. The American wigeon was the most abundant (76% of all dabblers) waterfowl species observed on the Refuge. Numbers of wigeon observed peaked at 12,813 in November 1987 but have been declining in recent years. About 90% of wigeon are found in Units 1, 2, and 4, which are primarily estuarine. The remaining 10% of average wigeon numbers were found in diked habitats in Unit 3.



C. Vadai

The American wigeon is the most abundant waterfowl species found on the Refuge.

Other commonly observed dabblers include mallard, northern pintail, and green-winged teal. Dabblers consume vegetation mainly

in shallow water, on mudflats, and in the salt marsh. Dabblers, as well as other waterfowl, feed on species such as eelgrass and wigeon grass present in the estuary (Klotz et al. 1978). In the fall and winter, during hunting season, a majority of the delta waterfowl rest far out on the reach. When not on the outer reach, they may rest and drink in freshwater wetlands during the day (i.e., in the Nisqually Valley and move out to the salt marsh to feed at the tide's edge throughout the night) (Berge et al. 1974; Shanewise 1996). Some animal foods, including crustaceans, insects, and mollusks, comprise a small component of their fall and winter diets. Most of the dabbling ducks feed primarily on seeds of aquatic plants, but the American wigeon prefers stems and leafy portions. Berge et al. (1974) stated that large numbers of waterfowl were seen on the reach in November, indicating that American wigeon, pintail, green-winged teal, and northern shoveler, among other waterfowl, opted for the estuarine areas over the diked interior. The inner diked areas of the Refuge are used by wigeon and other waterfowl in smaller numbers, especially during the period when seasonally flooded ponds are present. When the dike was breached in 1975 and the diked interior remained flooded in a brackish or altered estuarine state for a year and a half, it was heavily used by waterbirds (Klotz et al. 1978). Plants in the inner diked areas that are primary foods of waterfowl include pondweed, smartweed, bulrush, and grasses (Klotz et al. 1978).

Other waterfowl commonly observed on the Refuge include Canada geese, northern shovelers, bufflehead, and scoter. Both migratory and resident Canada geese subspecies are observed on the Refuge. Migratory Canada geese (primarily cackling subspecies) are present during fall and winter months, while resident (western subspecies) are present in much smaller numbers throughout the year. Observations of geese, primarily migrating subspecies, have increased since the early 1990s. The number of geese observed during winter waterfowl surveys peaked at 687 in 2000. Most Canada geese are observed in grassland areas of Unit 3. Northern shovelers are filter feeders in shallow water and consume a greater amount of small aquatic animals than other surface feeders (Klotz et al. 1978). Small numbers are commonly observed in ponds located in the inner diked area (Unit 3). Scoter are observed most often in Unit 2. Diets of scoter primarily consist of mollusks but can include decapods (crabs, shrimp), amphipods, barnacles, insects, fish, and plants (Klotz et al. 1978). Bufflehead feed on similar items, with insects making up a more important component of their diet. Bufflehead are observed most often in Units 4 and 2. Seaducks, including scoter and scaup, have declined in Puget Sound according to WDFW surveys (Nysewander and Evenson 1998).

Waterfowl are also found in the study area south of the Refuge, primarily in freshwater wetlands and seasonally flooded agricultural fields. Many waterfowl species travel between the delta estuary and freshwater habitats south of the Refuge.

3.4.2 Waterbirds and Seabirds

Waterbirds and seabirds commonly observed on the Refuge include great blue and green herons, American bittern, American coots, Virginia rails, grebes, loons, cormorants, and gulls. Most birds within this group use the Refuge as feeding or resting grounds, departing the delta during the breeding season. Most of these birds also use the river, creeks, and sloughs within the study area south of the Refuge.

Figure 3.4-1. Waterfowl Survey Units

Back of Figure 3.4-1

A few species, such as the great blue heron, feed and nest on the Refuge. The great blue heron hunts on the mudflats, salt marsh, and diked area, with principal foods consisting of fish, frogs, small mammals, insects, and crustaceans (Klotz et al. 1978). Great blue herons are found in all four units of the Refuge, but they are frequently seen feeding along McAllister Creek and the mudflats. The northwest bluffs of McAllister Creek provide habitat for a great blue heron colony (Thurston County Dept. of Water and Waste Management 1993). Herons were first observed nesting in this area in 1977 (1 nest). Nesting activity increased gradually to a high of 101 nests in 1994. Since then, nest counts have declined to 3 nests in 2001. This decline



V.J. Anderson

Great blue herons are common sightings on the Refuge throughout the year, but nesting success has declined in recent years.

corresponds to the establishment of a nearby bald eagle nest. Predation by bald eagles appears to have influenced the movement of the nesting colony northward on the bluff, farther away from the bald eagle nest. The colony has also been abandoned during the chick rearing stage in recent years resulting in nesting failure. It is unknown whether eagle predation, human disturbance, or changes in the heron food resource are causing the decline in nesting birds and nesting failure. The great blue heron is a monitored and priority species in the State of Washington because of the increasing loss of foraging and breeding habitats as well as increasing environmental pollutants associated with human expansion and development.

Small numbers of American bitterns and Virginia rails are frequently observed on the Refuge in the spring and summer during nesting season (Ramsey 1997). Soras are less common but can be observed during spring and summer (Ramsey 1997). Sandhill cranes (3-4 at a time) have been observed infrequently in the inner diked area since 1983 (Ramsey 1997; USFWS data).

Western grebes are common migrants and winter residents. Pied-billed and horned grebes are common along McAllister Creek during winter and spring. Eared grebes can be observed occasionally on the Refuge. Fish are the primary food of western grebes. Other grebes feed on fish, crustaceans, insects, and mollusks.

Common and red-throated loons are commonly observed on the Refuge during the winter months. The common loon is considered a State candidate threatened species due to limited nesting locations and increasing human disturbances (Rodrick and Milner 1991). The yellow-billed loon, which is on the Birds of Conservation Concern (BCC) list (USFWS 2001), is an accidental vagrant to this area. Loons feed primarily on fish but do take other foods including crustaceans, mollusks, and insects.

Double-crested cormorants are commonly observed in McAllister Creek and the Nisqually River, or perched on driftwood or large snags in Unit 2. Gull species commonly observed on the Refuge include Bonaparte's gull, mew gull, ring-billed gull, California gull, and glaucous-

winged gull. Gulls, primarily fish eaters and scavengers, forage on the exposed and flooded mudflats in Unit 2 and the reach. Large numbers of gulls are due in part to the proximity of the Hawks Prairie Landfill, where some gull species feed. Closure of the landfill in 2000 has likely changed gull abundance on the Refuge since numbers have declined slightly. Caspian tern sightings are becoming more common on the Refuge since the establishment of a colony in nearby Commencement Bay in Tacoma. Although this colony was displaced in 2001, Caspian tern sightings are still common in the spring and summer. Common murre and rhinoceros auklets are infrequently observed in tidal waters during the winter months.

3.4.3 Shorebirds

Shorebirds (42 species which occur in the Pacific region [Alaska, British Columbia, Washington, Oregon, and California]) migrate long distances from breeding grounds in Alaska and Canada to wintering grounds in Central and South America. Habitats used by these shorebirds include coastal wetlands, freshwater lakes, seasonally flooded wetlands and grasslands, and saline-alkaline lakes. Only 30% of the original coastal wetlands remain in the Pacific region (Helmert 1992). Numerous interior wetland and estuarine areas have been lost to agriculture or industry.

Large numbers of shorebirds, up to 22 species, feed on the Refuge mudflats and salt marsh as they pass through during spring and fall migrations. Western sandpipers and dunlin, the predominant species, can be observed feeding on the exposed mud at low tides, concentrated in higher areas along the marsh, or in the inner diked area. Western sandpipers feed on annelid and nematode worms, arthropods, and other invertebrates, as well as salt marsh sandspurry seeds (Klotz et al. 1978). Greater yellowlegs, least sandpipers, killdeer, and common snipe are also commonly observed during the spring and summer. Other occasional sightings during this time of year include lesser yellowlegs, spotted sandpipers, semipalmated plovers, sanderlings, whimbrels, and dowitchers. A small number of common snipe and killdeer nest on the Refuge. A wintering population of dunlin has also been observed on the Refuge. An average of 480 birds (peak of 2,000 birds) have been observed during aerial winter waterfowl surveys; however, tidal conditions during surveys are often not conducive to high



V. J. Anderson

Dunlins are common winter residents, often feeding on exposed mudflats.

shorebird numbers. Black-bellied plovers are also occasionally seen on the tideflats in the winter months. On very rare occasions, marbled godwits and Wilson's phalaropes are seen.

3.4.4 Landbirds

Over 100 species of landbirds have been observed on the Refuge, including 22 species of raptors (owls, hawks, falcons, and eagles), 17 nonpasserines (e.g., woodpeckers, hummingbirds, kingfishers, doves, and pigeons), and 77 species of passerines (e.g., sparrows, finches, warblers,

flycatchers, and swallows). Landbirds found on the Refuge and study area include both residents and migrants. Long-distance migrants travel between breeding grounds in temperate North America and wintering grounds in Mexico, the Caribbean, and Central and South America. Short-distance migrants travel between wintering grounds north of the Mexican border and breeding grounds to the north. Resident species both breed and winter in the local area. Landbirds can be found in all habitats of the Refuge including riparian woodlands, agricultural lands, and freshwater wetlands.

In the 1980s, scientists observed a decline in numbers of migratory landbirds across the nation, apparently due to habitat loss and degradation both on breeding and wintering grounds. Nationwide efforts are now underway to identify more clearly the causes of these population declines, monitor populations of the most affected species, and reverse the declines, e.g., where possible through large- and small-scale land management efforts. Several species (e.g., olive-sided flycatcher, white-crowned sparrow, and pine siskin) on Nisqually NWR have been identified as “priority” species in this effort, and the Service is actively monitoring these populations.

3.4.4.1 Raptors

Raptors are found throughout all habitats of the Refuge. Some of the 22 species found on the Refuge are considered neotropical migrants because they spend their winters in South America. Northern harriers are the most regularly observed raptor, hunting over the salt marsh and non-native grasslands throughout the year. Other frequently observed species on the Refuge include bald eagles, peregrine falcons, red-tailed hawks, great-horned owls, and American kestrels. Greater species diversity and larger numbers are observed in the fall and winter months. Northern harriers, red-tailed hawks, American kestrels, and great-horned owls are known to nest on the Refuge. Barn owls have also been observed to nest in either one of the Twin Barns. Ospreys and merlins are observed occasionally on the Refuge. Ospreys feed exclusively on fish and are a State-monitored species that breeds along coasts, rivers, and lakes of coastal North America in the summer. Limiting factors include availability of snags, suitable live trees, or other suitable nest structures near large bodies of water that produce adequate fish supplies (Rodrick and Milner 1991). Northern goshawk, a BCC list species, is seen in the area on rare occasions.

Fall and spring migrating peregrine falcons are commonly observed hunting over the Refuge. They feed primarily on medium to small-sized birds such as pigeons, doves, shorebirds, waterfowl, and woodpeckers. Occasional sightings have been recorded from April through October. Peregrine falcons were recently taken off the Endangered Species List because their populations have rebounded. However, they are still listed as endangered by the state and are on the BCC list, and populations will be monitored for several years to ensure the population is stable or increasing. Falcons are observed most often hunting over the salt marsh and along the Nisqually River.

3.4.4.2 Nonpasserines

Common species in this group include rufous hummingbird, red-breasted sapsucker, downy woodpecker, belted kingfisher, and band-tailed pigeon. Hummingbirds arrive in late March and depart the Refuge by August. While downy woodpeckers are common, the Lewis’ woodpecker

is an uncommonly seen BBC list species. Belted kingfishers are commonly observed along McAllister Creek and the salt marsh areas, with nesting pairs observed along McAllister Creek. Band-tailed pigeons are commonly observed on the Refuge and the East Bluff throughout March and April early in the breeding season. Primary food sources include cascara, elderberry, wild cherry, huckleberry, dogwood, and madrone (Rodrick and Milner 1991), all of which are found on the Refuge and study area. Rufous hummingbird and band-tailed pigeon populations have been declining in this region (Sauer et al. 2000).

3.4.4.3 Passerines

Most of the 77 species of passerines found on the Refuge are observed during the spring and summer months. American robins, cedar waxwings, common yellowthroats, song sparrows, red-winged blackbirds, and 4 species of swallows nest on the Refuge during this time. American goldfinches and savannah sparrows nest in open grassland areas. Many species migrate south after breeding (e.g., common yellowthroats and the swallows), but some remain on the Refuge throughout the year (e.g., black-capped chickadee, Bewick’s wren, and American robin). Western meadowlarks winter on the Refuge and can be observed from September through December in areas adjacent to mowed fields. A few species on the BCC list include olive-sided flycatchers, white-crowned sparrows, and pine siskins that probably breed in the area; horned

larks and golden-crowned kinglets that are seen during migration; and vesper and sage sparrows that are accidental visitors.

The salt marsh, freshwater, and brackish marsh habitats provide a year-round home for the marsh wren. Other passerines that feed on the salt marsh, often in large flocks, include the European starling, blackbirds, and finches. Crows commonly forage on the mudflats. Barn, cliff, violet-green, and tree swallows are commonly observed feeding on insects over estuarine habitats during spring and summer (Ulmschneider 1976).

The riparian woodlands along the Nisqually River on the Refuge and in the study area are a critical habitat for several breeding species with significantly declining region- or nation-wide population trends. These include the yellow warbler, willow flycatcher, downy woodpecker, and Swainson’s thrush (Sauer et al. 2000).



V.J. Anderson

Marsh wrens use a variety of habitats on the Refuge, including freshwater wetlands and salt marshes.

3.4.5 Marine Mammals

Puget Sound has a rich diversity of marine mammals that either feed or breed in these waters. Some, such as the harbor seal, are year-round residents. Other species, such as the gray whale,

may move into Puget Sound during their migration between wintering and breeding grounds. The harbor seal is the most abundant marine mammal observed in the Nisqually delta. Seals haul out on logs in the Nisqually River mouth or on flooded mudflats in the northeast area of the delta. They are also often observed swimming in the Nisqually River or McAllister Creek. In the 1940s, the delta was described as an important breeding ground for the harbor seal. Currently, no seals are known to breed on the delta, most likely because of human disturbance and harassment by boaters and other users of the delta (Klotz et al. 1978). Gray whales, minke whales, false killer whales, and orcas are occasionally sighted during the winter months in the Nisqually Reach. Sea otters are occasionally sighted in the Nisqually delta reach. California sea lion observations have increased in recent years, with a few sightings of the Federally threatened Steller sea lion.

3.4.6 Land Mammals

Forty-eight species of land mammals have been observed on the Refuge. Common large land mammals observed on the Refuge include Columbian black-tailed deer, coyote, river otter, long-tailed weasel, mink, eastern gray squirrels, raccoon, skunk, opossum, eastern cottontail, and beaver. All of these species probably occur in the study area as well. The eastern gray squirrel is an introduced species from the eastern United States that now commonly occurs in urban areas of the west. Observations of this species have been increasing on the Refuge in recent years. Native western gray squirrels have been observed in the study area near McAllister Creek and east of the Nisqually River (Thurston County Dept. of Water and Waste Management 1993; WDFW 2001). Western gray squirrels prefer oak woodland habitats, and it is unlikely that a population historically or currently occurs on the Refuge. Small mammal trapping conducted in 1977 and 1978 resulted in the identification of vagrant shrews, shrews, shrew moles, deer mice, Oregon voles, Townsend voles, and Pacific jumping mice on the Refuge (Klotz et al. 1978). Townsend's vole, deer mice, and vagrant and masked shrews were also found in grassland habitats, with Townsend's voles at the highest density (120.7/ha) (Bowman and Dobos 1976). Deer mice, on the other hand, are abundant in forested areas. Townsend voles and deer mice can also be found in salt marsh areas (Bowman and Dobos 1976). In addition, various species of bats have been observed on the Refuge, but there are little data on abundance and distribution.

3.4.7 Reptiles and Amphibians

Sixty-two species of amphibians and reptiles occur in the Pacific Northwest (Nussbaum et al. 1983), 13 of which have been observed on the Refuge. Red-legged frogs, Pacific tree frogs, and garter snakes inhabit open grassland and riparian areas of the Refuge (Klotz et al. 1978) and most likely occur in similar habitats in the study area. Long-toed salamanders, rough-skinned newts, and the introduced bullfrog are also found in emergent wetland, ponds, and woodland areas (Klotz et al. 1978). In recent years, northwestern and western red-backed salamanders have been observed on the Refuge.

The western pond turtle is listed by Washington State as an endangered species due to limited distribution, low numbers, and isolated populations. Historically, the Puget Sound lowlands were considered the northernmost limit of their range, but they were considered extirpated from this area and many other parts of Washington State by the 1980s (Hays et al. 1999). Western pond turtles spend much of their life in streams, ponds, lakes, and wetlands, but they also require

terrestrial habitat for nesting, dispersal, dormancy during parts of the warmest months, and overwintering (Hays et al. 1999). The Refuge has suitable habitat for western pond turtles; however, none have been seen in recent years. In 1991, a western pond turtle was found near McAllister Creek under highway I-5 (Thurston County Dept. of Water and Waste Management 1993). The turtle was released within the Refuge, but after 2 weeks it was not seen again. No western pond turtles were found during extensive surveys in the Fort Lewis area (Cassidy et al. 1997).

The Oregon spotted frog, recently differentiated from the closely related Columbia spotted frog, is listed in Washington State as an endangered species and is also a candidate species under the Federal Endangered Species Act. The frog's limited number of existing populations and lack of protection for these populations warrants State and Federal protection (McAllister and Leonard 1997). While Oregon spotted frogs have a wide variety of predators, they are particularly vulnerable to introduced species including bullfrogs and numerous warmwater fishes. Oregon spotted frogs require freshwater emergent wetlands, which were historically found in the floodplains of many larger bodies of water. Much of this habitat has been drained, filled, diked, or degraded due to exotic plants like reed canary grass (McAllister and Leonard 1997). The Nisqually NWR has appropriate Oregon spotted frog habitat, but there are no known populations occurring on the Refuge or in the area.

3.4.8 Invertebrates

Many of the organisms found within estuaries depend on small marine invertebrates as a food resource. The marine invertebrate community in the Nisqually delta has been minimally studied in the past. A survey conducted in 1978 (Wisseman et al. 1978) found an abundance of ghost shrimp, bivalves, polychaetes, spionids, and nematodes in mudflats in the RNA portion of the Refuge. Polychaete assemblages found in cobble and mixed sediment areas contrasted sharply with those found in muddy areas. Small crustacea (tanaid and cumacean) and numerous amphipod species were found in sediment surfaces in high numbers. Bivalves were the most abundant species found in the mudflats between the Nisqually River and McAllister Creek. This area also contained gastropods and opisthobranchs at lower tide levels as well as amphipods, which were abundant in the sandy flats. Geoducks were found occasionally, low in the intertidal along the delta front (Wisseman et al. 1978).

Terrestrial invertebrates are also very important to the wildlife community. No complete inventory has been conducted on the Refuge or study area. In 1992, a specimen collection was prepared for educational purposes. It included 82 specimens from nine families, ranging from damselflies and grasshoppers to wasps and bees (USFWS data). During the summer of 1994, a butterfly study detected 47 different species of butterflies on the Refuge (USFWS data).

3.4.9 Invasive and Exotic Wildlife Species

European starlings are abundant on the Refuge during the nesting season and winter months. Their early nesting behavior has eliminated many cavities for wood ducks, American kestrels, and swallows. Non-native bullfrogs are a threat to native amphibians because they prey on

juveniles and adults. Competition between larval bullfrogs and larvae of native amphibians may also be a factor in the decline of native species. Mitten crabs and green crabs are aquatic nuisance species that are rapidly spreading in coastal Washington, but they have not yet been found on the Refuge or elsewhere in south Puget Sound (K. Aitkin, pers. comm.). Monitoring programs are being designed to ensure early detection of these invasive species.

3.4.10 Federally Endangered and Threatened Species

The Federally threatened bald eagle, marbled murrelet, and Steller sea lion, and endangered brown pelican occur on Nisqually NWR. Of these species, the bald eagle is most commonly observed. Wintering bald eagles are observed feeding and resting on the Refuge from October through March. A peak count of over 25 individuals has been observed feeding on the Refuge tideflats, whereas as many as 200 have been observed on the Nisqually River (Stalmaster 2001). Bald eagles are scavengers but also hunt for fish and birds. Nesting activity occurs from February through mid-July. A pair of eagles has used the same nest site along the western bluff of McAllister Creek every year since 1992. This breeding pair has fledged two healthy chicks every year, with the exception of 1997. Three other breeding pairs have been identified within the vicinity of the Refuge, including one in the study area on the eastern bank of the Nisqually River south of I-5. These birds most likely use the Refuge as feeding grounds. Eagles depend on dead or weakened prey such as fish, waterfowl, seabirds, and small mammals (Rodrick and Milner 1991).

Brown pelicans have been observed occasionally in the Nisqually Reach. Marbled murrelets have been observed in or heard flying over the Nisqually Reach. The Nisqually Reach probably serves as important feeding grounds for much of the south Puget Sound population (B. Ritchie, pers. comm.). Murrelets probably travel from the reach through the study area, using the Nisqually River corridor, to unidentified nesting locations in forested upland areas. The WDFW considers all of Thurston County potential marbled murrelet habitat (Thurston County Dept. of Water and Waste Management 1993).

The Steller sea lion is observed occasionally in the Nisqually Reach.

3.4.11 State Listed Species

There are several Washington State listed species that are discussed in previous sections. These include the endangered western pond turtle, Oregon spotted frog, brown pelican, and sandhill crane. Washington State threatened species include the Steller sea lion, bald eagle, and marbled murrelet. Among the Washington State candidates for listing or species of concern, 11 species are either known to occur or potentially occur on the Refuge. These are Townsend's big-eared bat, common loon, western grebe, Brandt's cormorant, northern goshawk, merlin, common murre, pileated woodpecker, Lewis' woodpecker, willow flycatcher, and purple martin.

3.5 Special Uses

3.5.1 Haying

Since 1974, permittee(s) have hayed the non-native grasslands on the Refuge in late summer to provide fall browse for migrating waterfowl, primarily American wigeon. The total acreage hayed varies from year to year with each permittee and depending on rainfall. Acreage cut has ranged from 100 to 312 acres. Currently, approximately 250 acres of non-native grassland are cut once from July 1 through September 30. Haying is delayed until July to maximize survival of any ground-nesting birds. The permittee pays a percentage per ton of hay cut.

3.5.2 Scientific Research

It is Service policy to encourage and support research and management studies to provide scientific data upon which decisions regarding management of units of the Refuge System may be based. Priority is granted to studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitats in their natural diversity. All special use permits issued for research specify that they be conducted in a manner to cause minimal effects on wildlife and habitat. The Refuge is occasionally used for various research projects addressing vegetation, habitat, bird, small mammal, and other resources.

3.5.3 Tribal Fishing

Tribal fishing by members of the Nisqually Indian Tribe occurs in McAllister Creek and the Nisqually River. The fishing is provided for in the Treaty of Medicine Creek of 1854 (10 Stat. 1132). The Nisqually Indian Tribe fishes in McAllister Creek, the Nisqually River, and adjacent marine waters, using set nets or other traditional methods, or with modern, improved fishing techniques without curtailment of the right of access to these fishing areas. Tribal fishing is conducted by power boat in both the creek and the river with set nets. The commercial tribal fishery occasionally causes unintentional take of non-target species such as harbor seals or diving birds.

3.6 Public Access, Education, and Recreational Opportunities

This section describes the public access, education, and recreation opportunities at the Nisqually NWR. Recreation features and access points on the Refuge are shown in Figure 3.6-1.

3.6.1 Public Access

The Refuge is open daily during daylight hours. The main access point is by road at Exit 114 off I-5. In addition, visitors access the Refuge by boat. Most boaters launch from the State-owned Luhr Beach boat ramp at the northwest corner of the Refuge. The Refuge has a daily entrance fee of \$3.00 per family. The Golden Eagle, Golden Age, Golden Access Passports; Refuge Annual Pass; and Federal Duck Stamp also admit one family. Children under 16 are free. The entrance fee is waived for educational groups studying nature as part of a course of curriculum. Visitors pay the entrance fee at a fee station at the entrance to the Visitor Center.

The only public access points within the study area are outside of the Refuge boundary located on WDFW and Fort Lewis lands for bank fishing access on the Nisqually River.

3.6.2 Recreation

3.6.2.1 Wildlife-Dependent Recreation

More than 100,000 people per year visit the Refuge to participate in a variety of wildlife-dependent recreational and educational activities. These include wildlife observation and photography, interpretation, environmental education, and fishing. A 7-mile trail system, Visitor Center, Environmental Education Center, designated bank fishing access, and photoblinds support these activities.



More than 100,000 people visit the Refuge annually to participate in wildlife observation, interpretation, photography, fishing, and environmental education.

Wildlife Observation and Photography

Although wildlife observation and photography are good year round at the Refuge, the best times for wildlife viewing are fall, winter, and spring. The Refuge's location, with its wildlife diversity and mosaic of habitats and trail access to those habitats, makes it a popular place for birdwatchers; Nisqually NWR is considered by many to be one of the best birding areas in Puget Sound.

The Refuge's 7 miles of trails include a 5½-mile loop trail and a 1-mile loop trail for walking only. Bikes, jogging, and pets are not allowed on the Refuge. Wildlife observation is also conducted by Refuge visitors entering the Refuge by canoe or kayak.

The Brown Farm Dike Trail is a 5½-mile loop in which all major habitats on the Refuge can be viewed. The trail is on the dike and is flat, wide, and easy to walk. Along the trail are benches, an observation tower, two photoblinds, and two short spurs, a ½-mile Ring Dike Trail and the McAllister Creek bank fishing area. The Brown Farm Dike Trail is a popular trail for hikers and birdwatchers; because of its length, ease of walking, and access to many habitats, it is unique in the area. Visitors spend anywhere from 2-6 hours on this trail. On any given day, birdwatchers can tally upwards of 60 different bird species seen along this trail.

From early October to mid-January, 3 miles of the Brown Farm Dike Trail (between the Ring Dike and McAllister Creek) are closed during the waterfowl hunting season; specific dates vary from year to year. The trail is closed because waterfowl hunting is allowed on WDFW inholdings that are adjacent to large portions of the trail. The trail closure provides a dual purpose: to ensure safety for trail users and provide wildlife sanctuary. Waterfowl benefit by being able to move into the closed diked interior undisturbed by trail users when the trail is closed. This annual trail closure negatively affects large numbers of Refuge visitors unable to access certain areas of the Refuge during fall and winter. It is the single largest conflict among visitors within the Refuge boundary. Although the trail is closed with a gate and signs explain the closure, trespassing regularly occurs.

The Twin Barns Loop Trail is a 1-mile long boardwalk trail, which is fully accessible to people with disabilities. Along the trail, visitors pass through riparian habitat, freshwater wetlands, and grasslands. Habitat restoration along the 1-mile boardwalk trail has improved wildlife observation opportunities. At various locations along the trail, there are benches, viewing decks, scopes, and interpretive panels. SaniCans and trash receptacles are located at the northern end of the trail. Here, the trail also extends to include an elevated viewing platform with four different levels, scopes, and benches. Two short spur trails offer views of the Nisqually River and surge plain habitat. This trail is used by education groups and visitors who have less time to spend at the Refuge or want a shorter walk.

Interpretation

A new 4,800 square foot Visitor Center was opened to the public in fall of 1999. The Visitor Center has an interpretive exhibit room with displays that focus on the Nisqually River watershed, the Pacific Flyway and migratory birds, and the Nisqually River Estuary and delta. A 100-person auditorium, with full audiovisual capacity, is used for special events, lectures, and training sessions. The auditorium also has a rotating wildlife art exhibit.

The Visitor Center is open Wednesday through Sunday, 9:00 a.m. to 4:00 p.m. Trained Refuge volunteers staff the information desk, answering questions, handing out brochures, and selling entrance passes and items from the cooperating association sales outlet. The Nisqually Refuge Cooperating Association operates the sales outlet and helps support Refuge programs. Refuge staff are on-site at all times.

Figure 3.6-1. Current authorized public recreation within the study area.

Figure 3.6-1
back side



J. Takekawa

The Refuge visitor center and administrative headquarters include exhibits that focus on the watershed, estuary, and migratory birds in the Pacific Flyway.

Refuge staff and volunteers conduct special events throughout the year to help people learn more about Nisqually's fish and wildlife resources. These events include International Migratory Bird Day, a Summer Lecture Series, National Wildlife Refuge Week, and the Nisqually Watershed Festival. The Twin Barns Loop Trail has interpretive panels at a number of locations that focus on the habitats and wildlife along the trail.

A private non-profit organization operates the Nisqually Reach Nature Center at Luhr Beach on WDFW land. The center is open to the public 2 days

a week and has a variety of interpretive displays on the various fish and wildlife dependent on the marine waters of the Nisqually delta.

Fishing

The Refuge offers fishing opportunities for salmon, steelhead, and trout in McAllister Creek and the Nisqually River, and for shellfish and bottomfish in the tideflats. All State fishing regulations are in effect. No fishing is allowed inside the dike. The Refuge estimates that 3,800 visitors fish at the Refuge each year, but the number is difficult to verify as no counting system is in place. Some fishing occurs within the RNA in the northeast part of the Refuge. This is considered an administratively uncontrollable area as the RNA is not signed.

Most anglers access the Refuge by boat from Luhr Beach. Bank fishing is permitted only in the designated McAllister Creek bank fishing area, located on the east side of the creek and accessible from the Brown Farm Dike Trail. Anglers must walk 3/4 of a mile to access the bank fishing area. Persistent and numerous illegal entries occur from anglers entering this area at the southern boundary of the Refuge near the I-5 ramp. WDFW has recently proposed to close the McAllister Creek Hatchery; if this occurs, fishing opportunity in McAllister Creek would decline dramatically.

In 1996, due to loss of trails, river bank, and bank instability, the bank fishing area along the Nisqually River was closed. Currently, there is no Refuge bank fishing access along the Nisqually River although several points of illegal entry exist and are used by anglers. Two bank fishing sites on the Nisqually River that are open to the public are located south of I-5 and within the study area. This includes a State-managed site on the west bank of the river and a site on Fort Lewis property on the east bank. The State site is owned and managed by WDFW and provides parking, bathrooms, and accessible bank fishing. However, changes in the river have made this site less usable for anglers with disabilities. The Fort Lewis site is open to the public with minimum management. The public is allowed to drive through riparian habitat down to the river

bank. A variety of dirt roads have been created from this off-road driving activity. There are no restroom facilities on-site.

In 1992, the Washington State Department of Health reclassified 2,130 acres of commercial and recreational shellfish beds in Nisqually reach from “approved” to “conditionally open” after finding elevated levels of fecal coliform bacteria in the reach following storm events (Whiley and Walter 1996; Emmett 1995). Following further evaluation, the shellfish beds in the vicinity of Luhr Beach were closed to harvest in spring 2000 (W. Clifford, pers. comm.). Prior to these closures, recreational shellfishers accessed the tideflats by foot from Luhr Beach during spring and summer low tides to collect shellfish including littleneck, butter, and horse clams, crab, and geoduck. Dungeness crab is also harvested with pots in deeper water. Dungeness crab harvest is not affected by the Luhr Beach closure. Signs notifying the public of the shellfishing closure and health hazards are posted at Luhr Beach, and compliance is entirely voluntary. No enforcement is conducted and violations do occur. Shellfishing activity at Luhr Beach creates trespass problems on the Refuge tideflats and shoreline by attracting other visitors onto the tideflats. Dog and beach walkers enter the area illegally during low tides.

Hunting

Currently, the only authorized public waterfowl hunting that occurs within the delta is on State WDFW tidelands. Refuge lands are not open to hunting. The Nisqually NWR Conceptual Plan (CH2M Hill et al. 1978) proposed a quality waterfowl hunting program in the Nisqually tideflats area and on land east of the Nisqually River. This program has never been implemented because the Service has not been able to come to an agreement with the State on the hunting program design. In addition, the Refuge has been unsuccessful in acquiring the inholdings east of the Nisqually River. Because the Refuge and WDFW lands are not adequately posted, waterfowl hunting does occur on some Refuge tidelands (up to 1,189 acres) that are administratively uncontrollable.

Refuge staff and volunteers have been monitoring waterfowl harvest activities associated with State lands in the Nisqually delta almost annually since 1981. Prior to 1998, monitoring efforts consisted of sporadic hunter bag checks, conducted at Luhr Beach boat ramp, varying in effort from year to year. Analysis of the 1990-1997 data set showed that the annual number of ducks harvested per hunter visit ranged from 1.5 to 1.9 ducks/hunter visit. The number of geese harvested ranged from 0.0 to 0.2 geese/hunter visit. Between 1991 and 1997, annual hunter visits ranged from 11 visits/day in 1997 to 31 visits/day in 1991 and 1994. The vast majority of ducks harvested were dabblers, primarily American wigeon, mallards, and green-winged teal. American wigeon comprised 51% of the total duck harvest over all years. Fifty-five percent of hunter visits occurred in the area known as Survey Unit 2, the Nisqually tideflats area (Figure 3.4-1) (Seto 1998).

In October 1998, an intensive hunter bag check project was initiated to better document and understand hunting activity on the delta. All hunting activities occurring on weekend days, holidays, and 41% of weekdays were monitored throughout the waterfowl hunting season. The results of this monitoring effort showed similar results in terms of species harvest with wigeon, teal, and mallard comprising over 80% of the harvest. Hunter success averaged 1.5 birds/hunter

visit over the season. There were an estimated 1,000 to 1,200 hunter visits during the entire season. Hunter visits were four times higher on weekends, averaging 20.5 hunters visiting each weekend day, and only 5.2 hunters per weekday. The level of hunting activity was relatively stable throughout the season, with only a slight decrease in activity after mid-November. No information was collected to map the distribution of hunters throughout the area (Seto 1999).

Some private hunting (Medicine Creek Hunt Club) occurs on property south of I-5 in the Study Area, although use levels are believed to be low. Waterfowl hunting also occurs in the Trotter's Woods area by approximately 3-4 hunters.

3.6.2.2 Non-Wildlife Dependent Recreation Activities

Non-wildlife dependent recreational activities that occur on the Refuge include boating, PWC use, and fruit and berry picking.

Boating

Both motorized and non-motorized recreational boating occur in all waters of the Refuge outside the Brown Farm Dike. Some of these activities are wildlife-dependent and are addressed above. The majority of boaters access the area from Luhr Beach. Commercial rafting, canoe, and kayak tours use the waters of the Refuge on a year-round basis. No boating is allowed inside the Brown Farm Dike. Boating occurs within the RNA in the northeast portion of the Refuge.

It is estimated that 6,700 boaters access the Refuge annually, although this number is difficult to verify as no counting system is in place. Recreational boating has increased dramatically and is expected to continue to increase in concert with residential development underway on adjacent lands. Luhr Beach is one of the few launch sites in the area with access to Puget Sound.

There is no boat speed limit for motorized craft in open waters, except for Thurston County's Shoreline Protection regulation that limits speeds of motorized watercraft to 5 mph within 200 feet of shoreline (Thurston County Regulations, Title 16, Waterways and Vessels [16.04.110]). A compatibility determination completed in 1994 stipulated several restrictions that have not been put in place, including: a posted no-wake zone, area and seasonal closures on the tidflats, regulations information in brochures and at Luhr Beach, and closure of most of the water of McAllister Creek year round.

PWC Use

PWC use occurs on the Refuge, mostly along McAllister Creek and in the reach, with users typically launching from Luhr Beach. There are no good estimates as to the amount of PWC use that occurs. Several complaints have been received from trail users about the disturbance caused by PWC activity related to noise and wildlife disturbance.

Fruit and Berry Picking

During the historical farming period, an apple and pear orchard was planted in what has now become the maintenance compound and adjacent areas. The Service does not routinely maintain the orchard trees, and the trees produce a large crop of fruit each year. Visitors are allowed to pick up windfall fruit or pick fruit off the trees that they can reach from the ground. No climbing of the trees or knocking down of fruit is allowed.

Visitors are also allowed to pick small amounts of blackberries that grow profusely in thickets along the Refuge trails and parking lot. The harvest of both fruit and berries is for personal use only; no picking for commercial use is allowed. Blackberry picking occurs during August and September, while the harvest of orchard fruit occurs from September through November.

Most picking of fruit and berries is done along the trails by small groups of visitors that are at the Refuge to walk and observe wildlife. However, off-trail berry picking and picking of large quantities of fruit and berries do occur, creating a trespassing problem and oversight problem for Refuge staff.

3.6.3 Environmental Education

Since the establishment of the Refuge, educators and youth professionals have been using Nisqually NWR as an outdoor classroom to enhance course curricula. The Refuge's environmental education program serves educators and youth professionals who work with pre-school through college-age youth. Educators include teachers, professors, and outdoor education leaders. Youth professionals include leaders for Scouts, 4H, and Campfire.

Each year, approximately 5,000 students and teachers from King, Pierce, Thurston, and Mason counties participate in the Refuge's environmental education program. Although educational groups use the Refuge throughout the year, the highest use period is from early April through mid-June. Summer use has increased dramatically in the past several years.

Environmental education field trips at Nisqually NWR are teacher-led. Due to limited Refuge staff availability, teachers and group leaders are expected to plan and lead their own field trip activities with minimal assistance from Refuge staff. It is recommended that teachers visit the Refuge prior to their field trip, walk the trail, and prepare clearly defined field trip goals and objectives. The Refuge offers lesson-planning assistance to teachers and orientation talks to school groups while at the Refuge. Approximately eight volunteers work with 90% of the school groups visiting the Refuge. Volunteers provide an orientation talk and may walk with groups along the trails. They also talk with the teachers prior to their trip about their goals and activities. Since November 2000, an Environmental Education Intern has been hired through the Washington Conservation Corps AmeriCorps program. This full-time position helps improve and facilitate the education program. Plans are to recruit and fill this position each year as funding allows.

Prior to visiting, educational groups are required to make a reservation indicating pre-trip activities, goals, field trip activities, locations and times, and what assistance they would like

from the Refuge. If the educational group is coming as part of a course of curriculum to study nature, the entrance fee is waived. Education groups visiting the Refuge are limited to 100 students per day. Groups are only allowed on the trails, the Environmental Education Center,



The Refuge provides an ideal setting to reach a diversity of students and teachers.

Visitor Center, and currently in three designated environmental education (EE) study sites. They may not collect samples or go off trail unless allowed through a special use permit.

The Twin Barns Education Center was severely damaged and closed following the 2001 Nisqually Earthquake. The Environmental Education Center has been temporarily moved to a trailer near the maintenance compound. A replacement facility is required to upgrade facilities and ensure a safe, quality experience for school children participating in the program.

The only other education center within the Refuge or study area is located at Luhr Beach. The private, non-profit Nisqually Reach Nature Center doubles as a wildlife interpretation center and an educational center for school children ranging from 3rd to 12th grades. The educational focus at the Nature Center is on the marine environment. They have supported up to 2,000 students per year. In 2000, the Refuge provided half the cost to fund an AmeriCorps intern to enhance the program as part of a growing partnership with the Nature Center.

3.7 Cultural Resources

3.7.1 Native American Cultural History and Landscape

From 13,500 to 8,000 years ago, aboriginal peoples may have used the delta estuary as a travel corridor between the sound, upland prairies (which were more prevalent at that time), and the glacial Lake Nisqually drainage channels (Forsman et al. 1998).

Aboriginal people were known to have a village at the mouth of the Nisqually River about 5,000 years ago (Stevenson 1998). During and since 3,000 years ago, winter and seasonal camps for foraging were maintained on the Nisqually River. Winter villages and camps have also been recorded at several locations along the lower reach of the Nisqually River.

The Nisqually Indians lived along the Nisqually River and its tributaries in numerous small villages. Permanent villages were noted for their cedar planked houses, while seasonal camps on the delta were characterized by temporary shelters. The variety of ecozones—prairies, woods, and the delta estuary—provided rich resources for fishing, hunting, and gathering activities. Coho, king, sockeye, chum, and pink salmon constituted a major part of their diet. Shellfish (clams, oysters, geoducks, mussels, and barnacles) were gathered along the shores of the river. Small and large game (deer, bear, and beaver) and waterfowl were also hunted. The delta and river basin supplied abundant plant resources for food, medicine, basketry, and other technological needs. The open prairies were used for social gatherings and ceremonies (Forsman et al. 1998).

The Refuge is the site of the signing of the first Indian treaty in Washington Territory. In December 1854, at a grove of trees along the east bank of McAllister Creek now known as the Treaty Trees, representatives of southern Puget Sound tribes met with Territorial Governor Isaac Stevens to negotiate and sign the Medicine Creek Treaty. Through the treaty, Indian tribes relinquished rights to the land and agreed to relocate to certain reservations. The Nisqually Indians received a reservation along the Nisqually River 5 miles upstream from the delta. In 1918, the 3,300-acre holding in Pierce County was condemned to establish Fort Lewis. The Nisqually Tribal reservation currently includes 1,400 acres in Thurston County (Thurston Regional Planning Council 1997). The treaty reserved certain fishing, hunting, and gathering rights for the tribes. Members of the Nisqually Indian Tribe still exercise these treaty rights, fishing for salmon in Refuge waters (G. Walter, pers. comm.).

3.7.1.1 Archaeological Resources

Twelve recorded archaeological sites are located within the existing boundary of the Refuge. Prehistoric sites occur primarily along the west bank of McAllister (previously known as She-Nah-Num or Medicine) Creek and in various locations along the adjacent bluffs. Historical sites are found predominantly in the south-central portion of the Refuge. Of the 12 sites, six fall within the boundaries of the waterways managed by WDFW.

One prehistoric site, known ethnographically as She-Nah-Num and archaeologically as the Medicine Creek Site, was determined eligible to the National Register of Historic Places (NRHP)

in 1977. A nomination was prepared but never submitted, however, so its status remains “eligible.” It is one of the six sites outside Service jurisdiction. The site contains both prehistoric (shell, fire-cracked rock, bone, and lithics) and historical (bricks and bottles) elements. A shell midden site located on the McAllister Rod and Gun Club, which also contains an historical component, was determined ineligible to the NRHP. The remaining six prehistoric sites are all characterized as shell concentrations suffering from various degrees of tidal erosion.

Eighteen additional recorded cultural resources are located within the boundaries of the study area. Among the most significant of these resources is a shell midden with both prehistoric and historical components, which is identified as the probable home site of Sinnaywak, a noted Nisqually leader and shaman who lived from 1814-1904. Radiocarbon dating on another prehistoric midden deposit in the study area has returned occupation dates between 5,000 and 1,300 years ago, making it one of the oldest shell midden sites known in the southern Puget Sound area. A third shell midden site occurs in the study area but has received no in-depth archaeological research.

3.7.2 Euro-American Cultural History

In 1833, the Hudson’s Bay Company established a trading post and farm in the Nisqually River delta. Soon after, Euro-Americans began to settle in the area, attracted by the proximity to water and the large, unforested tracts of land. By 1839, the character of the Nisqually Valley began to change as a major part of the economy shifted from fur trading to raising sheep and agricultural pursuits. In 1845, the McAllister family settled on Medicine Creek, now McAllister Creek. By 1852, James McAllister had dammed McAllister Creek and built a sawmill which produced some of the first lumber to be exported from Puget Sound to San Francisco (Stevenson 1998; Guth 1998). Other early settlers included the Shazer family, William Packwood, and Joel Myers. Land survey maps of 1853 described the area around McAllister Creek as “rolling hills and burnt timber” (United States Surveyor General 1853).

North of present-day I-5 on the southeast corner of current Refuge lands, low-lying upland areas along the Nisqually River were cultivated by homesteaders such as the Shazers and Myers. During the late 1800s, many estuarine habitats were lost, including parts of the Nisqually River Estuary, as pioneers throughout the Puget Sound diked and drained deltas for agriculture. George Shannon acquired the Shazer property, located north of I-5 on the Refuge, in 1872. He began to dike the property to grow grain and hay, raise cattle and horses, and develop private hunting and fishing areas. Delta lands east of the river were purchased and diked in the late 1890s by Ollie Braget (Stevenson 1998). Ditches, dikes, and fence remnants on the tidelands seaward of the main dike found today indicate past use of some marsh areas. Old pilings and cable in the surge plain forest suggest past logging activities (Kunze 1984).

In 1904, Alson L. Brown and his wife purchased about 2,350 acres of the Nisqually River Estuary west of the mouth of the Nisqually River and along the McAllister Creek hillside. Brown constructed the original 4-mile dike which is now a prominent feature of the Refuge. The dike, which altered the hydrologic regime of the delta, was built using a horse-drawn scoop and a crew of 30 men. In 1910, the dike was reinforced by a dredge that filled in the remaining sloughs. The fertile river delta soils were converted to crop production. The farm also maintained chickens,

hogs, a dairy operation, shipping operations, and a general store. The foundations of various buildings, most probably associated with the A.L. Brown Farm, are scattered around the delta. In addition, the apple orchard adjacent to the Refuge headquarters is also a remnant of the farm's early years. Structural and landscape elements associated with the Brown Farm are eligible to the NRHP. Although Brown went bankrupt after WWI, the farm continued to operate under the subsequent owners who rebuilt the dike, higher than the first, and built the Twin Barns in 1932. These barns were determined to be ineligible to the NRHP in the 1970s.

Historical sites within the study area, but outside of the approved Refuge boundary, include examples of residential complexes, civil infrastructure, and structures associated with various organizations. Seven homestead locations were recorded, with settlement dates ranging from the 1870s to the 1940s. In some instances, a collapsed building or foundation marked the site of a structure at the time of recording, but in most cases the presence of fruit trees, clearings, and other landscape features was the only evidence remaining. Since these sites were first recorded in the late 1970s and 80s, it is likely that further deterioration or complete obliteration has occurred. At least two of the homestead sites occur on land originally allotted to Nisqually Indian Tribal members. While most of the sites have not been evaluated, two of the homesteads have been determined ineligible to the NRHP.

Other historical structures recorded within the study area include: the Indian Agency Headquarters dating to 1859, an old Boy Scout Camp structure, a gas station, and a structure of unknown function which may have been constructed and utilized by the U.S. Army. Of the four, both the Boy Scout Camp structure and gas station have been determined ineligible, and the others have not been evaluated. Foundations of four historic bridges and/or trestles, two of which date from the 1930s, have also been recorded. At least two of the bridges have been completely destroyed.

3.8 Socioeconomics

This section provides an overview of the local demographic, land use, and economic setting in the vicinity of the Nisqually River delta and watershed, with emphasis on issues specific to inform comprehensive conservation planning efforts. The study area includes the lower Nisqually River Valley, including the delta. Socioeconomic data for both Pierce and Thurston counties are cited in this section.

3.8.1 Socioeconomic Setting

Nisqually NWR is located in south Puget Sound, straddling the Pierce and Thurston County border and within easy driving distance of approximately 4 million residents. The Seattle metropolitan area is the largest population concentration nearby, located roughly 50 miles to the northeast. Other large populations reside in the vicinity of Tacoma, 20 miles to the northeast, and Olympia, 10 miles to the west. All of these urban areas are provided an easy access to the Refuge via I-5.

Government provides the greatest share of employment in the vicinity of the Refuge. Olympia, the State Capitol, is the nearest major employment center to the Refuge. Fort Lewis, a major Army installation, is located adjacent to and northeast of the Refuge. The major private sector employers in Thurston County include St. Peter Hospital, Capital Medical Center, Group Health, Crown Cork & Seal, Miller Brewing Company, and CNC Corporation (Thurston County Economic Development Council 2001). The nearest major Pierce County employers are Intel and State Farm Insurance, both located in the nearby City of DuPont.

3.8.1.1 Population and Demographics

The population of Washington State has grown by 1.3 million since 1985, from 4.7 million to 6 million residents in 1999. Forecasters expect this figure to rise to approximately 6.5 million by the year 2005 (Office of Financial Management [OFM] 2001). The Puget Sound region, consisting of Pierce, Kitsap, King, and Snohomish counties, contains the largest population concentration in the state, with an estimated 1999 population of 3,125,200. This figure has increased by 441,130 new residents since 1990, an annual average increase of 1.8% (Thurston County Regional Planning Council 2000; Puget Sound Regional Council [PSRC] 2000). Consistent with regional trends, urban growth and resulting population pressures in the area surrounding the Refuge have expanded dramatically over the last 50 years.

The population of the Puget Sound region is expected to grow by 30% in the next 15 years (White 1997). Table 3.8-1 shows the 1999 estimated population and growth projections for the areas surrounding Nisqually NWR, including both Thurston and Pierce counties and the nearest local communities of Lacey (including Hawks Prairie) to the west and DuPont to the east.

Table 3.8-1. Local Population Trends.			
Locality	Estimated population 1999	Anticipated Population, 2020	Percent Growth
Thurston County	202,700***	296734	46
Olympia	40,210**	54020	34
Lacey	29,020**	45760	57
Hawks Prairie	3000	12250	398
Pierce County	700,000**	848610	23
Lakewood	63,790*	81,290****	27
Tacoma	187,200*	249,000*****	33
City of DuPont	1,755***	No Estimate	Unknown
Fort Lewis Military Reservation and McChord AFB	46438	No Estimate	Unknown
Sources: *PSRC (2000) **Thurston County (2001) ***OFM (2000) ****City of Lakewood 2000 (Note: projection for 2017 not 2020) *****GLUP, Adopted 12/11/2001 P. 58, Pers. Comm, Dana Brown, Urban Planner, City of Tacoma (Note: projection for 2017 not 2020)			

Thurston County

Thurston County has consistently exceeded the State's overall rate of growth since the 1960s and remains one of the fastest-growing counties in the state. Thurston County's 2000 population was estimated to be 204,300, having increased on average by 2.4% per year since 1990 (Thurston Regional Planning Council 2000), representing a 27% growth between 1990 and 1999 (DoA 2002). Thurston County's population is split between incorporated jurisdictions and unincorporated areas of the county. The county's seven incorporated cities have a combined population of 88,950, while the remaining (unincorporated) parts of the county have 115,350 residents. Lacey, the second largest city in the county with an estimated 2000 population of 29,240, lies to the west of Nisqually NWR. Since 1990, Lacey has averaged the fastest population growth rate of any large community in the county at 4.3% (Thurston Regional Planning Council 2000).

The community of Hawks Prairie, a portion of the City of Lacey located largely within the McAllister Creek basin to the west of Nisqually NWR, had a 1999 estimated population of 3,000. The population within Hawks Prairie is estimated to climb significantly to 12,250 by the year 2020 (V. Tabbutt, pers. comm.).

In 1997, Caucasians made up about 90% of the county's population, with 5.5% of the population comprised of Asians and Pacific Islanders. The African American population constitutes 2.5% of Thurston County, and the Indian/Eskimo/Aleut population is less than 2% of the Thurston County population (Thurston Regional Planning Council 1998).

Pierce County

Pierce County is the second-most populated county in Washington State (Thurston Regional Planning Council 2000). In 1990, 57% of the county's population lived in unincorporated areas (Pierce County Public Works and Utilities 1997). Pierce County's 1999 population was estimated at approximately 700,000 residents. This number is forecasted to grow by 21% over the next two decades to reach approximately 848,610 by 2020 population (National Association of Counties 2000).

The cities of Tacoma and Lakewood contain the largest concentrations of Pierce County's current population. Pierce County is also home to two sizable military installations, the Army's Fort Lewis Military Reservation and McChord AFB.

Fort Lewis supports 16,870 troops plus nearly an equal number of military dependants. Of these, 9,308 military personnel plus 9,192 dependants live on post, with the remainder residing in adjacent communities. In addition, 4,920 local civilians are employed by Fort Lewis. The Army expects to add 1,500 additional troops by the year 2003, many of whom will be accompanied by dependants (CH2M Hill 2001).

The population of McChord AFB includes 3,631 active duty personnel and 2,514 reserves. Of these, 1,441 live on base along with 1,669 out of a total of 4,547 dependants. In addition, 2,310 civilians are employed at McChord AFB (S. Eggman, pers. comm.).

No population growth estimates were available for Fort Lewis Military Reservation or McChord Air Force Base (AFB).

The City of DuPont lies in Pierce County to the east of the Nisqually delta. In 1992, the City of DuPont had a population of 600 people. This figure increased to an estimated 1,755 residents by 1999. By 2025, DuPont is expected to reach a population level of 10,994 people (OFM 2000). A significant component of DuPont's population and employment growth is located within a planned unit development currently under construction by the Weyerhaeuser Real Estate Company called Northwest Landing. Northwest Landing is particularly relevant to the Nisqually NWR because portions of the Northwest Landing abut the Nisqually NWR and are visible from many places on the delta. Completed portions of the 3,000-acre project currently accommodate approximately 2,000 residents. At full build-out in 2010, the project may grow to 11,000 residents and 20,000 jobs (Martinson, pers. comm.).

In 1998, almost 80% of Pierce County's population was Caucasian. African Americans comprised the largest minority population, making up approximately 7% of the population; Asians and Pacific Islanders comprised 6% of the population, with a variety of minorities comprising the remainder (National Association of Counties 2000).

3.8.1.2 Employment and Income

Thurston County

The Thurston County economy is primarily supported by employment by the State government, headquartered in Olympia. In addition to providing the largest share of the county's jobs, the government sector also provides the highest average wage.

The real (adjusted to account for inflation in 1998 dollars) per-capita income was \$28,443 in 1998 (Thurston Regional Planning Council 2000). In 1998, 48.1% of wages and 39.3% of employees were based in the government sector. Also in 1998, the service industry was responsible for roughly 23% of employees and 20% of wages. Retail trade was responsible for just under 20% of employees and about 10% of wages. Manufacturing, construction, agriculture, forestry, fishing, transportation, and wholesale covered about 17% of employment and wages. In total, 4.6% of the county's labor force (4,600 workers) were unemployed in 1999, slightly lower than the statewide average of 4.7% (Thurston Regional Planning Council 2000).

Pierce County

The Pierce County economy is primarily supported by employment in the Fort Lewis-McChord AFB military complex, the City of Tacoma, local manufacturing in Tacoma, and aerospace-related industries. The largest employment sectors include services, government, and retail trade. The three largest individual private employers are all hospitals (Tacoma-Pierce County 2001).

The closest major employers to Nisqually NWR are Intel and State Farm Insurance, which both maintain large campuses in DuPont's Northwest Landing with a combined total of approximately 2,750 employees (Northwest Landing 2001). Employment within the Nisqually River Valley itself primarily includes education, retail trade, government, tourist services, agriculture, and forest production and harvesting (Pacific Coast Joint Venture 1996; Consoer et al. 1974).

In 1998, real Pierce County per capita income was estimated to be \$27,493 (Tacoma-Pierce County 2001). The largest employers were in the services sector (27%); Federal, State, and local government (21%); and retail trade (20%). Manufacturing, construction, real estate, agriculture, forestry, and other services in the industrial sector comprised approximately 25%, with the remaining 7% employed in other sectors. In 1999, Pierce County had a resident civilian unemployment rate of 4% (Tacoma-Pierce County 2001).

3.8.1.3 Transportation Patterns

The major transportation corridor providing access to Nisqually NWR is I-5, a major interstate highway linking many cities and major destinations in western Washington. I-5 provides convenient, direct access to Refuge lands at the Nisqually Interchange, Exit 114. In 2000, the Washington Department of Transportation (DOT) estimated traffic flow past Exit 114 at approximately 72,400 trips west of Exit 114 per day and 79,700 vehicles per day east of the Nisqually exit. In 1999, average daily flow of traffic was more than twice what it was in 1976. Peak traffic can reach as high as 132,000 vehicles per day (R. Decker, pers. comm.). Ramp

counts of vehicles using Exit 114 were 1,550 westbound vehicles entering the freeway per day. Daily counts of vehicles exiting the freeway and Exit 114 averaged 1,450 and 5,100 westbound and eastbound, respectively. Three-fourths of the residents of Pierce County who commuted to Olympia or elsewhere in Thurston County passed the Refuge to and from work (PSRC 1993).

3.8.2 Environmental Justice

In February 1994, President Clinton issued Executive Order 12898, requiring that all Federal agencies seek to achieve environmental justice by “identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Executive Order 12898). Environmental justice is defined as the “fair treatment for people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies.”

The U.S. Department of Housing and Urban Development (HUD) defines low income as 80% of the median family income for the area, subject to adjustment for areas with unusually high or low incomes or housing costs. The 1999 estimated median family income was \$43,475 in Thurston County and \$43,624 in Pierce County, respectively. This compares with an estimated state-wide median income of \$48,289 (OFM 2001). Since median family incomes for both counties were approximately 90% of the state median family income, neither county would be classified as low income. Caucasians made up about 90% of Thurston County’s population and 80% of Pierce County’s population in 1997 and 1998, respectively. Significant minority populations included Asians and Pacific Islanders and African Americans (National Association of Counties 2000).

The 400-member Nisqually Indian Tribe’s reservation is located within the Nisqually River Valley, making the tribe the minority group most affected by the CCP alternatives. In addition to the tribe’s reservation, there are numerous parcels of Nisqually Trust land in the Valley, as well as the newly acquired 325-acre Braget parcel which is located within the Refuge.

3.8.3 Land Use

This section presents an overview of land uses within the study area. Because the Refuge straddles the boundaries of both Pierce and Thurston counties, the land use practices and regulations of both counties are presented. This section also emphasizes the lands comprising the Nisqually delta, especially special status lands within the study area such as the site’s National Natural Landmark designation, Research Natural Area, Nisqually Public Use Natural Area, Shoreline of Statewide Significance, and National Recreation Trail.

3.8.3.1 General Land Use and Management

Historically, the Nisqually delta supported a variety of land uses, including subsistence hunting and gathering, logging, commercial shipping, recreational and commercial fish and shellfish harvesting, and agriculture (Burg 1984). Today, low density residential and agriculture constitute the prevailing land uses surrounding the Refuge (Thurston County Dept. of Water and Waste Management 1993). The Refuge itself provides open space and quality wildlife habitat and

wildlife-dependent recreation and education to an expanding regional population (Pacific Coast Joint Venture 1986).

Growing demand for residential, commercial, and industrial land poses continuing threats to natural resource areas, including estuaries, freshwater wetlands, and agriculture (Klein and Reganold 1997). In 1990, Thurston County adopted an ordinance that allows development on rural lands to a density of 1 dwelling unit per 5 acres. In 1992, the Thurston County Planning Department created the Nisqually Planning Area south of I-5 to protect the Refuge from adjacent developments. The boundaries of this area, shown on Thurston County planning maps as the “Heart of the Valley,” fall within the CCP Study Area south of I-5 (OFM 2000). To maintain the existing rural environment of the Nisqually River Valley, agricultural lands in this area became part of Thurston County’s Purchase of Development Rights (PDR) program since 1994 (Thurston County Planning Department 1992). The PDR program permanently preserves farmland while supporting the farming community. The PDR program is administered by Thurston County using perpetual conservation easements attached to each deed. Within the 840 acres of PDR properties, agricultural uses would continue. These can include growing, raising, and producing horticultural and agricultural crops, as well as the processing and marketing of these products. Other uses include raising, processing, and marketing of animals and the lying fallow or disuse of the land. Structures allowed can include residences, barns, machine sheds, permanent greenhouses and associated structures, retail and processing facilities, surfaced parking areas, surfaced driveways, surfaced roadways, and surfaced pads. Non-tillable surfaces can include asphalt, concrete, gravel, and any other material not normally associated with soil cultivation. Structure placement and non-tillable surfaces could occur on up to 5% of any parcel or lot and result in approximately 44 acres being removed as potential wildlife habitat.

Pierce County has a similar PDR program called “Conservation Futures,” administered by the Pierce County Parks program. Conservation Futures is a land preservation program for the protection of threatened areas of open space, timber lands, wetlands, habitat areas, and agricultural lands within the boundaries of Pierce County. Conservation Futures funds are used to acquire the land or the rights to future development of the land (Pierce County 2001).

Consistent with State Growth Management Act (GMA) and County planning requirements, population growth in Washington is directed within incorporated cities and designated urban growth areas. The City of Lacey’s urban growth area (UGA) is just west of the Nisqually Valley. Since 1995, a number of new homes have been constructed along the eastern edge of the UGA, close to the edge of the plateau which overlooks the Nisqually Valley (Thurston Regional Planning Council 2000). New single-family home construction activity is also occurring within the Nisqually Valley south of the Refuge both on and in the vicinity of the Nisqually Indian Reservation.

Under Thurston County’s Nisqually Sub-Area Plan (Thurston County Planning Department 1992), much of the land in the Nisqually Valley is zoned Rural Residential in recognition of the limited water supply, and agricultural and delta resources of the valley. The Refuge itself is

designated Public Reserve in the Sub-Area Plan. In general, land zoned Rural Residential may be developed for single-family housing with development densities of up to 1 dwelling unit per 5 acres.

The portion of the Nisqually River Valley referred to above as “the Heart of the Valley” is protected with a special zoning designation of Nisqually Agriculture (NA). Agricultural activities, including logging and other forestry practices, are the primary uses within this zone. Housing and other development are permitted, but only ancillary to agriculture. The development standards mandated by this zone are unique to the Nisqually Planning Area, and this zone is applied to those lands within the Nisqually Planning Area that: (1) contain large farms on primary agricultural soil, (2) have been farmed for several generations, or (3) are enrolled in or eligible for enrollment in the Agricultural Open Space Tax Program (Thurston County 2001).

Some local jurisdictions are actively preserving their natural heritage. The City of DuPont, for example, has identified 22% of the land area as open space to protect wetlands, steep slopes, buffers, and other areas, including an oak savannah habitat (P. Clarke, pers. comm.).

Major land uses on Fort Lewis properties include cantonment, range, and training areas. Effect areas such as artillery ranges are surrounded by buffer areas to prevent noise and safety effects to surrounding areas. Fort Lewis lands between the bluff and the Nisqually River buffer the range, located on the prairie above the bluff. At this time, the range is expected to remain operational for the foreseeable future; the Army expects to continue to rely on its holdings between the range and the river as an un-populated buffer area (W. Vanhoesen, pers. comm.).

3.8.3.2 Special Status Lands

The Service manages several areas on the Refuge that fall under special designations. These are shown in Figure 3.8-1 and described below.

National Natural Landmark Designation

The Nisqually delta was added to the National Park Service’s Registry of Natural Landmarks in March 1971 (Boyer 1993). The designation was based on its significance as one of the best examples of a nationally representative river delta and estuarine ecosystem (Washington State Game Department 1971; USFWS 1978). The delta supports one of the five highest quality known examples of Washington and Oregon salt marshes (Friedman 1987).

The designated 2,765-acre landmark includes public and private ownerships of land, including lands of the National Audubon Society and WDFW. The 1,000 acres of diked Refuge lands are not included in the designation. The landmark status holds no legal obligations; however, the Service has a resource management responsibility for high quality habitat types, as recognized in the Landmarks Program (USFWS 1978).

Research Natural Area

Located at the mouth of the Nisqually River, the 837-acre Nisqually delta RNA was established by the Service in 1989 (Caicco 1989b). RNA objectives are limited to: (1) preserving and protecting the delta as a significant natural ecosystem; (2) serving as a gene pool for the preservation of native and endangered species; and (3) providing educational and research areas for the study of scientific aspects, including successional trends. Management activities that modify or alter natural ecological processes, including consumptive uses, are not allowed in RNAs (CH2M Hill et al. 1978; USFWS 1981). The Nisqually RNA boundaries are as follows: the east boundary of the RNA runs along the border of the East Bluff; the north boundary runs along the Nisqually Reach; and the west boundary runs along the Thurston-Pierce County line. The southern boundary generally runs east-west from the top (northernmost section) of the Brown Farm Dike across to the East Bluff.

A candidate RNA on Fort Lewis property is located in the Nisqually floodplain, along the eastern bank of the river, partially within the CCP Study Area. The boundaries of this Nisqually Floodplain Candidate RNA include the Nisqually River to the west, the top of the Seventh Infantry Bluff to the east, I-5 to the north, and the confluence of Muck Creek and the Nisqually River to the south. This area is representative of a low elevation stream and riparian system in the Puget Trough. Nearly all of the original low elevation riparian systems in the Puget Trough have been converted to agriculture or have been altered for development. The Nisqually Floodplain Candidate RNA is the largest remaining example of such a system in this physiographic province. This riparian system has statewide significance. Contained within the upland bluffs rising from the river valley, old river channels, oxbows, and other hydrogeomorphic features illustrate the dynamic processes of a low elevation riparian floodplain system. The mosaic of vegetation communities found within the floodplain supports rich and varied wildlife use.

Nisqually Public Use Natural Area

Forty acres of the Nisqually River surge plain in the Refuge were designated as a Public Use Natural Area (PUNA) in 1990 (Caicco 1989a). PUNAs are designated by the Service to ensure the preservation of significant Refuge natural areas through restricted public access (USFWS 1981). Permitted public use activities are hiking, birdwatching, and fishing. The high quality freshwater surge plain includes a forested riparian area with a dense shrub layer along the west bank of the Nisqually River. The river is influenced by tidal waters from Puget Sound (Kunze 1984; Caicco 1989a). During high tides and floods, overflow in tidal channels carries fresh and slightly brackish water into and over the wetland area (Caicco 1989a).

Shoreline of Statewide Significance

In 1976, the Thurston County Shoreline Master Program designated the Nisqually Reach and River, from Alder Lake to Puget Sound, as shorelines of statewide significance (Giebelhaus 1998). The program segments the shoreline into different designations to regulate development (Thurston County Planning Department 1992; see F,S,L Policies, Plans and Zoning section).

Figure 3.8-1. Special Designated Areas

Back of Figure 3.8-1

Shoreline regulatory criteria protect water quality, aquatic habitats and public health, and public access, which preserve or enhance shoreline characteristics that existed prior to public access, and require preservation of aesthetic, scenic, historic, or ecological qualities (Thurston Regional Planning Council 1990).

National Recreation Trail

The Brown Farm Dike was designated as a National Recreation Trail in 1981 (Boyer 1993) as a result of the National Trails System Act of 1968. National recreation trails provide for a variety of outdoor uses in or near urban areas. The 5½-mile dike trail designation allows for appropriate public uses on Service lands. The Service retains full latitude to control or restrict public use of the Brown Farm Dike in favor of wildlife resources (Waddell 1981; Watt 1981; Heritage Conservation and Recreation Service no date).

3.8.4 Refuge Management Economics

The existing Refuge staff consists of eight permanent and two temporary employees who account for an annual payroll (including salaries and benefits) of approximately \$380,000. Seventy trained volunteers are part of the Refuge's volunteer program. In 1999, volunteers contributed 8,000 hours assisting with the public use and biology programs, and maintenance and administration of the Refuge. Training for new volunteers is conducted once a year.

In addition to providing salaries and benefits, the Refuge purchased goods and services totaling approximately \$948,000 in 1999, approximately 70% of which was spent in Thurston County. Some of these expenditures (e.g., for flood damage restoration and maintenance management system projects) were one-time costs and are not expected to be repeated. The baseline non-salary costs of Refuge management were estimated at approximately \$197,000 per year, mostly for operations and maintenance activities. Approximately 30% of these purchases involve wildlife- and habitat-related projects, with the remaining 70% involving public use-related projects.

National Wildlife Refuges contribute funds to local counties through two revenue sharing programs, one that applies to Refuge lands reserved from the public domain, and one that applies to lands purchased in fee title. The majority of lands comprising the Refuge are held by the Service in fee title. For fee lands, the Federal government typically pays the counties up to 0.075% of the appraised value of the land each year out of the Refuge Revenue Sharing Fund. In 1999, for example, the Federal government paid \$2,613 to Pierce County and \$18,167 to Thurston County.

3.8.5 Area Recreation Sector

In 1996, 45% of Washington State's adults age 16 and older participated in outdoor recreational activities that included some form of hunting, fishing, or wildlife-watching. Thirty-nine percent of Washington State's adults participated in wildlife-watching. Additionally, in 1996 almost \$3 billion was spent on wildlife-associated recreation in Washington, and over \$1.6 billion of the \$3 billion was spent on wildlife-watching. Consumer spending for wildlife-watching has a

significant effect on local, state, and national economic activity and employment. Wildlife-watching can directly benefit the local economies around the Nisqually Valley. Benefits can be derived through sales of food, lodging, and transportation, as well as through expenditures such as binoculars, cameras, books, wild bird food, and touring vehicles (Gibilisco and Filipek 1998). The increasing economic benefits from wildlife-associated uses create a compelling need for greater conservation of the delta's natural resources, which help generate these funds.

3.8.5.1 Thurston County

Thurston County Parks and Recreation developed a full range of recreation opportunities to support the recreation needs of its residents. Thurston County provides many cultural, historic, natural, passive interpretive, and other recreation opportunities. County Natural Area Preserves focus on preserving natural areas (Thurston County Parks and Recreation Department 1996).

Thurston County policy is to acquire land and develop its resources to support the leisure activities of residents and visitors. Along with State and Federal lands, Thurston County is establishing a coordinated approach to recreation services with the cities of Olympia, Lacey, and Tumwater. These cities maintain approximately 1,222 acres of park lands. Rural Thurston County cities maintain an additional 80 acres of park lands (Thurston County Parks and Recreation Department 1996).

In 1996, the Thurston County Parks and Recreation Department had a total land inventory of 2,595 acres of park lands, recreation lands, trails, and open space preserves. Twenty-one Thurston County parks include six natural area preserves and 23 miles of trails. Sixteen parks have freshwater and saltwater access. Roughly 7½ miles (39,580 feet) of freshwater waterfront can be accessed, as well as over ½ mile (3,296 feet) of saltwater access (Thurston County Parks and Recreation Department 1996). Trail systems, such as the Chehalis Western Trail (southwest of Nisqually NWR) and the Yelm-Tenino Trail (south of Nisqually NWR), provide a regional system of trails for walking, bicycle, equestrian, and hiking use (Thurston County Parks and Recreation Department 1996).

The Nisqually Sub-Area Land Use Plan recommends that the Thurston County Public Works and the Thurston County Parks and Recreation departments work together with DOT, the City of Olympia, and local bicycle clubs to locate park and bike locations at areas such as the Nisqually Interchange, McAllister Springs, Old Nisqually, and the Nisqually Tribal Center. South of McAllister Springs, State Route 510 has an improved bike lane adjacent to the travel lane (Thurston County Planning Department 1992). The Thurston Regional Transportation Plan recommends that bike lanes be constructed with all future road projects of regional significance (Thurston Regional Planning Council 1997).

3.8.5.2 Pierce County

The Pierce County Parks Department maintains over 2,000 acres at over 30 park sites, including two recreation centers, five boat launch sites, trail corridors, and a large variety of passive and active facilities (Pierce County 2001). Pierce County also offers a number of outdoor recreation opportunities. The Foothills Trail is a planned 25-mile trail initiated in 1991 for non-motorized

users. The trail parallels the Puyallup River from McMillin to Carbonado. Four trail sections of over 8 miles are open to the public. Popular bicycle trails include a 7-mile trail at Fort Steilacoom Park and a 3-mile Breseman Forest trail system at Spanaway Park. Other shorter trails for non-motorized users can be found at Seeley Lake Park, the wooded Chambers Creek Trail, Sunrise Beach Park, and Lake Tapps Park. Waterfront sites can be found at Half Dollar Park, Orangeate, Parkland Habitat, Rimrock Park, Riverside Park, South Hill Park, Swan Creek Park, and Wilkeson Creek Park (Pierce County 2001). The Pierce County growth management plan also lists a trail in the planning stage from Nisqually NWR to Mount Rainier.

A goal of the 1995 DuPont Comprehensive Plan is to develop a system of parks and open spaces that provides for passive and active outdoor recreation, preserves cultural and archeological sites, and protects unique physical features. Preservation of oak savannah habitat with limited trails and buffering and providing trails around creeks and wetlands are policies of the plan. A pedestrian trail system is recommended to enhance public enjoyment of natural areas, historic and cultural sites, and scenic views (McConnell/Burke et al. 1995).

3.8.5.3 Nisqually NWR

More than 100,000 people per year visit the Refuge to participate in a variety of wildlife-dependent recreational and educational activities. These include wildlife observation, photography, interpretation, environmental education, and fishing. These visits include approximately 5,000 students and teachers from King, Pierce, Thurston, and Mason counties who visit the Refuge to participate in the environmental education program.

Located adjacent to a major interstate highway, Nisqually NWR is also likely to continue to serve as a secondary destination for visitors en route to better known recreation destinations such as Mount St. Helens National Volcanic Monument and Mount Rainier, North Cascades, and Olympic National Parks.

3.8.6 Agricultural Sector

Approximately 1,108 acres of agricultural lands are located within the CCP Study Area. The principal crops grown in this area that represent the majority of economic activity include hay, corn, and Christmas tree farms. Agricultural uses in Thurston County cover 56,000 acres and produced \$36 million worth of farm products in 1997 (Thurston Regional Planning Council 2000). The Nisqually River Management Plan (Nisqually River Task Force 1987) states that enhancement of the natural-resource-based economic sectors and supporting land uses should be preferred to others throughout the river valley.

Agriculture is expected to remain an important component of the south Puget Sound economy, but farmland is increasingly being subdivided and developed for other uses (Pacific Coast Joint Venture 1996). In Thurston County, farmland conversion to non-farm uses is often associated with increases in land values and property tax assessments. Environmental regulations requiring expensive and complex livestock waste management have also resulted in the reduction of land in dairy farms (Klein and Reganold 1997). Traditional local resource-based economies are expected to decline in the area, and commercial activities such as manufacturing, trade, and service-related

industries such as outdoor recreation and tourism will continue to grow and diversify (Pacific Coast Joint Venture 1996). The County has addressed this concern through its PDR program (see Section 3.8.3.1).

3.8.7 Commercial Shellfishing

At Nisqually NWR, shellfishing is allowed throughout tidal habitat, under State regulations. Research Natural Area closures are currently not being enforced.

Commercial shellfish growers in Thurston County marine waters use about 10,000 acres of commercial shellfish beds. More oysters are grown here than anywhere else in Puget Sound. Shellfish growers support the Puget Sound shellfish industry by producing about 120,000 gallons of oysters and 140,000 pounds of clams annually. Over ten million pounds of geoduck clams, worth \$60 million, are found subtidally (Thurston County Advance Planning and Historic Preservation 1994). However, commercial geoduck tracts in the Nisqually Reach have never been open because of seasonal pollution due to heavy rainfall events.

The commercial shellfish growing area incorporating 2,130 acres of the Nisqually Reach was downgraded in 1992 from “Approved” to “Conditionally Approved” by the State Health Department. On November 1, 2000, 74 of these acres near Luhr Beach were further downgraded to “Restricted” meaning no commercial shellfish harvest is allowed. Both downgrades were due to elevated levels of fecal coliform bacteria (S. Davis, pers. comm.). Operations for geoduck harvesting in the delta are being considered by the Nisqually Indian Tribe (Washington State Department of Health 1997).

Chapter 4. Environmental Consequences

This chapter identifies the effects of the four alternatives described in Chapter 2 (Table 4.0-1) on various aspects of the environment within the CCP Study Area. Alternatives under consideration could have effects on a wide range of existing Refuge characteristics. This chapter is organized similarly to the Affected Environment chapter. Effects of each alternative are described in three main action categories—Habitat Restoration, Refuge Expansion, and Public Use Program. Also see Table 4.9-1 at the end of the chapter for a summary of effects.

Alternative	Habitat Restoration	Refuge Expansion	Public Use Program
A	Minimal improvements within diked area	No Refuge expansion	Continue to provide limited environmental education (EE) program (5,000 students); no changes to trail system, hunting, or fishing access
B	318 acres muted estuarine and 140 acres full estuarine restoration, improved management of 542 acres freshwater wetlands	Proposed 2,407 acres of Refuge expansion along East Bluff and south of I-5	Greatly expand EE program (20,000 students), minor changes to trail system, hunt closure enforced, no changes to fishing access
C	515 acres of estuarine restoration, improved management of 447 acres of freshwater wetlands, 38 acres riparian restoration	Proposed 2,407 acres of Refuge expansion along East Bluff and south of I-5	Expand EE program (15,000 students), trail reduced to 3¼-mile loop and boardwalk trail, new eastside trail, new accessible fishing site at Luhr Beach and Nisqually River, 713 acres of Refuge open to hunting (with restrictions)
D	699 acres of estuarine restoration, improved management of 263 acres of freshwater wetlands, 38 acres riparian restoration	Proposed 3,479 acres of Refuge expansion along East Bluff, south of I-5 and Nisqually River corridor	Expand EE program (15,000 students), trail reduced to 3½-mile round-trip (with boardwalk in estuary), new eastside trail, new accessible fishing site at Luhr Beach and Nisqually River, 191 acres of Refuge open to hunting

4.1 Effects to the Physical Environment

4.1.1 Alternative A

4.1.1.1 Habitat Restoration

Effects to Hydrology

Under the No Action Alternative, no significant changes to hydrology are anticipated. The Nisqually River and McAllister Creek would continue to be contained by dikes in the delta, restricting the flow and natural movement of these waterways. Seepage of tidal waters through the dikes would continue until dikes are repaired.

Minimal changes in flood storage area would occur, and flooding frequency and duration would not be influenced. Extreme flood events could continue to result in a large surge of water into the diked area through two major overflow channels. Wetland hydrology within the diked area would remain as it is currently. Any changes would be similar to those that are currently taking place, as the invasive reed canary grass encroaches upon open water areas. Existing levels of groundwater use would continue. Some limited improvements in water management would occur as a result of water control structure replacement or installation.

Effects to Soils and Sediments

No significant changes to soils or sediments are anticipated. Sediment carried by the Nisqually River would continue to be deposited at the mouth of the river and in deeper portions of the Nisqually Reach, except during extreme flood events that flood the Refuge through overflow channels or breached dikes. Subsidence associated with diking and draining of organic (wetland) soils would continue as these soils decompose during dry periods. Extensive dike repairs would be necessary to strengthen the dike to retain the freshwater impoundment and prevent further dike failure. The dikes were further weakened by the magnitude 6.8 Nisqually Earthquake in February 2001, which created thousands of lineal feet of cracking on the surface of the dike and its slopes, and severely fractured a 500-foot section. Repairs may include topping or stripping the dike, installing erosion fabric on the outboard side of the dike, graveling or depositing fill along or on top of the dike, and filling seeps, among other measures. Some disturbance to existing soils or sedimentation due to construction or added fill would occur during dike repair.

Effects to Geology

The only effect to geology anticipated under Alternative A is the possibility of increased erosion of the bluffs that flank the east and west side of the Refuge. While bluff erosion is a natural process throughout Puget Sound, development of homes along the edges of bluffs and the removal of trees and other vegetation by property owners seeking to improve their view often accelerate this process (Menashe 1993).

Effects to Water Quality and Salinity

Alternative A would cause little direct change to water quality or salinity parameters. Water chemistry, temperature, and risk of contaminant release would remain unchanged. Some localized, short-term effects might occur associated with dike repairs. Water quality would continue to decrease in the summer months within the diked area due to lack of water circulation, particularly in the borrow ditch. Indirect benefits to water quality would occur if efforts to strengthen watershed protection through partnerships outside of the Refuge boundary were successful.

Effects to Air Quality

No significant changes in air quality are anticipated with Alternative A. Factors that could affect air quality, such as construction and traffic, would not change from current conditions.

4.1.1.2 Refuge Expansion

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

Other than the completion of the existing approved Refuge boundary, there is no Refuge expansion proposed in this alternative. There are no effects anticipated to hydrology, soils and sediments, geology, water quality, salinity, or air quality that are different than that described above in the Habitat Restoration section.

4.1.1.3 Public Use Program

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

There are limited changes to the public use program in Alternative A; therefore, no major consequent changes are anticipated to hydrology, soils and sediments, geology, water quality, salinity, or air quality. Extensive dike repairs would be necessary to strengthen the dike that supports the 5½-mile Brown Farm Dike Trail. Potential effects associated with dike repair would be the same as described above in the Habitat Restoration section. A primitive loop trail would be established in the surge plain forest in this alternative to replace a trail lost during the 1996 flood. It would be minimally maintained, so no gravel or other fill would be added to this tidal habitat. Effects on hydrology, soils or sediments, or water quality should be minimal from trail use. Boat and PWC use on the Refuge would continue to be a source of gas and oil pollution in the water. Erosion of salt marsh areas caused from wakes created by boat and PWC use in shallow areas would also continue. Bank fishing and shellfishing may have some effects on soils due to foot traffic and digging in the mudflats. Motorized boat wakes and propellers would continue to cause some amount of soil disturbance in tidal areas.

4.1.2 Alternative B

4.1.2.1 Habitat Restoration

Effects to Hydrology

Under Alternative B, more intensive management of freshwater wetland habitats inside the diked area would increase groundwater use, as greater volumes of water are withdrawn to control reed canary grass. Changes in wetland hydrology within management units would include creation of impoundments and more intensive water level management, and these areas would be wetter for longer periods during the year. Other effects to wetland hydrology would be associated with estuarine habitat restoration and associated changes from seasonally to semipermanently flooded freshwater (palustrine) wetlands (see Figure 3.2-2) to regularly flooded estuarine (tidal) conditions. Areas that would be restored to muted tidal influence may retain more water for a longer period of time than those fully restored areas where dikes have been removed, particularly in borrow ditches and lower elevations (Appendix J, Hydrodynamic and Sediment Transport Modeling Summary [ENSR 1999]). While there would be an increase in the flood storage area of the lower Nisqually River, no measurable upstream flood relief benefits are expected (ENSR 1999). Extreme flood events would continue to result in a large surge of water into the diked area through two major overflow channels.

Effects to Soils and Sediments

Alternative B would have little effect on sediment deposition. Dikes along the river would continue to direct river-borne sediments out toward the delta. Deposition rates would be very low in breached areas, even during flood events when sedimentation is higher, because of the limited direct hydrological exchange between the restored area and the Nisqually River, the primary source of sediment (ENSR 1999). High volumes of water draining through breaches may lead to water velocities capable of eroding existing sediments outside the dike during ebb tides (ENSR 1999). Bridged breaches would need to be stabilized through the use of riprap and wing walls to prevent erosion or widening of the breaches. Some effects on soils and sedimentation are expected as a result of dike removal and construction. Filling the borrow ditches, adding new fill material for exterior and interior dikes, and repair of existing dikes would cause soil disturbance during and after construction, until soils have stabilized. Extensive dike repairs would be necessary to strengthen the existing dike to retain the freshwater impoundment and prevent further dike failure (see Alternative A). Repairs would cause some disturbance to existing soils, or sedimentation due to added fill until soils stabilized.

Based on comparison of topographic elevations inside and outside the diked area, subsidence has occurred inside the diked area. This observation is consistent with other diked areas, where marsh surface elevations began to increase following dike breach restoration (Mitchell 1981; Frenkel and Morlan 1990). Restoration of tidal influence arrests oxidation of organic soils and associated subsidence. Sediment accretion also increases estuarine habitat elevations. In intertidal areas with elevations sufficiently high to support salt marsh vegetation, organic soils would slowly begin to rebuild, reversing the effects of subsidence over time. However, sediment

accretion would be limited in the muted tidal area because of limited breaches and the continued presence of dikes (ENSR 1999).

Intensified management within the diked area would include discing and sculpting to improve freshwater wetlands and grasslands. These activities may have short-term effects on soils and sedimentation. Timing, extent, contouring, and reseeded would be designed to minimize erosion and sediments in runoff.

Effects to Geology

Action Alternatives (B, C, and D) include expansion of Refuge holdings along valley bluffs, especially on the east side. Protection and revegetation of these areas may cause bluff erosion rates to stabilize.

Effects to Water Quality and Salinity

Alternative B would have little if any effect on the distribution of environmental contaminants. Two areas of potential concern, the orchard and Twin Barns (Momot 1993), would remain largely undisturbed. Some short-term effects to water quality are expected; specifically, biological oxygen demand (BOD) would increase locally from the die back and export of decaying plant matter (reed canary grass) as a result of tidal restoration. Intensified management within the diked area would include the limited use of fertilizer in the haying program. Timing and amount would be designed to minimize movement of nutrients into runoff.

In areas where tidal inundation is restored by dike removal, significant salinity concentrations are expected. However, the presence of dikes with breaches would permit saline waters to enter the restored area only at certain locations, affecting the overall pattern of saltwater influence. In places where salinity is reintroduced, soil salinity (pore water salinity) would increase, changing soil characteristics and associated flora (Frenkel and Morlan 1990).

Effects to Air Quality

Action alternatives (Alternatives B, C, and D) may result in minor effects to air quality from heavy equipment operation during dike breaching and removal. These activities may lead to local, short-term effects associated with fugitive dust and engine exhaust.

4.1.2.2 Refuge Expansion

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

Moderate expansion of the Refuge boundary would benefit some of these physical factors. Refuge expansion could potentially protect and restore lands that would otherwise be developed for residential or commercial development or that would not be restored. Additional protection of areas along the East Bluff north of I-5 would prevent accelerated bluff erosion caused by development. Retaining more of this bluff habitat in a natural, vegetated condition may improve

water quality in wetlands and waterways by reducing sedimentation and nonpoint source contamination from stormwater and runoff from adjacent developments and roadways. Areas that have been logged on the East Bluff would be reforested, improving watershed protection. Similar benefits would be gained by stronger protections for bluff habitats south of I-5.

Refuge expansion south of I-5 could lead to freshwater wetland protection and restoration, which may benefit hydrology and water quality. Wetland areas store flood waters and help maintain water quality by trapping sediments and removing excess nutrients. Air quality may decline if residential and commercial development increases in the study area, as effects associated with increased traffic, industrial development, and other pollutant sources such as wood stoves increase. Refuge expansion would reduce this possibility. However, only limited benefits would occur along the Nisqually River corridor south of I-5 since only a small area would be included. In addition, approximately 386 acres within the Nisqually Valley could not be provided further protection from development and gravel mining in comparison to Alternative D, which would negatively affect some of these physical factors.

4.1.2.3 Public Use Program

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

Changes in the public use program under Alternative B are not expected to cause large changes in hydrology, soils and sediments, geology, water quality, salinity, or air quality. Minor changes in the trail system would still require extensive dike repairs, as described in Alternative A, since a large proportion of the existing dike would remain to support the Brown Farm Dike Trail. Some disturbance to existing soils, sedimentation, or added fill may occur during dike repairs and construction of new interior dikes for the freshwater units. New study sites established for the enlarged environmental education program would produce localized areas of soil compaction from foot traffic, but locations would be selected to minimize effects.

Effects from bank and shellfishing would be similar to Alternative A. Differences would be in the enforcement of closures to consumptive uses in the RNA and hunting on Refuge lands. These closures would reduce foot, boat, and PWC traffic in mudflats and salt marsh areas and reduce gas and oil pollution in the water. Motorized boat wakes and propellers would continue to cause some amount of soil disturbance in tidal areas, although it would be reduced in the RNA due to winter and consumptive use closures and throughout the Refuge by boat speed restrictions. In addition, a new bank fishing area would be developed in the Trotter's Woods area, if acquired. Some effects on soils would occur from vehicle parking areas and foot traffic, but these would be expected to be less than current conditions because of planned improvements in access, including controlling vehicle use.

4.1.3 Alternative C

4.1.3.1 Habitat Restoration

Effects to Hydrology

Many of the changes in hydrology would be similar to those described under Alternative B, with the largest difference being the restoration of 515 acres to full tidal influence through the removal of dikes. The Nisqually River would be allowed to move more freely, overtopping its banks or changing course in areas where dikes are lowered to grade. The restored area would have a more direct hydrological connection to the Nisqually River and McAllister Creek than in Alternative B. Dikes would be removed to grade, and borrow ditches would be filled in the restored area; therefore, water retention during ebb tide would not occur as it would under Alternative B.

Hydrological changes in the area retained within dikes would be similar to those for Alternative B, except that the impounded area would be smaller and would contain five interior management units instead of five, with less overall storage capability. Extreme flood events would continue to result in a large surge of water in the remaining diked area through two major overflow channels. Water control structures, spillways, or pumps would be needed to reduce flooding more quickly within the dikes.

Effects to Soils and Sediments

Decrease in soil oxidation and associated subsidence would occur as described under Alternative B. Differences in effects between Alternatives B and C are largely associated with the difference in how tidal influence would be restored. Filling the borrow ditches, adding fill material to construct new exterior and interior dikes, and repairing existing dikes would cause soil disturbance during and after construction, until soils have stabilized. Alternative C would require less repair and maintenance of existing dikes than Alternative B.

Alternative C would lead to the removal of the dike along the west side of the Nisqually River and north of the Twin Barns area. This would allow for the river to discharge over a larger area, especially during flood events. Sediments carried by the river during floods would be deposited over a broader area, unlike Alternative B, and contribute directly to the restoration of estuarine habitats (ENSR 1999).

Intensified management within the diked area would include discing and sculpting to improve freshwater wetlands and grasslands, which may have short-term effects on soils and sedimentation. Timing, extent, and contouring would be designed to minimize erosion and sediments in runoff.

Effects to Geology

Alternative C includes the removal of the west bank river levee north of the Twin Barns. This would allow for the lower portion of the river channel to migrate naturally across the floodplain

and through the restored area. Changes in river channel location would alter patterns of river sediment deposition (ENSR 1999). No roads, buildings, or other infrastructure would be adversely affected if the Nisqually River changed its course in this portion of the study area.

Effects to Water Quality and Salinity

Alternative C would have no effect on environmental contaminants or short-term effects on BOD associated with export of decaying plant matter, as described for Alternative B. Additional effects on water quality parameters associated with these alternatives include potential water temperature decrease in the lower Nisqually River. Restoration of 38 acres of riparian habitat and improved protection of existing habitats may increase shading from vegetation cover with a corresponding reduction in water temperature. Intensified management within the diked area would include the limited use of fertilizer in the haying program, although the program would be reduced in area compared to Alternative B. Timing and amount would be designed to minimize movement of nutrients into runoff.

Alternative C does not include breached, bridged dikes but rather relies exclusively on the removal of the dike to grade. Therefore, salinity distribution patterns would be more typical of those associated with a natural estuarine system. Salinity distribution in turn affects soil and water salinity, soil characteristics, and the flora and fauna associated with estuarine habitats (Frenkel and Morlan 1990).

Air Quality

Same as Alternative B.

4.1.3.2 Refuge Expansion

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

Same as Alternative B.

4.1.3.3 Public Use Program

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

Except for those noted below, changes in these physical characteristics as a result of the public use program would be similar to Alternative B. Some disturbance to existing soils or sedimentation due to construction or added fill would occur during removal and construction of exterior and interior dikes. This effect is expected to be less than Alternative B. A new boardwalk section would be installed, extending from the new exterior dike along McAllister Creek. Boardwalk installation may have some short-term effects on soils; however, these would be minimized through the use of a pinned foundation boardwalk, eliminating the need to drive pilings into soils. Because boardwalks in tidal areas would be elevated, effects on hydrology should be minimal. In addition, a new 2½-mile loop trail would be installed east of the Nisqually River on Refuge and tribal lands. Large portions of the trail would be on existing low

roads and dikes. Boardwalk sections would be installed where water levels require them or dike removal is needed to support habitat restoration. A new bank fishing area on the east side of the Nisqually River along this new loop trail would be designed to minimize effects on soils through the placement and extent of the fishing area. The new hunting area on Refuge property is within the current unauthorized hunting area. Effects from boat activity associated with hunting would be similar to Alternative B but potentially increased because of the larger hunting area. Some effects to soils would also occur from foot traffic of hunters in mudflats and marshes. However, effects to soils and water quality would be reduced in McAllister Creek.

4.1.4 Alternative D (Preferred Alternative)

4.1.4.1 Habitat Restoration

Effects to Hydrology

Alternative D would lead to significant changes in wetland hydrology within the currently diked area, as 699 acres would be restored to tidal influence. As with Alternatives B and C, these effects would result in changes from seasonally flooded/saturated palustrine to regularly flooded estuarine conditions in restored areas. The Nisqually River would be allowed to move more freely, overtopping its banks or changing courses in areas where dikes are lowered to grade. The restored area would have a more direct hydrological connection to the Nisqually River and McAllister Creek. The McAllister Creek tidal system would be most functional in Alternative D because it would not be as constricted by dikes, allowing the major Shannon Slough system to become tidal over a greater area.

A smaller area of freshwater wetland management units would occur under Alternative D. There is an increased likelihood that water level manipulation would be effective in this smaller area and would be more intensively employed as a management technique. This may lead to increased use of groundwater resources as a water supply.

Alternative D is expected to reduce future flooding on the Refuge because the McAllister Creek overflow channel, which carried an estimated 30% of flood volume onto the Refuge in the February 1996 flood, would empty directly into McAllister Creek instead of into diked habitat (ENSR 1999). The second overflow channel, which carried the remaining 70% of the flood volumes in 1996, would continue to flow into the remaining diked area. Water control structures, spillways, or pumps would be needed to reduce flooding more quickly within the dikes.

Effects to Soils and Sediments

Alternative D would have similar effects on soils and sediments as described under Alternative C, although the size of the restored area is greater under Alternative D. Changes in soil characteristics associated with tidal inundation and salinity would occur over a broader area. As in Alternative C, more sediment would be deposited in the restored area due to dike removal along the Nisqually River (ENSR 1999). Sediment deposition may be slightly increased in the restored area along McAllister Creek during flood events because the McAllister Creek overflow

channel would empty directly into the restored area. Effects to soils and sediments as a result of dike construction and removal activities would be similar to Alternative C. Alternative D would require the least amount of dike repair.

The remaining diked area is the smallest in this alternative; intensified management would include discing and sculpting to improve freshwater wetlands and grasslands, which may have short-term effects on soils and sedimentation. Timing, extent, contouring, and reseeding would be designed to minimize erosion and sediments in runoff.

Effects to Geology, Water Quality, and Salinity

In general, effects would be the same as Alternative C. In addition, the larger amount of area restored along McAllister Creek could improve water quality due to increased tidal flushing and the larger amount of estuarine habitat, which could act as a filter for downstream flows before they reach the mouth of McAllister Creek and the Nisqually Reach.

Effects to Air Quality

Same as Alternative B.

4.1.4.2 Refuge Expansion

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

Effects to these physical environment factors under this larger expansion of the Refuge boundary would be similar to those described for Alternatives B and C, with the following exceptions. Implementation of Alternative D would increase boundary expansion in the Nisqually River corridor and valley by more than 1,000 acres. Improved protection of this portion of the lower watershed would maintain or improve natural river processes that protect water quality, reduce flooding effects to human infrastructure, and distribute river sediments. Reduced development within the floodplain would allow for overbank flooding and decrease the need for river levees, bank stabilization, and other engineered approaches to flood control. Improved protection of the river corridor could reduce erosion and sedimentation, improving water quality.

4.1.4.3 Public Use Program

Effects to Hydrology, Soils and Sediments, Geology, Water Quality, Salinity, and Air Quality

Effects to physical environment factors would be similar to Alternative C. New boardwalk extensions along McAllister Creek would be longest in this alternative, affecting a slightly greater area during construction. Effects from boating activity associated with hunting would be similar to Alternative B, with somewhat more activity at the river mouth.

4.2 Effects to Vegetation and Habitat Resources

The effects to habitats, including estuarine, freshwater wetland, riverine and riparian, and upland habitats, are described below for each of the four alternatives. Effects to native, exotic (non-native), and invasive plants are also described.

4.2.1 Alternative A

4.2.1.1 Habitat Restoration

Effects to Estuarine Habitat

Maintaining the existing diked area would provide no new benefits for estuarine habitats within the study area. Additional estuarine habitat would not be restored, nor would the indirect benefits that existing habitats may receive by restoring adjacent diked areas to tidal conditions occur.

The existing dikes have some negative effect on the estuary. The dikes are potentially increasing tidal current velocity, which can contribute to the erosion of salt marsh and mudflat habitats (Burg 1984). The Nisqually River, and the sediments that it carries, would continue to be confined to its present course. This restriction, combined with reduced sediment load due to upstream dams (Nelson 1974), would continue to prevent a broader distribution of river sediments necessary to offset the effects of erosion and sustain estuarine habitats.

Retaining the dike would continue to interrupt tidal channels and keep the tidal prism, water volumes, and nutrient exchange reduced in existing estuarine habitats. This would limit the health and function of the salt marshes and sloughs of the delta, including the ability to provide habitat support for juvenile salmonids (Thom et al. 1985). Sediments would continue to deposit in artificial patterns, slowly contributing to the buildup of the bench surrounding the dike exterior. The reduced tidal prism and water volume would also continue to limit the creation of smaller channels and slough branches, producing a less complex, lower channel order system that provides less habitat for fish and other wildlife.

Effects to Freshwater Wetland Habitat

Existing diked areas would remain in their current condition with only limited improvements in management. In the short term, the existing mix of freshwater wetland habitats would persist. However, as discussed in Chapter 3, habitat conditions within the dike are slowly changing as reed canary grass dominance increases, modifying the vegetation community and reducing open water areas. Higher elevation, drier areas are changing to a scrub-shrub community. To slow these changes, an increased effort would be placed on reed canary grass management, including mowing, discing, and herbicide application. However, due to the size of the management area, feasibility of access in a moist soil environment, freshwater supply limitations, limited effectiveness of flooding to prevent regrowth, and concerns about widespread herbicide use within the Refuge, these measures would be limited in their effectiveness. It is expected that

deterioration of freshwater wetland conditions would continue, as well as decreased wildlife habitat function. Replacement or addition of water control structures would provide some limited improvements in water management, allowing ponding over longer periods in some wetlands. The entire dike would also need major repairs to prevent seepage and eventual failure. If the dikes were to breach, they would be repaired as soon as possible to stop tidal flooding.

Effects to Riverine and Riparian Habitat

No focused efforts to restore riverine and riparian habitats associated with natural hydrology would occur under Alternative A. Native tree and shrub plantings would continue to restore riparian habitat within the diked area, but these diked areas would not be associated with a hydrological connection with the Nisqually River or McAllister Creek. Efforts to conserve existing habitats would continue, including preservation of riparian vegetation along dikes where possible. Extensive dike repairs and dike maintenance would damage riparian vegetation and brush along dike tops and banks. No restoration of natural flow of the Nisqually River would occur because all existing dikes would remain.

Effects to Upland Habitat

Existing dikes would be repaired and maintained, and no effects on current upland habitats within the diked area, including forests, pasture lands, or developed areas, are expected. Some limited fertilizing, discing, plowing, and reseeded of non-native grasslands would be conducted, in addition to the haying and mowing program. These techniques would encourage non-native pasture grass over weed species in limited areas. A long-term goal to re-establish a native conifer-dominated forest is currently being implemented on the West Bluff parcel and would continue under all alternatives. The establishment of this forest would reduce erosion from this West Bluff parcel into McAllister Creek.

Effects to Native, Exotic, and Invasive Plants

Vegetative communities of the Refuge would continue under this alternative, although there is the potential of an increased acreage of exotic species such as reed canary grass and Himalayan blackberry. Habitat conditions within the dike are already changing as reed canary grass dominance increases. Control measures within the diked area would be minimal due to the size of the management area, feasibility of access in a moist soil environment, freshwater supply limitations, limited effectiveness of flooding to prevent regrowth, and concerns about widespread herbicide use within the Refuge; these measures would be limited in their beneficial effects. It is expected that the spread of exotic species would be a constant challenge and lead to the deterioration of freshwater wetland conditions, as well as decreased wildlife habitat function.

Although cordgrass is not present on the Refuge, it is spreading in coastal Washington and portions of north Puget Sound. This alternative does not include any actions that would change the potential for establishment of this species.

4.2.1.2 Refuge Expansion

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

Under status quo conditions, no expansion of the Refuge boundary would occur. Areas outside the existing boundary would not be brought under Service protection or management. Indirect benefits to these habitats would occur if efforts to strengthen watershed protection through partnerships outside of the Refuge boundary were successful.

Efforts to acquire in-holdings within the existing boundary would continue, as would plans to develop and implement a Cooperative Agreement with the Nisqually Indian Tribe for the Service to manage properties owned by the tribe on the east side of the Nisqually River as part of the Refuge. In-holdings and tribal properties include estuarine habitats and some areas that are being restored to estuary, and Refuge protection and support of these areas would be beneficial to their long-term conservation. In-holdings along the west side of McAllister Creek include riparian habitat. Refuge acquisition and management of these parcels would be beneficial to their long-term conservation. Indirect benefits to riparian habitats would occur if efforts to strengthen watershed protection through partnerships outside of the Refuge boundary were successful.

4.2.1.3 Public Use Program

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

Some aspects of the public use program would continue to have limited or short-term effects on habitats. Trails would be cleared or brushed out periodically. Herbicides would be used on a very limited basis to keep public facilities maintained. Boardwalks would shade limited portions of freshwater wetlands, dike banks, and grasslands. Dikes that also support trails would periodically be mowed, brushed, or graveled. Shellfishing and fishing would result in disturbance to the habitat caused by foot traffic or digging activity on mudflats, aquatic plants, and nearby salt marshes. Boat anchoring and foot traffic associated with various recreational activities such as unauthorized hunting may cause trampling in salt marsh areas. Eelgrass bed scarring may occur as a result of boat propeller or anchor damage that cuts eelgrass roots, stems, and leaves (Sargeant et al. 1995). Potential erosion of salt marsh areas caused from boat and PWC wakes would continue.

4.2.2 Alternative B

4.2.2.1 Habitat Restoration

Estuarine Habitat

A limited amount of estuarine restoration would occur under Alternative B. Approximately 318 acres of the diked area would be restored to a muted tidal condition by creating breaches in the dike in select locations. In addition, approximately 140 acres of the diked area would be fully restored to intertidal conditions by removing dikes in the north half of the Shannon Slough area

along McAllister Creek. Approximately 9,500 feet of exterior dike would be constructed, the largest amount of all action alternatives. Alternative B would benefit the estuarine habitats of the Refuge by expanding the amount of this habitat type. Although the exact types and conditions of estuarine habitats resulting from a muted tidal condition are more difficult to predict than if dikes were completely removed, several generalizations can be made (ENSR 1999):

- If dike breaches are sized to be at least as large as the natural channels that historically carried water in and out of intertidal areas, it is possible to obtain full tidal penetration in restored areas. Undersized breaches would lead to less-than-full tidal flooding.
- Breaching dikes would not yield the same distribution of sediment and salinity as dike removal.
- Incomplete drainage and storage of water in unfilled borrow ditches and other depressions can occur when dikes are breached and not returned to grade and the borrow ditches are not filled. Topographic depressions inside the breached dike area could trap fish during low tide.

Borrow ditches also affect tidal channel formation by reducing the amount of hydraulic energy available to form and maintain the highly developed pattern of tidal channels associated with natural systems. This in turn results in less overall channel area, a reduced proportion of the estuarine habitat area connected to channels, and less channel edge ©. Simenstad, pers. comm). These factors reduce the ability of restored estuarine habitats to provide functions for fish and wildlife comparable to those of natural systems.

The distribution and species composition of vegetation in estuarine habitats are strongly influenced by physical factors, including the period of inundation and salinity (Burg et al. 1980). Exposure to wave energy, sediment supply, and the counterbalancing forces of erosion and accretion also strongly influence marsh distribution. Therefore, objectives to restore natural habitat conditions would not be fully met by this alternative.

The area of north Shannon Slough to be fully restored to tidal influence would provide the estuarine habitats that are the goals of restoration actions. However, this area would remain separated from the Nisqually River and the associated freshwater discharge and river-borne sediments. Shannon Slough itself would remain fragmented. The lower portion of this historic tidal channel would be connected to the estuary; however, the upper portion would remain detached, separated by a dike and tide gate system. There may also be reduced circulation in portions of this area due to the backwater effect caused by the new exterior dikes and limited tidal prism or volume restored. The configuration of this restoration area could also alter patterns of sedimentation due to its small size and the presence of dikes on three sides.

Estuarine habitats would be enhanced by increasing the total estuarine habitat area and tidal flow. Any increases in the areal extent of marsh vegetation cover would increase total primary productivity, as well as increase availability and distribution of detrital (decaying plant matter) material. Detritus is a key ingredient in estuarine habitat food webs, including those that support prey resources important to juvenile salmon (Naiman and Sibert 1979; Northcote et al. 1979).

Effects to Freshwater Wetland Habitat

Under Alternative B, approximately 45% (458 acres) of the currently diked area of freshwater wetland habitat would be restored to estuarine habitat. In the northern portion of the currently diked area, 318 acres of freshwater wetland would be restored to muted tidal conditions. Much of this area is currently dominated by reed canary grass. The northwestern portions of the diked area have a higher proportion of seasonal wetlands due to lower elevations and greater saltwater influence caused by seepage through the dikes. However, in the northeastern part of this area, there are areas of higher ground that currently support a mixed forest and scrub-shrub community. Based on the elevation of these areas (3.5 to 4.5 feet National Geodetic Vertical Datum [NGVD]) relative to reference areas outside of the dikes, these trees and shrubs are predicted to die back after dike breaching due to saltwater inundation. Similarly, the 140-acre area near the northern portion of Shannon Slough where dike removal is proposed would change after tidal influence is restored. Existing vegetation communities would be eliminated, including reed canary grass and other grasses prevalent in low areas, as well as shrubs that persist in areas of higher ground and dikes. Historic tidal slough systems that currently provide permanent freshwater channels within the dikes would revert to tidal sloughs. Freshwater wetland plants and submerged aquatics would be eliminated.

New internal dikes would be built to improve freshwater wetland management in the remaining 542-acre diked area. This would provide benefits to this habitat type, as reed canary grass growth would be more effectively managed. A mixture of native vegetation communities in seasonal wetlands and grasslands would be created in this area, modeled after existing ponds on the Refuge with high bird use. Other than riparian shrubs planted along sloughs and the edges of wetland areas, very little scrub-shrub habitat would be created or maintained. However, due to the large size of management units and freshwater supply limitations, the effectiveness of management actions may be limited, including the ability to flood large areas to depths sufficient for vegetation control. Reed canary grass and non-native pasture grasses would continue to dominate areas that could not be intensively managed, including the edges of some seasonally flooded marshes and ponds.

Effects to Riverine and Riparian Habitats

As no active restoration of riverine and riparian habitats is included under Alternative B, effects to these habitats would be the same as under Alternative A. The dike along the Nisqually River would continue to be maintained, confining the river and its associated habitats to the current location.

Effects to Upland Habitat

In general, implementation of this alternative would likely have little, if any, effect on existing upland habitats because the areas to be restored are largely freshwater wetlands. Exceptions would occur along a portion of McAllister Creek where brush habitat lining the dike banks would be lost due to dike removal. Trees and brush along internal road banks that are removed or restored in the currently diked area would also be lost. New native trees, shrubs, and herbaceous vegetation would be planted or seeded along the new exterior and interior dikes,

which would provide new brush habitat, screening, and also protect new dikes from erosion. Effects to the West Bluff parcel would be the same as Alternative A.

Effects to Native, Exotic, and Invasive Plants

Vegetative communities of various habitat types on the Refuge would still occur under this alternative. The proportion of estuarine habitat vegetation on the Refuge would increase because of the proposed estuarine restoration. Reed canary grass and blackberry would be expected to be eliminated in full estuarine restoration areas and largely controlled in muted tidal areas. The exact types and conditions of estuarine habitats that would result from a muted tidal condition are more difficult to predict than under complete dike removal (see Effects to Estuarine Habitats, above). Therefore, objectives of restoring natural vegetative communities may not be fully met by this alternative, where dike breaching (as opposed to dike removal) may lead to a deviation from natural conditions for these physical factors. Since this alternative would increase the acreage of estuarine habitat, the potential areas for *Spartina* spp. to become established are increased. Therefore, monitoring efforts would be needed to ensure that *Spartina* spp. does not become established on the Refuge.

Management of the remaining diked area would improve with the construction of new internal dikes that would allow more effective control of reed canary grass. A mixture of native vegetation communities and water depths could be created in this area. However, due to the large size of the management units and freshwater supply limitations, the effectiveness of management actions may be limited, including the ability to flood large areas to depths sufficient for vegetation control.

4.2.2.2 Refuge Expansion

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

The expanded Refuge boundary under Alternative B would allow for acquisition and increased habitat protection for the upland forest and shrub habitats in the East Bluff area. If acquired, future development and associated loss and/or degradation of these habitats would be prevented and reforested where needed. A continuous corridor of protected forested habitat would potentially be established, improving riparian habitat quality below the bluff and adding to the diversity of Refuge habitats.

Inclusion of a limited amount of riparian habitat south of I-5 would allow for some improvements in habitat protection and restoration. Specific habitats affected would depend on areas acquired and protected and could include vegetated areas of riparian forest, scrub-shrub, and emergent (wetland) habitats, as well as unvegetated portions of the river channel and floodplain, including gravel beaches and bars. For example, riparian restoration, improved vehicle traffic management in riparian forest, and increased enforcement of the riparian area in Trotter's Woods could reduce habitat damage caused by unregulated public access and the existing network of dirt roads and trails in the riparian corridor. This would have little or no direct effect on estuarine and freshwater wetland habitats. Indirect effects would include

benefits associated with maintaining existing bluff slope stability, as well as improved integrity of riparian and upland corridors adjacent to estuarine habitats.

Expansion south of I-5 in the lower Nisqually Valley could provide extensive freshwater restoration opportunities, including seasonal wetlands and riparian corridors along sloughs and creeks, such as the upper portion of McAllister Creek. Seasonal wetland restoration projects on former agricultural lands would be very similar to those conducted on current Refuge lands within the diked area. For example, seasonal wetlands west of the headquarters area were enhanced in 2001 by mowing dense reed canary grass areas, discing, sculpting new depressions and seasonal ponds, and seeding, followed by flooding during the fall and winter months, greatly enhancing waterfowl habitat. Depending on the areas acquired, restoration of freshwater wetlands could reduce the effects from the conversion of freshwater wetlands back to estuarine habitat north of I-5 and could increase the size and complexity of wetland habitats in the lower watershed.

In addition, upland habitats could benefit from improved management and enhancement. Specifically, if areas of upland pastureland or grassland south of I-5 were acquired, protection and improved management for wildlife could offset conversion of grasslands back to estuarine habitat north of I-5. The opportunity to restore estuarine habitats is limited to the area north of I-5, but substantial options for upland and freshwater wetland restoration and protection are possible south of I-5.

Acquisition of in-holdings and the development of a Cooperative Agreement with the Nisqually Indian Tribe would occur as described under Alternative A.

4.2.2.3 Public Use Program

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

Effects of the public use program under Alternative B are similar to those described under Alternative A. However, the retention of dikes to support trails would have a larger effect on habitats in this alternative, by restricting restored estuarine habitat to primarily a muted system. Since this alternative would breach dikes and construct bridges to maintain the trail system, Refuge objectives to restore natural habitat conditions would not be fully met because of reduced physical processes that are required to build tidal systems (see also sections on physical factors and habitat for Alternative B above and habitat for Alternative C below).

Closure of the RNA to all consumptive uses and winter boat use would reduce localized effects of shellfishing, hunting, fishing, boat propellers, anchoring, and foot traffic on algae and submerged aquatic plants. The enforcement of no hunting areas would reduce some effects to salt marsh and mudflat areas on Refuge lands currently frequented by hunters. All action alternatives would reduce potential erosion of salt marsh caused by watercraft wakes. Alternative B would serve the largest number of students in the EE program. Some localized trampling of vegetation would occur as part of the enlarged program; however, study site locations would be selected to minimize effects to sensitive habitats.

A new bank fishing area would be developed in the Trotter's Woods area, if acquired. Some effects on riparian habitats would occur from vehicle parking areas and foot traffic, but this is expected to be less than present conditions because of planned improvements in access, such as controlling vehicle use.

4.2.3 Alternative C

4.2.3.1 Habitat Restoration

Effects to Estuarine Habitats

Alternative C would restore approximately 50% (515 acres) of the currently diked area to estuarine habitat, an additional 57 acres more than Alternative B.

Perhaps of greater significance are qualitative improvements in the condition of the restored area. Unlike Alternative B, which would retain large sections of the dike to allow for continued use of dike-top trails, Alternative C would remove the dike to grade in restoration areas. Therefore, the tidal connection between restored areas and the Nisqually River delta would be complete, with no possibility that "muted" tidal conditions would develop. Unimpeded tidal hydrology would increase the probability that restored estuarine habitats would function like natural systems by providing more natural physical conditions, including tidal hydrology, sediment distribution, and salinity patterns (ENSR 1999).

Removal of the dike along the lower portion of the river would allow the river channel to migrate naturally across the floodplain and through the restored area, a substantial benefit to estuarine habitats compared to Alternative B. No longer constrained to the existing channel by dikes, freshwater from the Nisqually River would be discharged across a larger area. This would allow for a natural distribution of river-borne sediments and a more variable salinity regime (ENSR 1999). These more natural physical conditions would provide for a wider distribution of river-borne sediments that help build and maintain elevations suitable for plant growth, and for distribution of diverse estuarine habitats throughout the delta. The river could also deliver large woody debris to estuarine habitat, increasing habitat structure and diversity. As with Alternative B, an increase in estuarine marsh would enhance functions of existing habitats by increasing availability and distribution of detrital material.

One drawback of Alternative C, relative to Alternative B, is a limited amount of restoration along the western margins of the diked area. Specifically, the Shannon Slough system would remain diked, reducing the amount of historical tidal channel habitat restored along McAllister Creek. McAllister Creek would remain relatively confined in a narrow area for approximately one-half of its length below the bridge at I-5. This alternative would result in an area of fully restored habitat that is largely constrained to the area immediately south of the existing outer dike face.

Effects to Freshwater Wetland Habitat

Alternative C would concentrate 515 acres of estuarine habitat restoration in the northern portion of the currently diked area. Freshwater wetlands in this area would be converted to tidal conditions, changing the current habitat functions. The converted area currently includes areas of a mixed forest and scrub-shrub community, seasonal wetlands, former pasturelands, and areas dominated by reed canary grass. Dikes would be removed instead of breached, allowing for a full tidal connection, increasing the probability that any existing vegetation, including trees and shrubs on higher ground and reed canary grass, would be displaced by estuarine habitat types such as salt marsh and mudflats. Management of freshwater wetland management units would be the same as described for Alternative B, resulting in similar effects. However, since Alternative C would have a slightly smaller area of freshwater wetlands (447 acres as opposed to 542 acres), water management would be easier; thus, the proportion of seasonal wetlands would be higher than grasslands and scrub-shrub habitats.

Effects to Riverine and Riparian Habitats

Implementation of Alternative C would restore 38 acres of riparian forest habitat along the Nisqually River, immediately north of the Twin Barns area. However, the dikes to the east and north of this area may be removed or lowered (graded) substantially to restore a natural flow to the Nisqually River. Riparian vegetation on this portion of the dike and its banks, including many large trees, would be removed or damaged by this activity. Riprap (rock) placed along the river levee in the past to repair dike breaches and weak spots would also be removed.

It is expected that much of the riverine and riparian habitat along the Nisqually River would be sustained and benefitted following restoration in Alternative C. Erosion would most likely be reduced in high flow or flood events because the river would be able to move freely rather than have all the energy restricted within a diked channel. In some cases farthest downstream, trees may be lost due to the marine influence and increased salinities from Puget Sound. However, an equilibrium would eventually be reached between saltwater and the large freshwater flows coming down the river, maintaining much of the existing riparian habitat.

Effects to Upland Habitat

Alternative C would enlarge the area of estuarine restoration and extend it farther south into the currently diked area. The vast majority of this area is a mosaic of wetland types and pasture land. Tidal inundation would eliminate these pastures and convert them to estuarine habitats.

More brush habitat along the McAllister Creek Dike would be lost due to dike removal in Alternative C, compared to Alternative B. Trees and brush along internal road banks that are removed or restored in the currently diked area would also be lost. New native trees, shrubs, and herbaceous vegetation would be planted or seeded along the new exterior and interior dikes, which would provide new brush habitat and screening, as well as protect new dikes from erosion. Effects to the West Bluff parcel would be the same as described in Alternative A.

Effects to Native, Exotic, and Invasive Species

Implementation of this alternative would restore approximately 50% of the diked area to estuarine habitat. Complete tidal connection between restored areas and the Nisqually River delta would occur. Unimpeded tidal hydrology would increase the probability that restored estuarine habitats would function like natural systems by providing more natural physical conditions, including tidal hydrology, sediment distribution, and salinity patterns. As a result, reed canary grass and blackberry would likely be eliminated in the restored area. The potential effects of *Spartina* spp. introduction and establishment would be the same as described under Alternative B, but with more acreage available for potential establishment.

Management of freshwater wetland management units would be the same as for Alternative B, resulting in similar effects. However, Alternative C would have a slightly smaller area of freshwater wetlands (447 acres compared to 542).

4.2.3.2 Refuge Expansion

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

Effects to Refuge habitats would be the same as described under Alternative B.

4.2.3.3 Public Use Program

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

Effects of the public use program described under Alternative B also apply to Alternative C, without the effects associated with dike retention. Additional effects include the following. A boardwalk would be installed along McAllister Creek, extending along the northwest side of the estuarine restoration area. The boardwalk would create some shading along its length, disturbing plant growth, but effects on habitat would be very localized. Boardwalk installation may have some short-term effects on estuarine habitats from soil disturbance and trampling. However, these would be minimized through the use of a pinned foundation boardwalk. Pinned foundation boardwalks use concrete blocks that are pinned in place to support the boardwalk, eliminating the need to drive pilings into soils.

The new trail east of the Nisqually River would be designed to minimize effects on habitat, including boardwalk sections that would be required in estuarine restoration areas. Effects of the new Refuge hunting area would include foot and boat traffic in mudflats and salt marsh habitats within the largest hunting area of all alternatives. However, effects would be eliminated in closed areas, especially McAllister Creek, and reduced by the 3 day per week restriction. Some localized trampling of vegetation would result from new study sites in the enlarged environmental education program; however, study site locations would be selected to minimize effects to sensitive habitats.

4.2.4 Alternative D (Preferred Alternative)

4.2.4.1 Habitat Restoration

Effects to Estuarine Habitat

Alternative D represents the largest area of restoration under consideration in this CCP. Approximately 699 acres (70% of the currently diked area) would be restored to full tidal influence by removing large sections of the outer dike to grade. This alternative is most similar to Alternative 6, 70% estuarine restoration, described in the hydrological modeling study (ENSR 1999). This alternative would lead to an additional 184 acres of restored habitat as compared to Alternative C. Effects of removing dikes along the lower Nisqually River on estuarine habitats would be similar to those described under Alternative C.

Alternative D also significantly increases benefits to estuarine habitats in the vicinity of Shannon Slough and McAllister Creek in the western portions of the delta. Under this alternative, Shannon Slough would be fully restored to tidal influence. Dikes that might prevent the migration of the McAllister Creek channel, and the discharge of freshwater to the marsh during flood of the creek, would be removed. This alternative maximizes the range of physical conditions (e.g., salinity, elevation) within the area restored to tidal influence, leading to a more diverse and natural mix of estuarine habitats within the Nisqually delta.

Because Alternative D prescribes the largest contiguous area restored to tidal influence, it would increase the complexity and diversity of restored estuarine habitats, including producing more complex channel order and sloughs and greater elevational differences in the salt marsh mosaic. Alternative D would have the greatest benefit to existing estuarine habitats currently outside of the dikes by increasing tidal exchange, volume, and nutrient exchange to marshes north of the current dike, as well as along the length of McAllister Creek north of I-5.

Effects to Freshwater Wetland Habitat

Implementation of Alternative D would result in the largest conversion of freshwater wetland area to estuarine habitat. Approximately 263 acres of freshwater wetlands would remain after estuarine restoration is completed and a new exterior dike constructed. These would be located in the southeastern portion of the currently diked area. Existing freshwater wetlands in the northern half of the diked area, as well as the entire Shannon Slough area north of I-5, would be converted to estuarine habitat by full restoration of tidal influence (699 acres). Based on acreage, this would be the largest conversion of freshwater wetlands under consideration. Qualitatively, the effects would be similar to those described for Alternatives B and C. Tidal inundation would eliminate existing freshwater wetland vegetation communities. Most of this area is currently dominated by reed canary grass, but it also includes scrub-shrub and marsh communities. Higher elevation areas that currently support trees and shrubs would revert to salt marsh habitats. Lower areas, currently seasonally flooded and/or saturated and dominated by a mixed herbaceous community of grasses and forbs, would become unvegetated mudflats or low salt marsh. The Shannon Slough system would convert from permanent freshwater to tidally

influenced sloughs and channels. The permanent freshwater wetlands north of the headquarters buildings would remain.

As with the other action alternatives, Alternative D would require new internal dikes to improve freshwater wetland management options in remaining diked areas. The resulting management units would be smaller under this alternative and provide less total area of freshwater wetlands (263 acres). However, the size of these units would allow for more effective management. Limited freshwater supplied by the artesian wells would be applied to a smaller area, improving the ability to control reed canary grass. Higher quality freshwater wetlands with improved wildlife habitat functions would result.

Effects to Riverine and Riparian Habitats

With respect to effects on riparian and riverine habitats, habitat restoration in Alternatives C and D is similar, focusing on restoring 38 acres of riparian habitat along the Nisqually River. The primary differences between these two alternatives involve the amount of restoration on McAllister Creek and the Shannon Slough area, which would have little effect on the habitats on the east side of the delta. Effects related to riparian and riverine habitats are similar to those described under Alternative C.

Effects to Upland Habitat

Alternative D expands the estuarine restoration described under Alternative C, incorporating the Shannon Slough area all the way south to the Refuge entrance road. Given the relatively higher elevations in this portion of the currently diked area, there is a significant potential to affect existing upland habitat in this area. Areas currently managed as pasture land, and subject to periodic mowing or haying, probably contain a mix of seasonally flooded “wet meadow” wetlands and upland pasture land. Restoration of tidal influence in these areas would eliminate the pasture grass communities and reed canary grass. The higher elevation areas would most likely transition to salt marsh habitat more quickly than lower elevation areas, which would initially convert to mudflat habitat.

The brush habitat along the McAllister Creek dike would be lost during dike removal in Alternative D. Trees and brush along internal road banks that are removed or restored in the currently diked area would also be lost. New native trees, shrubs, and herbaceous vegetation would be planted or seeded along the new exterior and interior dikes, which would provide new brush habitat and screening and would also protect new dikes from erosion. Effects to the West Bluff parcel are the same as described under Alternative A.

Effects to Native, Exotic, and Invasive Plants

Effects of removing dikes along the lower Nisqually River on the vegetation community would be similar to those described under Alternative C. Since this alternative has the highest amount of acreage restored to estuarine habitat, the potential for *Spartina* spp. establishment would be the largest. Monitoring efforts would need to be the greatest to ensure early detection and control.

As with the previously described action alternatives, Alternative D would entail building new internal dikes to improve freshwater wetland management options in the remaining diked areas. The resulting management units would be smaller under this alternative and provide less total area of freshwater wetlands (263 acres). However, the size of these units would allow for more effective management. Limited freshwater supplied by the artesian wells would be applied to a smaller area, improving the ability to control reed canary grass. Higher quality freshwater wetlands with improved wildlife habitat functions would result, similar to habitat improvement projects completed in 2000 and 2001 in the headquarters area.

4.2.4.2 Refuge Expansion

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

Alternative D includes the largest expansion of the Refuge boundary. Acquisition of in-holdings and development of a Cooperative Agreement with the Nisqually Indian Tribe would occur as described under Alternative A. No additional estuarine habitat would be included in this alternative for expanding the Refuge boundary, limiting the direct effects to estuarine habitats. However, the proposed area of expansion would include areas where the freshwater wetland management capabilities of the Refuge could be further developed. Should the Service be able to acquire manageable properties, a larger, more diverse complex of wetland habitats would result, contributing to an overall improvement in watershed conditions. Therefore, implementation of Alternative D could indirectly benefit estuarine habitats at the Refuge.

Alternative D includes a larger expansion of riparian habitat than Alternatives B and C, including a portion of the Nisqually River corridor. Specific habitats affected would depend on areas acquired and protected, and could include vegetated areas of riparian forest, scrub-shrub and emergent (wetland) habitats, as well as unvegetated portions of the river channel and floodplain, including gravel beaches and bars. Active management and restoration of the riparian area could reduce habitat damage caused by unregulated public access and the existing network of dirt roads and trails in the riparian corridor. This would have little or no direct effect on estuarine habitats. Indirect effects would include benefits associated with maintaining existing bluff slope stability, as well as improved integrity of riparian and upland corridors adjacent to estuarine habitats.

Alternative D includes the largest plan for expansion of the Refuge boundary and would have the potential to enhance or restore the largest amount of freshwater and riparian wetland habitat of all the alternatives. Similar to Alternatives B and C, extensive freshwater restoration opportunities could result. Depending on the areas acquired, restoration of freshwater wetlands south of I-5 could reduce the effects from the conversion of freshwater wetlands to estuarine habitat north of I-5 and could increase the size and complexity of the wetland habitat mosaic in the lower watershed. As described in Alternative B, wetland restoration of agricultural lands could include periodic mowing, discing, sculpting, seeding, and flooding in the fall and winter months. This alternative would potentially provide additional protection for floodplain and riparian forest in the Nisqually Valley that is not included in Alternatives B or C. Combined with the greater potential for riparian protection and restoration, this alternative for Refuge boundary expansion could provide the greatest long-term benefit to freshwater wetlands.

Similar to Alternatives B and C, direct benefits for upland habitats could result. Specifically, this alternative proposes the acquisition of the largest amount of upland bluffs. If areas of upland pasture land or grassland south of I-5 were acquired, protection and improved management for wildlife could reduce the effects of the conversion of grasslands back to estuarine habitat north of I-5. Whereas the opportunity to restore estuarine habitats is limited to the area north of I-5, substantial options for upland and freshwater restoration and protection may be possible south of I-5.

4.2.4.3 Public Use Program

Effects to Estuarine, Freshwater Wetland, Riverine and Riparian, and Upland Habitats

Effects of boardwalk construction are similar to those described for Alternative C. All other effects—from closure of the RNA to boating, fishing, and shellfishing—are the same as described in Alternative C. Effects from the hunting area would be slightly less than in Alternative C because of the smaller acreage, but effects to habitats along McAllister Creek would continue. This alternative potentially includes new accessible fishing site locations at the Nisqually River or Luhr Beach, if acquired. These sites would most likely involve construction of small platform sites that contain all activities. Construction of these platforms would be conducted with minimal disturbance to adjacent habitats.

4.2.5 Effects to Regional Availability of Wetland Habitats

A specific analysis was done to better understand how estuarine restoration and freshwater conversion at Nisqually NWR would affect the larger south Puget Sound area (Tanner 1999). This discussion focuses on the effects of habitat restoration only within the current Refuge boundary in a regional context. Due to the large area of Nisqually NWR wetlands, and the significant shift in wetland habitat types that would occur if restoration of estuarine habitat is implemented, the regional context of the alternatives was considered (Table 4.2-1). Using historical data on the estimated distribution of estuarine habitats (Bortelson et al. 1980) and National Wetland Inventory (NWI) data on current wetland distribution, a geographic information system (GIS) analysis was completed and is summarized here. For this analysis, a definition for the region of south Puget Sound consistent with that used by the WDFW for salmonid stock management was used (see Tanner [1999] for further information on project boundaries and methods). This area extends north to the Cedar/Sammamish Water Resource Inventory Area (WRIA) in King County, west to Kennedy/Goldsborough WRIA in Mason County, east to Duwamish and Puyallup WRIs in Pierce County, and south to the Nisqually WRIA in Thurston County.

Table 4.2-1. Summary of Habitat Restoration Effects to Regional Estuarine and Freshwater Wetlands.

Alternative	Estuarine Habitat Restored (acres)	% Loss of Regional Freshwater Wetlands	% Gain of Regional Estuarine Habitat
A (Status Quo)	0	0.0%	0.0%
B – Minimum Estuarine Restoration	458	1.7%	30.0%
C – Moderate Estuarine Restoration	515	1.9%	33.7%
D – Maximum Estuarine Restoration	699	2.6%	45.7%

Nisqually River delta estuarine (intertidal and subtidal) habitats have decreased from 6,207 acres historically to an estimated 5,016 acres currently. Especially significant has been the loss of intertidal emergent habitat (high and low salt marsh), which has declined from 1,458 acres to 674 acres, a loss of 54%. Much of this loss is associated with diking and the conversion of estuarine habitats to palustrine (freshwater) wetlands inside the dike system (Tanner 1999). Palustrine wetlands comprise a substantial portion (18%) of the remaining wetlands in the south Puget Sound region. Emergent marshes comprise the largest single class of palustrine wetlands. Estuarine intertidal wetlands are much less prevalent in the region and comprise only 6% of non-upland areas. The vast majority of the estuarine intertidal area is comprised of unvegetated mudflats and beaches. Estuarine marsh habitat (salt marsh) is relatively scarce in south Puget Sound; approximately 1,529 acres account for 0.3% of the non-upland area in this region.

Freshwater wetlands are an important resource in south Puget Sound and continue to be threatened by incremental loss and degradation. Estuarine wetlands, historically less abundant, are becoming increasingly rare throughout Puget Sound, and opportunities for restoration of estuarine wetlands are limited. The Nisqually River delta historically contained more than twice the current amount of this wetland type. Restoration of intertidal wetlands at Nisqually NWR could produce a substantial increase in the amount of salt marsh in south Puget Sound, with a relatively small reduction in freshwater habitats in the region. From a regional perspective, estuarine restoration in the Nisqually delta would provide a significant increase in this habitat type, with important benefits to fish and wildlife resources throughout south Puget Sound and beyond. Implementation of Refuge boundary expansion alternatives south of I-5 could also reduce the effects of freshwater wetlands calculated within the diked area in this analysis.

4.3 Effects to Fisheries Habitats and Resources

The discussion of the effects of the alternatives on fish species focuses on the selected species described in the Affected Environment chapter (Table 3.3-1). These estuarine and anadromous fish species are of management concern in the study area and all depend upon estuarine habitats to some degree. These species are meant to represent what could happen to the broader set of fish species inhabiting the Refuge.

Both long-term and temporary effects to fish species may occur in association with each alternative. Temporary effects to fish species are identified as effects from construction activities, such as dike removal, road maintenance, and channel modification associated with estuarine restoration. Long-term effects to fish species may occur through changes in habitat abundance and diversity and changes in primary production and consequently the food chain. The following describes the potential long-term and temporary effects to various fish species that may occur in association with each alternative.

Effects to fish species listed in Table 3.3-1, Chapter 3 are discussed in this chapter. Species other than Pacific salmon are discussed collectively as “Forage Fish and Other Fishes” since these species all depend upon the nearshore marine environment.

4.3.1 Alternative A

4.3.1.1 Habitat Restoration

Effects to Pacific Salmon

Estuaries are among the most productive ecosystems on Earth (Odum 1971) and are critical habitat for juvenile Pacific salmon stocks (Levy et al. 1979; Levy and Northcote 1981; Simenstad et al. 1992). They offer juveniles abundant food sources, refuge from predators, and the ability to acclimate to higher salinities. Estuaries not only afford rich feeding and growth opportunities, but also allow fry to delay out-migration until population blooms of marine zooplankton prey occur, which can double fry survival to adulthood (Salo 1991). Optimal estuarine conditions are critical for those anadromous salmonid stocks that have evolved a dependence on the estuary for juvenile rearing. Upon return from the ocean, adult salmonids often hold in estuarine environments for some time while sexually maturing and adjusting to lower salinities (Olson 1989).

Under Alternative A, no estuarine habitat would be restored. Since all of the Pacific salmon found in the Nisqually Basin depend upon estuarine habitats to some degree, especially juvenile chinook and chum salmon (Dorcey et al. 1978; Healey 1982; Simenstad et al. 1982), there would be no expected increase in salmonid populations under this alternative. In addition, there would be no indirect benefits to these species, resulting from improvements or restoration of existing habitats to tidal conditions as would occur under the action alternatives. The existing estuarine habitats would continue to deteriorate under existing management. The dike would be maintained, continuing to interrupt tidal channels and reducing the tidal prism, water volumes,

and nutrient exchange in the existing estuarine habitats. Any diking of tidal channel habitat reduces the rearing capacity of an estuary. The reduced tidal prism and water volume associated with diking creates a less complex system by limiting the creation of smaller channels and slough branches, resulting in less habitat for fish (Thom et al. 1985).

Effects to Forage Fish and Other Fish

Effects to Pacific herring, surf smelt, Pacific sand lance, and other estuarine-dependent species under Alternative A are similar to those described for Pacific salmon. These species depend upon the nearshore marine environment and estuaries for spawning or rearing, or both. Alternative A would not increase foraging or rearing habitat preferred by these species, nor increase spawning habitat.

As described in Section 3.3, little is known about the current status of the bull trout in the Nisqually River system (WDFW 1998). Effects to bull trout in this alternative are the same as described above for Pacific salmon.

4.3.1.2 Refuge Expansion

Effects to Pacific Salmon, Forage Fish, and Other Fishes

There is no Refuge expansion proposed in this alternative, so no effects would be expected.

4.3.1.3 Public Use Program

Effects to Pacific Salmon, Forage Fish, and Other Fishes

This alternative does not propose any major changes in the public use program on the Refuge. Therefore, fish populations on the Refuge would not be affected.

4.3.2 Alternative B

4.3.2.1 Habitat Restoration

Effects to Pacific Salmon

Compared to Alternative A, Alternative B would provide some benefits to the anadromous and estuarine-dependent fish species in the Nisqually River, Estuary, and Reach. Restoration of the estuary under this alternative is expected to result in some increased primary production and consequent food chain support for fish species that depend upon estuarine and shallow marine habitats for survival.

Under Alternative B, a muted tidal condition would be created by breaching the dike in specific locations. There may be temporary, negative effects on Pacific salmon from increased turbidity due to dike breaching, channel modification, and bridge construction. Borrow ditches and other

unnatural drainage features would not be filled and could lead to the development of a less complex channel system. This would result in less overall channel area, a reduced proportion of the estuarine habitat area that is connected to channels, and less channel edge ©. Simenstad, pers. comm). Dike breaching, as opposed to dike removal, may result in a deviation from natural conditions for physical factors that influence the distribution and species composition of vegetation in estuarine habitats. Borrow ditches would likely pond water between tides (ENSR 1999), which may entrap fish. Topographic depressions inside the breached dike area could also trap fish during low tide if not connected to tidal channels. Unlike Alternatives C and D, the dike along the lower portion of the Nisqually River would remain intact. The fully restored area north of Shannon Slough would remain fragmented and separated from the Nisqually River and associated freshwater discharge and river-borne sediments that help build and maintain elevations suitable for plant growth. Therefore, muted estuarine areas of this alternative would not benefit salmonid populations as much as fully functioning restoration alternatives.

Effects to Forage Fish and Other Fishes

Compared to Alternative A, Alternative B would provide some benefits to forage fish and other fish species dependent upon estuarine habitats. This alternative would likely increase the amount of mudflats, a habitat preferred by juvenile and adult starry flounder, juvenile English sole, juvenile and adult Pacific staghorn sculpin, and all life-stages of arrow gobies. This alternative is the only action alternative that retains the dike along the lower portion of the Nisqually River, causing the restored area to remain fragmented and separated from the Nisqually River. This would result in less habitat for spawning and rearing of young starry flounder and less rearing for juvenile English sole than under Alternatives C and D. As with Pacific salmon, temporary effects to forage and other fishes would occur (see above).

4.3.2.2 Refuge Expansion

Effects to Pacific Salmon

Compared to Alternative A, the increased protection of Nisqually River, McAllister Creek, and associated tributaries in Alternative B would benefit salmon in the long term by protecting important spawning and rearing habitat and migrational corridors. If appropriate sites are acquired along the river or creek, riparian or wetland restoration could contribute to improved salmon habitat quality.

Effects to Forage Fish and Other Fishes

Increased protection of Nisqually River, McAllister Creek, and associated tributaries would likely not affect forage fishes but may benefit Pacific staghorn sculpin and starry flounder, which spawn and rear in rivers.

4.3.2.3 Public Use Program

Effects to Pacific Salmon

This alternative would allow the Service to manage a current bank fishing location on the Nisqually River (Trotter's Woods) and potentially create an accessible fishing site at Luhr Beach boat ramp. Nisqually River coho, chinook, and chum salmon and steelhead are co-managed by the State of Washington and the Nisqually Indian Tribe to achieve specific objectives (exploitation rate, escapement, or quota). Harvest-related effects to these stocks associated with an increase in sport fishing opportunity would be estimated and taken into consideration in the development of annual pre-season fishing agreements and associated regulations. Following post-season analyses and reporting of catch records, any adjustments in fishing regulations needed to achieve the desired management objectives for each stock would be made. Thus, effects to Pacific salmon associated with development of additional bank fishing opportunities would be negligible.

Effects to Forage Fish and Other Fishes

The creation of new bank fishing locations along the Nisqually River is not expected to affect these fish species.

4.3.3 Alternative C

4.3.3.1 Habitat Restoration

Effects to Pacific Salmon

Alternative C would restore 50% of the diked area to full estuarine habitat. The unimpeded tidal hydrology of the restored area under this alternative would increase the probability that restored estuarine habitats would function like natural systems. The removal of the dike along the lower portion of the river would allow the river channel to migrate naturally across the floodplain. This is expected to allow for a wider distribution of river-borne sediments that help build and maintain elevations suitable for plant growth and high salt marsh development. This would increase availability and distribution of detrital material to support the food chain, more so than Alternatives A or B. As in Alternative B, temporary adverse effects to Pacific salmon would occur from increased turbidity due to dike removal and channel modification.

Chinook Salmon

An assessment of primary critical habitat issues affecting chinook salmon in 15 Washington State watersheds concluded that estuarine loss was a limiting factor in 14 of the watersheds (Bishop and Morgan 1996). There are a number of factors controlling chinook salmon productivity in the Nisqually River, including ocean conditions, conditions in the estuary, harvest rates, and freshwater habitat effects. To develop comprehensive and integrated multi-species management plans for the Nisqually River basin, the Nisqually Indian Tribe analyzed environmental factors over multiple life history stages to determine current productivity and

prioritize recovery efforts (EDT Work Group 1999). The authors cited permanent protection and restoration of the estuary, which contains habitats critical to chinook salmon (an ESA-listed species), as one of three key factors for rebuilding salmon runs in the Nisqually Basin. Their analysis indicates that these actions in the estuary alone would double the natural production of fall chinook salmon in the Nisqually River and provide multi-species, as well as regional, benefits. Consistent with these observations is the conclusion of the draft Nisqually Basin Fall Chinook Recovery Plan that states “[t]op priorities for rebuilding natural fall chinook salmon production include restoration of the estuary...” (Nisqually Chinook Recovery Team 2001).

There is some evidence of utilization of restored estuarine areas by chinook salmon. Restored estuarine marsh habitat in the Fraser River and Puyallup River estuaries has been extensively used by juvenile chinook salmon (Levings and Nishimura 1997; Shreffler et al. 1990). Juvenile chinook salmon have accessed and utilized a created estuarine slough in the Chehalis River estuary (Simenstad et al. 1992). The diets of the fish indicate that likely sources of their prey are the sediments, marsh and marginal riparian vegetation, and channels. Based on the above studies, restoration of the Nisqually River Estuary under Alternative C would not only substantially increase available rearing habitat, but also offer off-channel refuge from high flows (floods) that could readily sweep fish out to marine waters before they are prepared to go.

Chum Salmon

Juvenile chum salmon, which reside in estuaries for a period of days to weeks, favor tidally influenced creeks through fresh and brackish water marshes, the confluence of major and minor distribution channels in the intertidal zone, and delta margins (Healey 1982). While chum salmon tend to spend less time in the estuary than subyearling chinook salmon, they still depend on the detritus-based food web that estuaries support (Sibert et al. 1977). Restored estuarine marsh habitat in the Fraser, Puyallup, and Snohomish River estuaries has been extensively used by juvenile chum salmon (Levings and Nishimura 1997; Shreffler et al. 1990, 1992.) Levings and Nishimura (1997) found that marked chum salmon fry resided in the restored marsh habitat as long as in undisturbed sites. Juvenile chum salmon have also accessed and utilized a created estuarine slough in the Chehalis River estuary (Simenstad et al. 1992).

Based upon the above studies, restoration of the Nisqually River Estuary, particularly under Alternatives C and D, would not only substantially increase available rearing habitat for juvenile chum salmon, but also offer off-channel refuge from high flows (floods) that could readily sweep fish out to marine waters before they are prepared to go.

Coho Salmon

Coho salmon are less able and take much longer to adapt to saline water than chum or chinook salmon (Crone and Bond 1976; Kennedy et al. 1976). Estuaries are important staging areas for coho salmon for the physiological transition needed when moving from fresh to saltwater. Downstream migrant coho salmon sub-yearlings that are unable to find suitable low salinity habitat may be forced to more brackish or marine waters, lowering their chance for survival.

Rapid growth of sub-yearling coho salmon in estuarine side channels of the Chehalis River has been reported (Miller 1993). Restored estuarine marsh habitat in the Chehalis River estuary and tidal fresh and oligohaline habitats in the Snohomish River have also been extensively utilized by juvenile coho salmon (Cordell et al. 1999; Simenstad et al. 1992). These restored sites have produced juvenile salmon prey organisms in densities that equaled or exceeded those at reference sites. Food habits of juvenile coho salmon in restored intertidal wetlands also appear to be similar to those occupying “natural” wetlands (Aitkin 1998).

Juvenile coho salmon utilize the Nisqually River Estuary during the spring and summer months; in a study conducted during 1980, the dominant prey item of juveniles was found to be sand lance (Pearce et al. 1982). An increase in forage fish abundance in the Nisqually Estuary due to estuarine restoration would likely benefit coho salmon. Based on the above studies, restoration of the Nisqually River Estuary under Alternative C would not only substantially increase available habitat for juvenile coho salmon to complete their transition from fresh to marine waters, but would also increase their forage base and offer off-channel refuge from high flows that could sweep fish out to marine waters before they are prepared to go.

Effects to Forage Fish and Other Fishes

Although there would be some temporary effects to fish from dike removal and channel modification (see above discussion in Pacific salmon), Alternative C would benefit the fish resources of the Nisqually River watershed. These benefits would exceed those offered by Alternative B, where a smaller extent of intertidal habitat restoration and muted tidal habitat restoration is considered. The unimpeded tidal hydrology of the restored area under Alternative C would increase the probability that restored estuarine habitats would function like natural systems. Under Alternative C, habitat for estuarine-dependent fish would be increased in both quantity and quality. This alternative would likely provide more foraging and rearing habitat preferred by these species than under Alternative A or B and may provide some spawning habitat for estuarine spawners.

Restoration of the estuary would increase primary production and consequent food chain support for nearly all fish species that depend on estuarine and shallow marine habitats for survival, including prey fish species preferred by bull trout. An increase in forage fish abundance in the Nisqually Estuary due to estuarine restoration would likely benefit bull trout. Based on field studies of bull trout in north Puget Sound, restoration of the Nisqually River Estuary under Alternative C would substantially increase available foraging and rearing habitat for juvenile, sub-adult, and adult bull trout ©. Cook-Tabor, pers. comm.).

4.3.3.2 Refuge Expansion

Effects to Pacific Salmon, Forage Fish, and Other Fish

Same as Alternative B.

4.3.3.3 Public Use Program

Effects to Pacific Salmon

Proposals to changes in bank fishing opportunities are similar to Alternative B, except for additional bank fishing locations on the Nisqually River, east of the river, and north of I-5. This would result in greater fishing opportunities on the Nisqually River. However, as described in Alternative B, harvest-related effects to salmon and steelhead stocks would be estimated and taken into consideration in the development of annual pre-season fishing agreements and associated regulations.

Forage Fish and Other Fishes

The creation of new bank fishing locations along the Nisqually River is not expected to affect these fish species.

4.3.4 Alternative D (Preferred Alternative)

4.3.4.1 Habitat Restoration

Effects to Pacific Salmon

Pacific salmon runs in the Nisqually River would benefit most under Alternative D, relative to all the alternatives. This alternative would restore 70% of the diked area to full estuarine habitat, creating larger, more complex estuarine system than any other alternative. Management actions under Alternative D would rehabilitate habitat-forming processes of the estuarine system that were degraded by the construction of the dike. Alternative D would produce the largest conversion of freshwater wetland area to estuarine habitats considered, as well as the largest increase in vegetated salt marsh habitat. Any increases in estuarine habitats with marsh vegetation cover would lead to increased total primary productivity, as well as increased availability and distribution of detrital material. Effects to chum, coho, and chinook salmon would be similar to those described under Alternative C, but would be substantially more beneficial in this alternative.

The removal of the dike along the lower portion of the Nisqually River would allow the river channel to migrate naturally across the floodplain. This would allow for a wider distribution of river-borne sediments that help build and maintain elevations suitable for plant growth, resulting in increased availability and distribution of detrital material. Detritus is a key component of estuarine habitat food webs, including those that support prey resources important to juvenile salmon and other fish species (Naiman and Sibert 1979; Northcote et al. 1979). Decomposing marsh plants release nutrients that would otherwise remain in the sediments (Dorcey et al. 1978). Invertebrates, important food resources for fishes, feed upon the decomposing marsh plants as they break up into organic particles or detritus.

Due to insufficient study or wide ranges in data on juvenile use of and benefit from estuarine rearing, it is not possible to accurately estimate the increased salmon production that would result from restoration of tidal function to the Nisqually River Estuary under the various alternatives. Monitoring efforts of a small estuarine restoration project on Red Salmon Creek, east of the Nisqually River, have documented presence of chinook salmon. In May 1999, 3 years after the former pastureland area was restored, 691 chinook salmon were observed (J. Dorner, pers. comm.). These data, as well as the research findings on the importance of estuarine rearing cited above, support the expectation that the estuarine restoration proposed in Alternative D would offer the most substantial benefit to the different populations. Restoration of the Nisqually River Estuary under Alternative D would not only substantially increase available rearing habitat but also offer off-channel refuge from high flows (floods) that could readily sweep fish out to marine waters before they are prepared to go.

Effects to Forage Fish and Other Fishes

Alternative D would offer a variety of benefits that are significant to the fish resources of the Nisqually River watershed, exceeding those offered by other alternatives. Habitat for estuarine-dependent fish would be greatly increased in both quantity and quality. Because of its parallel orientation relative to the river and floodplain, restoration in Alternative D would provide the greatest diversity of estuarine habitat types. Greater diversity would result from the range of elevations, salinity, and exposure, and the full mix of habitats that existed in the estuary historically would be provided long-term. On the other hand, Alternatives B and C would increase the amount of intertidal habitat in an east to west orientation across the face of the delta, and thus would not provide this same diversity in physical conditions and thus habitat types.

Anadromous bull trout would benefit most under Alternative D, followed by Alternatives C and B, because of an expected increase in forage fish abundance in the Nisqually Estuary due to restoration.

Pacific herring and surf smelt depend on the nearshore marine environment. All life stages of these species utilize Puget Sound estuaries. They spawn in intertidal or shallow subtidal waters at very specific locations throughout Puget Sound and rear in nearshore, shallow water areas (Emmett et al. 1991). Due to this dependence, Alternative D would be the most favorable for Pacific herring and surf smelt due to the creation of a larger, more complete and functional estuarine system. This alternative is the most likely to provide not only the most foraging and rearing habitat preferred by these species, but may also provide spawning habitat. Alternative C would be the next most favorable, for similar reasons, followed by Alternative B.

Although extensive studies documenting the utilization of restored estuarine habitats in Puget Sound by non-salmonids are not abundant, some examples are available. Starry flounder were found to utilize a wetland site restored to tidal inundation by breaching a dike in the Snohomish River estuary (Cordell et al. 1998). Due to the spawning and rearing requirements of starry flounder and English sole, Alternative D would be the most favorable for these species. This alternative would be the most likely to provide not only the most foraging and rearing habitat

preferred by these species, but may also provide more spawning habitat for starry flounders than currently exists.

Pacific tomcod, Pacific staghorn sculpin, shiner perch, and arrow goby would also benefit from estuarine restoration in Alternatives B to D. The increased total available habitat, primary production, and associated increase in detrital material under the action alternatives would expand the rearing habitat and foraging opportunities for these species over current conditions. In addition, an increase in estuarine habitat may provide more spawning habitat for arrow gobies and Pacific staghorn sculpin, both estuarine spawners. An increase in forage fish abundance likely to occur under the action alternatives would benefit the fish-eating fishes, such as adult Pacific tomcod and large Pacific staghorn sculpin. Pacific staghorn sculpin feed at high tide on mudflats (Love 1991) and have been found to utilize a created estuarine slough of the Chehalis River (Simenstad et al. 1992) and a wetland site restored to tidal inundation by breaching a dike in the Snohomish River estuary (Cordell et al. 1998). Shiner perch were also found to extensively utilize a created estuarine slough of the Chehalis River (Simenstad et al. 1992).

4.3.4.2 Refuge Expansion

Effects to Pacific Salmon

Effects would be similar to Alternative C, except the slightly greater protection of the Nisqually River corridor under Alternative D would provide even greater benefits.

Effects to Forage Fish and Other Fishes

Same as Alternatives B and C.

4.3.4.3 Public Use Program

Effects to Pacific Salmon

This alternative may create two or three new bank fishing locations on the Nisqually River, resulting in greater fishing opportunity. See Alternative B for a description of the associated harvest-related effects.

Effects to Forage Fish and Other Fishes

The creation of new bank fishing locations along the Nisqually River is not expected to affect these fish species.

4.3.5 Effects to Threatened and Endangered Species

4.3.5.1 *Alternative A*

Habitat Restoration, Refuge Expansion, and Public Use Program

This alternative would not increase the amount or quality of essential habitat of chinook salmon or bull trout. However, these species would benefit, although not significantly, from more uniform land protection and conservation within the Refuge. The increase in watershed-wide habitat protection under this alternative may increase water and intertidal habitat quality and could slightly improve foraging conditions for salmon and bull trout. The public use program under this alternative is not expected to affect chinook salmon or bull trout.

4.3.5.2 *Action Alternatives B - D*

Estuarine restoration under Alternatives B, C, or D would increase the amount (458, 515, and 699 acres, respectively) and improve the quality of essential habitats of chinook salmon and bull trout. No long-term adverse effects to chinook salmon compared to baseline conditions would be anticipated under the action alternatives. There may be temporary negative effects from reduced water quality caused by increased turbidity due to dike removal and channel modifications.

Little is known about the current status of the bull trout in the Nisqually River system (WDFW 1997). Anadromous bull trout, if present, would benefit most under Alternative D, followed by Alternatives C, and B, respectively. Restoration of the estuary is expected to result in increased primary production and consequent food chain support for nearly all fish species which depend upon estuarine and shallow marine habitats for survival, including prey fish species preferred by bull trout. An increase in forage fish abundance in the Nisqually Estuary due to estuarine restoration would likely benefit bull trout. Based upon these studies of bull trout in north Puget Sound, restoration of the Nisqually River estuary, particularly under Alternatives D and C, would substantially increase available foraging and rearing habitat for juvenile, sub-adult, and adult bull trout.

4.4 Effects to Wildlife

Under all alternatives, resource monitoring programs would be implemented. Refuge wildlife monitoring is a priority for the NWRs and would support adaptive management techniques that could be utilized for the benefit of various wildlife species (USFWS 2000). Potential effects are described below for birds, mammals, reptiles and amphibians, invasive and exotic species, and threatened and endangered species.

4.4.1 Effects to Birds

4.4.1.1 *Alternative A*

Habitat Restoration

Effects to Waterfowl, Waterbirds, Seabirds, and Shorebirds

A number of waterfowl, waterbird, seabird, and shorebird species use the freshwater wetlands within the diked area on the Refuge, particularly the seasonally flooded ponds. Waterfowl, such as American wigeon, Canada geese, mallards, and northern shovelers, make extensive use of specific types of freshwater wetlands and would benefit from the continued existence of this habitat within the Refuge boundary. Waterbirds that use permanent ponds or sloughs, such as great blue herons, American bitterns, and Virginia rails, would also benefit from the continued management of these areas. In addition, dunlin, common snipe, and killdeer use flooded wetlands and grasslands within the diked area. Shorebirds, such as common snipe and killdeer have both been documented to be declining in Washington State and across the region (Sauer et al. 2000) and would benefit from the continued management of freshwater wetlands and grasslands.

The management of current grassland habitat would continue to benefit Canada geese, particularly migrant populations. Geese currently concentrate in Refuge grasslands and would continue to do so under this alternative. Migratory populations are not considered to be increasing in Washington, unlike the resident population (United States Department of Agriculture [USDA] 1999). It is uncertain if Canada geese resident populations would increase under this alternative, but increases would be likely based on regional trends. Supporting large resident Canada geese populations can have detrimental effects on other Refuge flora and fauna (Smith et al. 1999). However, current resident populations are low and are not affecting habitat conditions.

Benefits to waterfowl, waterbirds, and shorebirds would gradually continue to decline because of the increased challenge of maintaining the quality of the freshwater wetlands and grasslands within the diked area. Habitat quality within the dike is declining as reed canary grass dominance continues, modifying the vegetation community and closing in open water areas (see Section 4.2.1). Although limited reed canary grass control would be implemented, its expansion would be expected to increase and would decrease seasonally flooded wetlands in the long term.

The continued conversion of grasslands to scrub-shrub habitat would also decrease the availability of seasonal wetland habitat used by waterfowl, herons, and shorebirds. In addition, the current dike system is not stable and is expected to deteriorate over time. Repair work may increase short-term sedimentation and thus negatively affect waterfowl and waterbirds. Long-term examination of the diked system indicates that it would not naturally maintain itself, contributing to saltwater intrusion, which would decrease habitat value for all areas (see Section 4.2.1).

Although freshwater wetlands on the Refuge provide habitat for some ducks and geese, Refuge monitoring data suggest that the majority of waterfowl use estuary areas (see Section 3.4.1). In addition, other species, such as herons, dunlins, western sandpiper, loons, gulls, and terns, concentrate in the estuary areas. The persistence of the current dike system may still affect the existing estuary due to tidal mudflat erosion, artificial sediment accretion patterns, and reduced tidal prism (see Section 4.2.1). Populations of American wigeon and other waterfowl on the Refuge have been declining in recent years. A possible cause for this decline is the change in habitat types in the region. Additional loss or deterioration of estuarine habitats in Puget Sound would continue to adversely affect many waterfowl species (Quiñonez 2001).

There is international concern regarding the long-term sustainability of shorebird species (Brown et al. 2000). Western sandpipers are considered a priority species in Washington due to their levels of concentration in certain areas (WDFW 2001). Estuaries are critical habitat because they typically support a great abundance and diversity of shorebirds compared to other habitats in the North Pacific region (Drut and Buchanan 2000). Threats to estuary-dependent species would continue under Alternative A due to maintenance of the current dike system, which would further degrade the existing estuary (Section 4.2.1). This alternative does not address estuarine restoration priorities identified in the Pacific Coast Joint Venture Strategic Plan (Pacific Coast Joint Venture 1996) and the Northern Pacific Coast Regional Shorebird Management Plan (Drut and Buchanan 2000). Overall, as discussed in Section 4.2.1, the estuarine habitats in the delta would not benefit from actions proposed in this alternative. The limited health and function of the salt marshes and sloughs of the delta would result in a less productive, less complex, lower channel order system that provides less habitat for waterfowl, waterbirds, seabirds, and shorebirds.

Effects to Landbirds

Raptors

Red-tailed hawks, barn owls, and northern harriers would benefit the most of all raptors from retaining the diked freshwater wetlands and grasslands. However, as described in Section 4.2.1, habitat quality within the dike is declining. The continued conversion from open wetlands and grasslands to scrub-shrub or reed canary grass dominated habitat would limit raptor use of the diked areas in the long term. Populations of other raptor species that forage in estuary areas, such as eagles, peregrine falcons, and osprey, could be negatively affected in the long-term, although not significantly, from the continued deterioration of estuarine habitat under this alternative (see Section 4.2.1).

The restoration of the West Bluff parcel, as called for under all alternatives, would enhance raptor habitat and have positive effects. Bald eagles that nest in this area would benefit from enhanced forest quality around the nest site. Washington State species guidelines indicate that eagles benefit from contiguous forested habitat with low human disturbance (Rodrick and Milner 1991). In addition to eagle habitat improvements, other raptor species, such as red-tailed hawks or owls, would benefit as most of these species nest or perch in trees along the West Bluff parcel.

Passerines and Nonpasserines

The restoration of the West Bluff parcel, common to all alternatives, would benefit passerine and nonpasserine species. Notable species that could benefit from enhanced forest habitat include downy woodpecker, Swainson's thrush, band-tailed pigeon, rufous hummingbird, olive-sided flycatcher, and yellow warbler. All of these species are declining in Washington State (Sauer et al. 2000).

Species that use the estuary, such as swallows, marsh wren, and finches, could be negatively affected by the continued deterioration of the estuarine habitat (Section 4.2.1). The retention of 1,000 acres of freshwater wetland and grassland habitat under Alternative A would continue to benefit certain passerines, such as savanna sparrows and goldfinches, that are associated most with this habitat type. However, the limited freshwater habitat enhancements under this alternative are not expected to significantly improve habitat quality over the long term. Freshwater wetlands within the current Refuge boundary are expected to deteriorate over time as a result of ongoing exotic species invasion and conversion to scrub-shrub habitat (Section 4.2.1). Thus, benefits from the availability of freshwater wetlands to passerines and nonpasserines are not expected to increase significantly, but instead could eventually decrease due to deteriorated habitat conditions.

Refuge Expansion

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

Under Alternative A, no expansion of the Refuge boundary would occur. Indirect benefits to waterfowl, waterbirds, seabirds, shorebirds, and landbirds would occur if efforts to strengthen watershed protection through partnerships outside of the Refuge boundary were successful. Increased watershed protection would improve water quality and associated habitat for the various avian species.

Efforts to acquire in-holdings within the existing boundary would continue under all alternatives. Acquisition of in-holdings consisting of estuarine habitat would eliminate the fragmented management of estuarine areas within the delta. Coastal wetlands are critical to shorebird migration as foraging sites (Page and Gill 1994). The documented widespread decline in estuarine habitat threatens shorebird population viability throughout the region (Drut and Buchanan 2000). Acquisition and long-term protection of these areas would benefit waterfowl, waterbird, seabird, and shorebird species.

Public Use Program

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

Under Alternative A, the recreational trail system would not change and would continue to be used for hiking and wildlife observation. Although this activity could have negative effects on avian species, especially those using habitats adjacent to trails, effects would be reduced through provisions described below. Studies have shown that migrant waterfowl are particularly vulnerable to disturbances from trail-based recreation (Klein et al. 1995). Many waterbird species were found to decrease their foraging time and increase their vigilance when people were nearby (Burger and Gochfeld 1998). Birds can be affected by human activities on trails when they are repeatedly disturbed and flushed from feeding, resting, or nesting areas. Shorebird numbers were reduced near people who were walking or jogging and about 50% of flushed birds flew elsewhere (Burger 1981). Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, increase exposure to predation, or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Recreational effects can have long-term cumulative effects that cause avian species to abandon otherwise suitable habitat (Riffell et al. 1996). However, since the number of trail users would be limited by the Refuge parking lot capacity (100-car maximum), the number of Refuge visitors on the trail system at one time is not expected to be exceptionally high. In addition, the requirement to stay on trails and designated sanctuary areas would greatly lessen human disturbance. Vegetative screening (plantings) would also reduce disturbance and increase wildlife viewing opportunities. Refuge outreach programs would emphasize responsible behavior of Refuge visitors and thus lessen wildlife disturbance (DeLong and Schmidt 1998; Larson 1995).

Under all alternatives, the restriction of fruit harvesting would benefit many passerines and nonpasserines that use these resources for forage, as well as reduce the potential for visitors to wander off trails for fruit picking. The primitive trail in the surge plain (common to all alternatives) could have negative effects on passerines and nonpasserines that occur in this habitat, especially if visitors wander off trail into the habitat. For many passerine species, primary song occurrence and consistency can be affected by a single visitor (Gutzwiller et al. 1994). This could potentially limit the number of breeding pairs of certain passerine species, thus limiting production (Reijnen and Foppen 1994). However, measures described above would lessen disturbance.

The environmental education program under Alternative A would be limited, serving up to 5,000 students each year. Since activities associated with this program would be focused on trails or within the Environmental Education Center, no significant effects to avian species are expected. Design of existing and new trails and facilities would provide adequate sanctuary for avian populations. A reservation system would be used to enforce a daily limit (100 students) for educational groups. A reduction in human disturbance along the west shoreline of McAllister Creek would benefit bald eagles and osprey, which frequent the area for foraging. Improved protection measures there would occur under all alternatives and would positively affect raptors.

Under this alternative, hunting would occur as it does currently on WDFW lands and much of the Refuge tideflats. The continued presence and associated activity of hunters across a wide area could have negative consequences to waterfowl, which are sensitive to disturbance. The amount of waterfowl harvest is not expected to have a measurable effect on Refuge populations, especially since waterfowl hunting activity is not extremely high in the delta. For example, the average hunter visits per day was 8.4 during the 1998/99 season (USFWS unpublished data). Direct effects of hunting on waterfowl are mortality, wounding, and disturbance (DeLong 2002). Hunting can alter behavior (foraging time), population structure, and distribution patterns of wildlife (Owens 1977, Raveling 1979, White-Robinson 1982, Thomas 1983, Bartelt 1987, Madsen 1985, and Cole and Knight 1990). In Denmark, hunting was documented to affect the diversity and number of birds using a site (Madsen 1995). Avian diversity changed from predominantly mute swan and mallard to a more even distribution of a greater number of species when a sanctuary was established. Hence, species diversity increased with the elimination of hunting.

There also appears to be an inverse relationship between the numbers of birds using an area and hunting intensity (DeLong 2002). In Connecticut, lesser scaup were observed to forage less in areas that were heavily hunted (Cronan 1957). In California, the numbers of northern pintails on Sacramento NWR non-hunt areas increased after the first week of hunting and remained high until the season was over in early January (Heitmeyer and Raveling 1988). Following the close of hunting season, ducks generally increased their use of the hunt area; however, use was lower than before the hunting season began.

Human disturbance to wintering birds and other wildlife using the open waters and marshes on the Nisqually delta would occur as a result of hunting activity. Migratory and wintering waterfowl generally attempt to minimize time spent in flight and maximize foraging time because flight requires considerably more energy than any other activity, other than egg laying. Human disturbance associated with hunting includes loud noises and rapid movements, such as those produced by shotguns and boats powered by outboard motors. This disturbance, especially when repeated over a period of time, compels waterfowl to change food habits, feed only at night, lose weight, or desert the feeding area (Belanger and Bedard 1995, Madsen 1995, Wolder 1993). Disturbance levels from hunting activity outside Chincoteague NWR were found to be high enough to force wintering black ducks into a pattern of nocturnal feeding within surrounding salt marsh and diurnal resting within refuge impoundments (Morton et al. 1989a, 1989b). Unhunted populations have been documented to behave differently from hunted ones (Wood 1993).

These impacts can be reduced by the presence of adjacent sanctuary areas where hunting does not occur, and birds can feed and rest relatively undisturbed. Sanctuaries or non-hunt areas have been identified as the most common solution to disturbance problems caused from hunting (Havera et. al 1992). Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1995, Paulus 1984). In Denmark, hunting disturbance effects were experimentally tested by establishing two sanctuaries (Madsen 1995). Over a 5-year period, these sanctuaries became two of the most important staging areas for coastal waterfowl. Numbers of dabbling ducks and geese increased 4 to 20 fold

within the sanctuary, and these species prolonged their staging periods up to several months compared to baseline periods (Madsen 1995). Thus, sanctuary areas are very important to minimize disturbance to waterfowl populations to ensure their continued use of the Nisqually delta.

Boating activity associated with hunting during the fall and winter can alter distribution, reduce use of particular habitats or entire areas by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). In the upper Midwest, motor boating and hunting have been found to be the two main activities that disturb waterfowl (Korschgen et al. 1985). In Connecticut, selection of feeding sites by lesser scaup was influenced by disturbances such as hunters, anglers, and pleasure boaters (Cronan 1957).

Recreational boating, estimated at 6,700 boats per year on the Refuge, can directly affect distribution and habitat use by migratory birds. More sensitive species may find it difficult to secure adequate food or loafing sites as their preferred habitat becomes fragmented and recreation-related disturbances increase (Skagen et al. 1991; Pfister et al. 1992). Motorized boats are likely to have more impact on wildlife than non-motorized boats because motorboats produce a combination of movement and noise (Tuite et al. 1983; Knight and Cole 1995). For example, a significant decrease in the proportion of bald eagles feeding at a site was observed when motorized boating activity occurred within 200 meters of that area in the preceding 30 minutes (Skagen 1980). Motorized boats can also cover a larger area in a relatively short time, in comparison to non-motorized boats. Boating pressure on wintering waterfowl in Germany had reached such a high level that it was necessary to establish larger sanctuaries and implement a seasonal closure on water sports and angling (Bauer et al. 1992).

Even canoes and kayaks can cause significant disturbance effects based on their ability to penetrate into shallower areas of the marsh (Speight 1973; Knight and Cole 1995). In the Ozark National Scenic Riverway, green-backed heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow-moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985). Huffman (1999) found that non-motorized boats within 30 meters of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964; Huffman 1999; DeLong 2002).

The presence of fast-moving boats also caused the most significant modifications to the amount of time animals spent feeding and resting. In England, an increased rate of disturbance from boats partly caused a decline in roosting numbers of shorebird species (Burton et al. 1996). In addition, boaters have been observed to cause massive flights of diving ducks on the Mississippi River (Thornburg 1973). Motorized boats within 100 meters of shore caused all wintering waterfowl and shorebirds to flush between the craft and shore in south San Diego Bay, regardless of speed (Huffman 1999). However, disturbance to birds in general was reduced when boats traveled at 5 mph speed limits.

Impacts of boating can occur even at low densities, given their noise, speed, and ability to cover extensive areas in a short amount of time. The total number of boats and people can be an inappropriate measure of recreational intensity because the presence of a single boat might be just as disturbing as that of many (Tuite et al. 1983; Knight and Knight 1984). This is especially the case in the RNA and McAllister Creek, both areas with high waterfowl use. Service survey data show that the RNA provides important resting and feeding habitat for large numbers of wintering waterfowl, including many wigeon, the predominant waterfowl species on the Refuge. Typically, the largest waterfowl concentrations are found in the RNA during the winter months.

The habitat along McAllister Creek is a relatively narrow tidal system that receives high use by a variety of waterfowl, waterbirds, wading birds, and raptors. Because boats in confined areas are generally closer to shorelines, waterbirds in tidal creeks and rivers may be exposed to more human activity than birds at other shoreline habitats (Bratton 1990). Even low levels of boating activity affect the duration and pattern of use by wildlife in this narrow system.

Boating activity also disturbs nesting birds. In Denmark, fast-moving boats were observed to have the greatest impact on red-breasted merganser broods (Kahlert 1994). An active bald eagle nest is located along McAllister Creek. The nesting period identified in the Bald Eagle Recovery Plan identifies January 1 as the beginning of the nesting season when special protective measures should begin (USFWS 1986). A great blue heron nesting colony, located along McAllister Creek since the 1970s, has been declining for several years. Nesting great blue herons are sensitive to a variety of human disturbances. Great blue herons were one of the more sensitive of 23 waterbird species, when measuring flush distances from motorized boats and PWC (Rodgers and Schwikert 2002). Washington State requires a minimum 300-meter buffer zone to protect colonies from human disturbances (WDFW 2001). However, boating activity in McAllister Creek falls within this buffer zone. It is possible that boating activities may be one of the contributing factors affecting these nesting birds.

PWC have more impact on wildlife than other motorized or non-motorized boats because they operate at high speeds and can maneuver into shallow areas (6 inches deep), penetrating areas not available to conventional boats (Izaak Walton League of America 1999). PWC have the capability to operate on top of salt marshes or mudflats with little or no standing water, causing direct damage to soils and habitat. The rapid overwater movement and loud noise created by PWC have been found to be the most disturbing type of boating activities for wildlife (Dalgren and Korschgen 1992). PWC produce noise levels in the range of 85 to 105 decibels (dB) per unit according to data produced by the National Park and Conservation Association (1997). The continual change in loudness and pitch during normal use make PWC more disturbing than the constant sounds of conventional motorized boats. PWC have been observed flushing wading birds and nesting ospreys in Florida (Snow 1989). PWC use also affected nesting success of common terns at Barnegat Bay, New Jersey, with larger numbers flushing in response to PWC than motorboats (Burger 1998). Rodgers and Schwikert (2002) found that great blue herons exhibited a greater flush distance from PWC compared to motorized boats.

Motorized boats introduce pollution, in the form of gas and oil in water, and particulates in the air in estuarine and riverine habitats at the Refuge. Two-stroke engines may lose about 25 to 40% of the unburned fuel and oil mix directly into the water (Muratori 1968). An EPA report

indicates that two-stroke engines found on many motorized boats and typical of PWC discharge as much as 25% of unspent oil and gas directly into the water. Hydrocarbons in gas and oil released from two-stroke engines float on the surface and settle within shallow estuarine habitats. Hydrocarbon pollution has been found to bioaccumulate within the complex food web, posing a serious threat to the marine environment (Tjamlund et al. 1993). Hydrocarbons can also be transferred to eggs from the plumage of incubating birds. Extremely small amounts of petroleum hydrocarbons can be toxic to eggs and birds that may ingest it (Hoffman 1989). PWC emit significantly more pollution than two-stroke outboards due to differences in horsepower, payload, and operation (California Air Resources Board 1998). The EPA has adopted regulations (40 CFR Part 91) that require marine engine manufacturers to improve the efficiency of engines by 2006. The EPA expects a 50% reduction in hydrocarbon emissions from present levels in marine engines by 2020.

Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1995; Paulus 1984). In Denmark, disturbance effects were experimentally tested by establishing two sanctuaries (Madsen 1995). Over a 5-year period, these sanctuaries became two of the most important staging areas for coastal waterfowl. Numbers of dabbling ducks and geese increased 4 to 20 fold within the sanctuary, and these species prolonged their staging periods up to several months compared to baseline periods. Thus, protection from disturbance is very important to waterfowl to ensure their continued use of the Nisqually delta.

Motorized boats and PWC use also result in conflicts with individuals participating in wildlife-dependent priority public uses, such as canoers, kayakers, wildlife observers, and anglers. Rapid movement and loud noise, particularly associated with PWC, flush wildlife, taking away wildlife observation opportunities. Loud noise and rapid, repeated movement disrupt the experience of visitors participating in priority public uses, including viewing wildlife. Dungeness NWR and San Juan County in northwest Washington have eliminated PWC use to reduce wildlife disturbance and conflicts with other users, and Thurston County has recently strengthened localized regulations.

4.4.1.2 Alternative B

Habitat Restoration

Effects to Waterfowl, Waterbirds, Seabirds, and Shorebirds

Under Alternative B, 318 acres of diked habitat would be restored to a muted estuarine system, and 140 acres would be restored to a fully functioning estuarine system. Alternative B is the only action alternative that would create muted estuarine habitat, which affects its function and predictability of success.

Waterfowl, waterbird, seabird, and shorebird species that use the estuary would most likely benefit from restoration actions. The magnitude of benefit would depend on the extent to which these species use the muted estuarine area. Dabbling ducks, such as American wigeon, have been observed to use temporary muted estuary areas that resulted from past dike breaching

events at the Refuge (Klotz et al. 1978). However, predicted waterfowl use in muted estuarine areas is uncertain because long-term habitat response may not be equivalent to short-term events. The ability of muted estuarine habitats to mimic the structure and function of full estuarine habitat is not well known (Section 4.2.2). The extent of the benefits depends on the dynamics of the tidal interchange that would result from the restoration. Consequently, the benefit to waterfowl, waterbirds, seabirds, and shorebirds is uncertain. Species that primarily use estuarine habitat, such as American wigeon, green-winged teal, and bufflehead, are expected to benefit from the creation of the muted estuary. Herons are also likely to use the muted estuarine area since they currently utilize all the habitats of the Refuge and are known to be generalist feeders (see Section 3.4.2). Dunlin and other shorebird species are also expected to use the newly established mudflats that would serve as feeding areas. In addition, roosting and feeding areas may be available at different times due to delayed tidal flows, which could benefit shorebirds when adjacent tidal areas are inundated. The extent of the benefits expected under this alternative depends on the dynamics of the tidal interchange that would result from the restoration.

There is more certainty that the fully restored estuarine area would benefit these same estuary-dependent species. In addition, loons, gulls, mergansers, and other water-associated birds that use estuarine habitat would benefit from a larger estuary area in the delta. However, use of both muted and full estuarine areas by these species may not be immediate. The newly breached areas would experience a short-term loss of vegetation as plants not adapted to saltwater die and are gradually replaced by saline-tolerant species (Harris and Marshall 1963). This would then be followed by a period of transition, when intertidal and salt marsh plants and invertebrates colonize. This process could temporarily decrease prey for avian species.

Alternative B addresses the estuarine restoration priority for shorebird and waterfowl management identified in the Pacific Coast Joint Venture Strategic Plan (Pacific Coast Joint Venture 1996) and the Northern Pacific Coast Regional Shorebird Management Plan (Drut and Buchanan 2000). Alternative B would provide more estuarine habitat than Alternative A. However, the benefits from estuarine restoration under Alternative B would not be as great as those under Alternatives C or D because the area provided is smaller and includes a high proportion of muted estuarine habitat.

Some avian species would be negatively affected by the conversion of freshwater habitat to estuarine habitat. Species such as American bittern, sora, Virginia rail, and green heron would lose some freshwater habitat. The conversion of the north Shannon Slough system to a full estuarine area would temporarily negatively affect several waterfowl species that currently use the area. Since many of these waterfowl species also use the estuary, they would not be significantly affected by this loss. In addition, loss of freshwater habitat would also temporarily affect some shorebird species, such as breeding snipe and killdeer. The estuarine restoration areas are currently not the primary areas on the Refuge in which these species occur; therefore, the effects would not be significant. In addition, the improvements in freshwater habitat management on the remaining diked area are expected to increase habitat quality for these freshwater-dependent species, including high tide roosting sites for shorebirds. The wood duck is another freshwater-dependent species that would lose nesting and foraging habitat around the ring dike area. However, the remainder of the riparian corridor along the Nisqually River is

expected to remain, and riparian restoration within the dike would enhance available habitat for this species.

As described in Alternative A, the persistence of the current dike system may still affect the existing estuary due to tidal mudflat erosion, artificial sediment accretion patterns, and reduced tidal prism (see Section 4.2.1). The limited health and function of the salt marshes and sloughs of the delta would result in a less productive, less complex channel system that provides less habitat for waterfowl, waterbirds, seabirds, and shorebirds.

Freshwater habitat improvements proposed in Alternative B would benefit many waterfowl, waterbird, and shorebird species and would reduce the effects from the conversion of freshwater habitat to estuarine habitat. Freshwater wetland habitats are limited in the Puget Sound region (Tanner 1999), especially areas without reed canary grass. Improvements in these freshwater habitats on the Refuge would benefit regional waterfowl populations (Hoffman and Kearns 1997). Alternative B offers the largest freshwater wetland area compared to Alternatives C and D, although the large diked area in Alternative B would limit water management capabilities and the control of reed canary grass, resulting in limited improvements in freshwater habitat quality (see Section 4.2.2). However, species such as wood duck, killdeer, rails, and soras, which primarily use the freshwater habitats, would benefit to some degree from improved freshwater habitat.

The maintenance and creation of dike systems and other project implementation actions may lead to short-term increases in sedimentation in a few wetland areas. This could negatively affect waterfowl and waterbirds that use these areas through a short-term decline in prey availability (Waters 1995).

Effects to Landbirds

Raptors

The creation of additional estuarine habitat under this alternative would increase winter waterfowl numbers benefitting some raptor species, such as eagles, osprey, falcons, and northern harriers that feed regularly in the estuary. However, since Alternative B has the least amount of estuarine restoration compared to Alternatives C and D, it would least benefit raptor species using the estuary. The extent of benefit to these species would also depend on the response of prey populations in the muted estuarine area; as described above, there is uncertainty whether the muted estuarine area would successfully mimic the structure and function of fully functional estuarine habitat, and the effect on raptor species is more difficult to predict.

The estuarine habitat created under Alternative B would be configured with more patchiness and edges than under Alternative C or D. This could benefit red-tailed hawks, sharp-shinned hawks, and other raptors that forage successfully along edges. However, this edge effect can have negative long-term effects on all raptor species as fragmented prey populations may not sustain themselves as well as those in more continuous areas (Meffe and Carroll 1994). Larger and more contiguous habitat would be more beneficial in terms of species viability; thus, this alternative would have fewer benefits relative to Alternatives C and D (Morrison et al. 1992; Noss et al. 1997).

Freshwater and grassland habitat improvements in Alternative B would benefit raptor species that use these areas, especially those that feed more predominantly on small mammals. Owls, red-tailed hawks, and northern harriers would all benefit, although not significantly. Benefits to these species would be limited because of minimal freshwater and grassland management (see Section 4.2.2). In addition, these species, especially northern harriers and great-horned owls, forage in estuarine habitats as well.

Common to Alternatives B, C, and D are short-term vegetation die-backs associated with the shift from fresh to saltwater systems. As described above, the expected short-term effects to prey species would also negatively affect raptor species. Negative effects to prey species associated with the maintenance of dike structures would also affect raptor species.

Passerines and Nonpasserines

The restoration of estuarine habitat would benefit some passerine and nonpasserine species. Species that regularly use this habitat include swallows, kingfishers, common yellowthroats, song sparrows, and red-winged blackbirds. As described above, Alternative B would provide the least benefit to passerine and nonpasserine species that use the estuary, as compared to Alternatives C and D. European starlings may have an advantage under Alternative B due to the increase in edges and fragmentation of the estuarine habitat. It is likely that starlings would persist on the Refuge under all alternatives due to the proximity of the Refuge to human development and thus would continue to compete with native birds for feeding and nesting habitat.

The conversion of freshwater to estuarine habitat would negatively affect some passerine and nonpasserine species that primarily use freshwater and grassland habitats. These include purple and house finches, northern flickers, western meadowlarks, hummingbirds, and savanna sparrows. However, improvement in freshwater habitat management would increase the quality of the remaining diked area. Currently, freshwater wetlands are degraded because of the dominance of reed canary grass. Restoration of these areas, especially in terms of exotic species and water level control, would increase carrying capacities of most passerines to be equal or in excess of those areas lost. However, species predominantly found in grasslands (e.g., meadowlarks and savanna sparrows) would be most negatively affected as the proportion of freshwater wetlands would be increased in proportion to grasslands. In addition, the small amount of riparian restoration in this alternative is also expected to improve riparian habitat for passerine and nonpasserine species. Riparian restoration is identified as a conservation management priority in this region in the Conservation of Land Birds Plan (Pashley et al. 2000). The increase in freshwater wetland and riparian habitat quality may reduce the effects of conservation due to estuary restoration. However, benefits to these species would be limited by limited management capabilities in this area (see Section 4.2.2).

Refuge Expansion

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

In addition to effects described in Alternative A, Alternative B proposes 2,407 acres of Refuge expansion. This addition would protect additional forested lands along the East Bluff and floodplain habitat south of I-5. Proposed expansion efforts in Alternatives B, C, and D would

incorporate new freshwater wetland areas into the Refuge. This would provide increased freshwater wetland acreage and some grasslands that could reduce the effects from the conversion of freshwater wetland and grasslands to estuarine habitat. However, because expansion could occur over many years, this reduction may not occur simultaneously with estuarine restoration.

Acquisition or management of floodplain, freshwater wetland, and grassland areas south of I-5 in the lower Nisqually Valley would provide long-term protection of these areas, as well as restoration opportunities. Seasonal wetland restoration projects on former agricultural lands would be very similar to those conducted on current Refuge lands within the diked area. For example, seasonal wetlands west of the headquarters area were enhanced in 2001 by mowing dense reed canary grass areas, discing, sculpting new depressions and seasonal ponds, and seeding, followed by flooding during the fall and winter months; these projects greatly enhanced waterfowl habitat. This would benefit many species of waterfowl and shorebirds that travel between the Refuge and seasonally flooded wetlands south of I-5. As described above, since Refuge expansion may not occur immediately, benefits to these species may not occur in the short-term. Improvements to freshwater areas under this alternative could benefit species such as killdeer, common snipe, and wintering flocks of dunlin, geese, wigeon, and other dabbling ducks. Many species of waterbirds and landbirds would also benefit from long-term protection of riparian and freshwater wetland areas. These include species such as belted kingfisher, yellow warbler, willow flycatcher, downy woodpecker, and Swainson's thrush. Proposed expansion would also have positive effects on raptors, especially northern harriers, red-tailed hawks, owl species, and kestrels that would use the areas south of I-5 for foraging and possibly nesting. Grassland species, including raptors, savanna sparrows, western meadowlarks, and goldfinches, would also benefit. However, the proposed expansion area in Alternatives B and C is not as large as in Alternative D.

Expanding protection to the East Bluff would better protect water quality of the adjacent estuarine habitats, as described under Section 4.2.2, and thus improve habitat quality for waterfowl, waterbirds, seabirds, and shorebirds in the estuarine habitat. The expansion on the East Bluff may increase protected habitat for all raptor species, especially small hawk species that prefer forested habitat. The proposed expansion would also reduce habitat fragmentation that currently occurs within the expansion area, improving connectivity and wildlife movement within and between areas. Overall, reduction in habitat fragmentation would increase undisturbed foraging, resting, and shelter areas available for wildlife. The benefit from decreased fragmentation under this alternative would be larger than under Alternative A but smaller than Alternative D (and the same as Alternative C).

Public Use Program

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

Under all action alternatives, the Luhr Beach area would be cooperatively managed with WDFW. Since this is a major access point for boaters, especially hunters and anglers, the installation of a Visitor Contact Station would increase visitor awareness and thus decrease disturbances from these recreational activities to waterfowl, shorebirds, and other species using the delta.

Effects to various bird species from activities associated with the recreational trail system would be similar to those described in Alternative A, especially since the trail system in Alternative B is only slightly different than in Alternative A. Eagles nesting along the West Bluff may experience less disruption under the Alternative B trail plan because the loop trail would be routed away from the McAllister Creek corridor. However, under Alternative B, the newly created full estuarine area would be encircled on three sides by a recreation trail. High public access of this area could have negative effects on waterfowl, waterbirds, and shorebirds. In addition, the EE program would be increased to serve up to 20,000 students, the largest proposed program of all the action alternatives. Disturbances to wildlife using habitats adjacent to the trail system from education groups would be the highest of all the alternatives. However, these effects would be minimized because groups would be restricted to trails and study sites and restricted to a 100 student/day limit. New trails and study sites would be located where minimal effects to Refuge resources would occur; as described above, Refuge outreach programs would emphasize responsible behavior and thus would lessen wildlife disturbance effects.

Waterfowl hunting would be limited to WDFW lands. The discontinuation of unauthorized hunting on Refuge lands would benefit wintering waterfowl that use Refuge habitats, as well as shorebirds and waterbirds also disturbed by the activity. However, the unconsolidated WDFW lands would fragment hunting-free areas and affect use patterns in and adjacent to Refuge lands by waterfowl, waterbirds, and shorebirds. Under all action alternatives, the RNA would be posted, and a no-hunting policy would be enforced. This would be an improvement over Alternative A, as wildlife disturbances would decrease for waterfowl, waterbirds, seabirds, and shorebirds. Additionally, the closure of shellfishing and other consumptive uses in the RNA would further protect shellfish populations, which may improve shorebird prey availability. Decreased disturbance to all these species in the estuary could also benefit various raptor species such as bald eagles, peregrine falcons, and osprey. The restriction of public access into the restored estuarine habitat under Alternatives B, C, and D would benefit all of the species described above.

Boating restrictions under all action alternatives are expected to have positive effects on waterfowl, waterbird, seabird, and shorebird species that use the estuary, Nisqually River, and McAllister Creek. Winter boating closures in the RNA would provide sanctuary for many migratory waterfowl, shorebirds, waterbirds, and raptors during a critical period. The new boating regulations (5 mph speed limit) would largely preclude the operation of PWC in Refuge waters. Boat restrictions under all action alternatives would improve estuarine habitat and decrease wildlife disturbance.

4.4.1.3 Alternative C

Habitat Restoration

Effects to Waterfowl, Waterbirds, Seabirds, and Shorebirds

Waterfowl, waterbird, seabird, and shorebird species that use the estuary would benefit from the restoration actions under Alternative C, similar to that described under Alternative B. However, since the restoration of full tidal conditions in the intertidal and river delta habitats would be in a larger area, benefits to waterfowl, particularly dabbling species (such as American wigeon and

green-winged teal), waterbirds, seabirds, and shorebirds would be greater compared to Alternative B. The enhanced tidal and sediment flow through the Nisqually River would likely improve estuarine habitat quality. Alternative C (and D) would restore a continuous estuary area, eliminating the uncertainties associated with the muted estuarine habitat provided in Alternative B. Waterfowl populations would likely increase due to the documented higher use in estuarine habitats on the Refuge (Shanewise 1996; USFWS data). Loons, grebes, terns, gulls, and herons that forage in estuarine areas would also benefit from the increased acreage of estuarine habitat. Dunlin and other shorebird species would also use the newly established mudflats as feeding areas. Since the estuarine habitat restoration actions accomplished under this alternative are more sustainable and would function more naturally in terms of tidal flow and sediment accretion than under Alternative B, restoration actions would provide higher quality estuarine habitat.

As in Alternative B, newly breached areas would experience a short-term loss of vegetation as plants not adapted to saltwater die and are gradually replaced by saline-tolerant species (Harris and Marshall 1963). Alternative C addresses the estuarine restoration priority for shorebird and waterfowl management identified in the Pacific Coast Joint Venture Strategic Plan (Pacific Coast Joint Venture 1996) and the Northern Pacific Coast Regional Shorebird Management Plan (Drut and Buchanan 2000).

Issues related to freshwater wetlands under Alternative C would be similar to those in Alternative B. Some species, such as American bittern, sora, Virginia rail, green heron, and wood duck, would be negatively affected from the conversion of 515 acres of freshwater habitat to estuarine habitat. However, implementation of intensive habitat improvement measures would be more feasible and effective because of the smaller acreage (447 acres versus 542 acres), resulting in higher quality freshwater wetlands than in Alternatives A and B. Less edge and greater habitat connectivity could also lead to higher quality freshwater habitat than under Alternative B. Higher habitat quality would increase the number of waterfowl, waterbirds, and shorebirds that the Refuge could support in the remaining freshwater habitat. In addition, the retention of the north Shannon Slough system would benefit many waterfowl (e.g., wigeon, bufflehead, and pintail) and waterbird species (e.g., great blue heron, bittern, and Virginia rail) that currently use the area.

As described in Alternative B, the maintenance and creation of dike systems and other project implementation actions may contribute to short-term sedimentation as well as affect the health and function of the estuary (Section 4.4.1.2).

Effects to Landbirds

Raptors

The improvements in estuarine habitat under Alternative C would benefit raptor species that use this habitat. Alternative C would have a larger estuary area (515 acres) than Alternatives A and B and would thus improve raptor habitat more than Alternatives A and B for such species as eagles, falcons, osprey, and northern harriers that feed regularly in the estuary.

As described in Alternative B, the loss of open grassland areas would affect species, such as the red-tailed hawk, that feed predominantly on small mammals and depend heavily on this habitat. The reduction of grasslands would likely reduce small mammal populations on parts of the Refuge and thus would reduce foraging areas for some species. However, improved management of grassland areas interspersed among the remaining freshwater wetland areas would provide higher quality grasslands than the existing reed canary grass dominated areas. The intensified reed canary grass control under Alternative C would promote prey species abundance, and the remaining habitat would provide higher quality foraging habitat for some raptors. The positive effects of freshwater management under this alternative for shorebirds and waterfowl would also increase prey potential for falcons and eagles.

Riparian zones would benefit under this alternative. The restoration of riparian habitat north of the Twin Barns, as provided under Alternative C (and D), would provide additional foraging, perching, and nesting sites for raptor species.

Passerines and Nonpasserines

Estuary restoration under Alternative C would be larger than in Alternative B and, thus, would have similar but somewhat greater effects for passerine and nonpasserine species. Species that regularly use estuarine habitat, including swallows, kingfishers, common yellowthroats, song sparrows, and red-winged blackbirds, would benefit from an increase in estuarine habitat. However, the conversion of freshwater to estuarine habitat would negatively affect some passerine and nonpasserine species that primarily use freshwater and grassland habitats. Freshwater wetlands that would remain under Alternative C would be smaller than under Alternative B, but improved management in a smaller area may reduce the effects of estuarine restoration and create slightly higher carrying capacities and diversity of bird species using the Refuge wetlands. The removal of dikes and the loss of associated trees and shrubs on dike banks would reduce this type of edge habitat for some passerines and nonpasserines, including song sparrows, American robins, and northern flickers. The effects of this loss would be partially reduced by native plantings along new external and internal dikes, where appropriate, although it would take some time for plantings to mature. Portions of dike bank vegetation may remain along the Nisqually River, where they are protected by wider corridors of riparian vegetation.

Riparian restoration along the Nisqually River would create high quality riparian habitat for many passerine and nonpasserine species. This continuous 38-acre area would provide higher quality foraging and nesting habitat than narrow riparian areas that would occur along the dike in Alternatives A and B. Allowing the Nisqually River to flow more naturally and to move during high flow or flood events may reduce erosion and loss of riparian habitat, which could benefit many passerine species that depend on this habitat. In addition, riparian habitat enhancement within the freshwater wetland units would provide more habitat for passerines and nonpasserines. These restoration efforts would support a conservation management priority (riparian restoration) identified in this region in the Conservation of Land Birds Plan (Pashley et al. 2000). Species that may benefit from riparian forest restoration include the willow flycatcher, yellow warbler, downy woodpecker, and Swainson's thrush.

The loss of grassland areas under Alternative C is greater than under Alternative B and would adversely affect passerines that predominantly use this habitat. However, improved management

of these areas adjacent to freshwater wetland areas and the improved control of reed canary grass could help reduce the effects of the loss of grasslands.

Refuge Expansion

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

The effects of Refuge expansion on waterfowl, waterbirds, seabirds, shorebirds, and landbirds under Alternative C would be the same as those described under Alternative B. Acquisition of freshwater wetlands and grasslands south of I-5 could provide for some of the habitat lost to estuarine restoration, reducing the effects from the conversion of freshwater wetlands and grasslands to estuarine habitat. Birds that depend on freshwater wetlands could greatly benefit by expansion and restoration in the Nisqually Valley.

Public Use Program

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

Effects to various bird species from activities associated with the recreational trail system would be similar to those described in Alternatives A and B. Although the trail system would be reduced from 5½ miles to 3¾ miles, effects would be greater for waterfowl, waterbirds, and shorebirds that use habitats within the proposed new loop trail around the northern half of the freshwater wetland units. High public access of this area could have localized negative effects on waterfowl, waterbirds, and shorebirds that use the area to forage or rest. These effects would be the greatest of all the alternatives because it is the only alternative that includes a loop trail around such a small area (approximately 500 acres). However, requirements to stay on trails would reduce disturbance. Habitat improvements and vegetative screening would be designed to provide buffers to wildlife. The estuary boardwalk segment under this alternative could also affect waterfowl and shorebirds using the areas adjacent to the boardwalk. Boardwalks can affect waterfowl through hiker-induced shadows, noise, and movement (Josselyn et al. 1989). In addition, the EE program would be increased to serve up to 15,000 students. Disturbances to wildlife using habitats adjacent to the trail system would be higher than Alternative A but not as great as Alternative B. However, as described in Alternative B, the program would be designed to minimize effects and localize disturbances.

Trails in Alternative C include a 2½-mile trail east of the Nisqually River. This new trail would take the public into an area that has had a lower level of human activity. This higher presence could disrupt waterfowl and other waterbirds that use the area, including Canada geese, American wigeon, and bufflehead. The introduction of a trail along the East Bluff, under Alternative C (and D), may also lead to effects in an area that currently has no trails. Many landbird species use the forested East Bluff habitats and would be disturbed by trail activity. These effects would again be reduced by requirements to stay on trails. Trail design and vegetative screening would reduce disturbance.

Alternative C would alter current hunting conditions by consolidating the hunting area in the delta to a 1,170-acre block, opening Refuge lands to hunting, and adding Refuge management of hunting activities and implementing a 3 day per week hunting season and a 25-shell limit. The

hunting area would be a single block with easily identified boundaries, focusing all hunting activity in the tideflats and open water areas just north of the Brown Farm Dike. This would remove all hunting activity from McAllister Creek and the RNA. The habitat along McAllister Creek is a relatively narrow tidal system that receives high use by a variety of waterfowl, waterbirds, and raptors. Hunting affects the duration and pattern of use by wildlife in this narrow system. Discontinuation of hunting in the Creek would reduce disturbance to waterfowl and waterbirds, as well as to nesting bald eagles in the early part of the season (January). In addition, the 3 day/week hunt period would allow more wildlife use in hunt areas during non-hunt days. However, the lack of a seasonal trail closure along McAllister Creek would create localized disturbance to some waterfowl and waterbirds, but this effect would be limited to the vicinity of the trail. Hunting also causes safety conflicts with trail or boardwalk use along McAllister Creek. This alternative would eliminate these conflicts. As described in Alternative B, enforcement of the RNA closures and elimination of unauthorized hunting would be an improvement over Alternative A, as wildlife disturbances would decrease for waterfowl, waterbirds, seabirds, and shorebirds. However, the modification of the western RNA boundary reduces the RNA from 829 acres to 663 acres, decreasing RNA sanctuary area for waterfowl using the estuarine habitats. New estuarine sanctuary areas would be established in the estuarine restoration site.

Boating restrictions under all action alternatives would be expected to have positive effects on waterfowl, waterbird, seabird, and shorebird species that use the estuary, Nisqually River, and McAllister Creek, as described in Alternative B.

4.4.1.4 Alternative D (Preferred Alternative)

Habitat Restoration

Effects to Waterfowl, Waterbirds, Seabirds, and Shorebirds

Waterfowl, waterbird, seabird, and shorebird species that use the estuary would benefit from the restoration actions under Alternative D, similar to those described under Alternative C. However, since the restoration of full tidal conditions in the intertidal and river delta habitats would be over a larger area, benefits to estuarine-dependent avian species would be the greatest of all the alternatives. The inclusion of the McAllister Creek slough system (Shannon Slough) would improve the diversity and function of the estuarine habitat more than Alternative C. The restoration of the McAllister Creek slough system would increase the area of dynamic river/tideflat interaction. In general, tidal freshwater is utilized by more avian species than any other wetland type (Mitsch and Gosselink 1993). Waterfowl would be expected to heavily utilize the large, restored estuarine habitat under Alternative D due to their documented use of estuarine habitat at the Refuge (Klotz et al. 1978).

Since the estuarine habitat restoration relative to other alternatives would be more sustainable and natural in terms of tidal flow and sediment accretion (see Section 4.1.4), this alternative would provide the highest quality of estuarine habitat than any other alternative and would be expected to produce the most complex and productive intertidal habitat. This alternative includes the strongest management activity to support the estuarine restoration priority for

shorebird and waterfowl management identified in the Pacific Coast Joint Venture Strategic Plan (Pacific Coast Joint Venture 1996) and the Northern Pacific Coast Regional Shorebird Management Plan (Drut and Buchanan 2000). Restoration activities outlined in the plans include the “restoration of tidal regimes to diked wetlands in estuaries.”

Species that predominantly use freshwater or grassland habitats would be most negatively affected by Alternative D because the largest acreage (699 acres) would be converted to estuarine habitat. Effects would be similar to those described in Alternatives B and C, although to a greater extent. The control of reed canary grass could be done most intensively under this alternative because of the smaller acreage, helping to compensate for the reduced total acreage of freshwater and grassland habitat (see Section 4.2.4). Since large portions of the wetland areas that would be converted are currently dominated by reed canary grass, their value to waterfowl is low (Maia 1994). The improved habitat management strategies in this alternative would result in higher quality freshwater wetlands available per acre for waterfowl, waterbirds, and shorebirds.

Effects to Landbirds

Raptors

Effects to raptors under Alternative D would be similar, although greater, than described for Alternative C. Alternative D proposes the largest area of estuary restoration, with the most benefit for species that could forage in estuarine habitat, such as eagles, osprey, falcons, and northern harriers. Common prey species of these raptors, such as waterfowl, shorebird, and salmonid populations, are predicted to have the greatest benefit from this alternative.

Restoration of the river/tidal dynamics between the Nisqually River and McAllister Creek would promote a habitat type used by more avian species than other wetland habitat types (Mitsch and Gosselink 1993), potentially increasing the carrying capacity for species that forage on avian prey, such as eagles, small hawks, and falcons. Bald eagles would especially benefit from the incorporation of the McAllister Creek area as they forage and nest in this area.

Open grassland area conversions due to restoration efforts would be the greatest under Alternative D. This would have significant effects on raptors currently using these habitats, such as the red-tailed hawk and northern harrier. However, northern harriers also feed regularly in salt marsh areas and, thus, would be more able to shift from foraging in freshwater grasslands to the new estuarine habitat.

Passerines and Nonpasserines

The effects to passerine and nonpasserine birds under Alternative D would be similar to those described for Alternative C. The conversion of freshwater to estuarine habitat in this alternative would be the greatest with the largest effect on passerine and nonpasserine species that primarily use freshwater and grassland habitats, including savanna sparrows, finches, and meadowlarks. However, the improved management of the remaining 263 acres of freshwater wetlands would have a higher carrying capacity than under current conditions and thus would improve avian productivity, reducing these effects for some of these species.

Refuge Expansion

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

Alternative D would provide the largest increase in the Refuge boundary and thus would provide the greatest potential benefit to waterfowl, waterbirds, shorebirds, and landbirds. Proposed expansion efforts in this alternative would incorporate more freshwater wetland and riparian areas into the Refuge as compared to Alternatives B and C, providing increased freshwater wetland and grassland acreage, which could reduce the effects in the current Refuge boundary resulting from estuarine restoration. However, as described in Alternative B, since Refuge expansion may not occur immediately, benefits from protection or restoration of these lands may not simultaneously reduce the effects from estuarine restoration occurring on the Refuge north of I-5. Benefits to various bird species are similar to those described in Alternative B but are expected to be greater because more habitat would be protected and managed by the Service. In particular, a larger portion of riparian habitat would potentially receive greater protection under Alternative D, greatly benefitting many passerines, waterfowl, and waterbirds that use the river. Effects from the proposed expansion on the East Bluff are the same as described in Alternative B.

Public Use Program

Effects to Waterfowl, Waterbirds, Seabirds, Shorebirds, and Landbirds

Effects to various bird species from activities associated with the trail system in this alternative would be similar to those described in Alternative C. However, disturbance effects from the main trail are expected to be the least of all the alternatives because it is the shortest and is located along the edge of the freshwater and restored estuarine habitats. Since there would be no loop trail in the freshwater or estuarine habitats, disturbance from trail users would not be as great. Since the boardwalk extension along McAllister Creek would be seasonally closed to prevent conflicts with hunters on WDFW lands, localized disturbance from trail users to waterfowl and other waterbirds would be reduced slightly in the winter months. The effects from the proposed trail on the eastside and East Bluff are the same as described in Alternative C, as would the effects of environmental education.

Alternative D would open a limited amount of Refuge lands (191 acres) to waterfowl hunting, 7 days per week. Although this alternative has fewer acres of Refuge lands open to hunting, similar to Alternative B, all three State parcels would still be open to hunting. This would not eliminate the patchwork of State hunting lands across the delta, potentially contributing to patchy or fragmented habitat use by waterfowl and shorebirds since hunting can shift bird distributions away from hunting areas (Fox and Madsen 1997). However, the effects from a 7 day/week hunt would be reduced compared to current conditions (Alternative A) because of the smaller hunt area. As described in Alternative B, enforcement of the RNA closures would be an improvement over Alternative A, as disturbance would decrease for waterfowl, waterbirds, seabirds, and shorebirds. However, the modification of the western RNA boundary would reduce the RNA from 829 acres to 756 acres, resulting in a decreased RNA sanctuary area for waterfowl and shorebirds using the tideflats and salt marsh areas at the mouth of the Nisqually River. The increase in hunter-based human disturbance in the RNA would reduce sanctuary area for waterfowl and shorebirds using estuarine habitats.

The closure of shellfishing and other consumptive uses in the RNA under all action alternatives would protect shellfish populations and decrease habitat disturbance in these tidal areas; such protection would enhance waterbird and seabird prey availability. Fishing-based interruptions of waterbirds can be detrimental to waterbird distribution, abundance, and productivity (DeLong and Schmidt 1998). The removal of fishing along McAllister Creek would provide localized benefits to great blue herons that forage in this area; loss of foraging habitat is considered to be among the threats that led to the current listing of this species as a Washington State Priority Species. Other waterbirds and seabirds that would benefit from reduced human use of the McAllister Creek area include pied-billed grebe, horned grebe, bufflehead, and double-crested cormorant.

The effects of boating restrictions would be the same as described in Alternative B.

4.4.2 Effects to Mammals

4.4.2.1 Alternative A

Habitat Restoration

Effects to Land Mammals

Management of the grasslands and freshwater wetlands under status quo conditions would benefit land mammals. However, as described above in Section 4.4.1.1, benefits would be expected to improve marginally compared to current conditions, although it would be difficult to retain this improved status because of the continual and increasing challenge of maintaining the quality of the freshwater wetlands and grasslands within the diked area. The conversion of seasonally flooded wetlands to scrub-shrub habitat would negatively affect species such as Townsend voles and deer mice, prey species for raptors and coyotes. Grassland areas would remain relatively unchanged from current conditions and thus would continue to support mammals such as coyotes, deer, Townsend voles, deer mice, and shrews.

Effects to Marine Mammals

Marine mammals occur in the saltwater areas of the Refuge and thus would not be directly affected by habitat management actions in this alternative. However, the retention of the full diked system under Alternative A may still affect the existing estuary due to tidal mudflat erosion, artificial sediment accretion patterns, and impeded tidal function (see Section 4.2.1). The effects of the dike on the estuarine habitat could affect marine mammal forage species and reduce food resources.

Refuge Expansion

Effects to Land and Marine Mammals

Under Alternative A, no expansion of the Refuge boundary would occur. Indirect benefits to land and marine mammals would occur if efforts to strengthen watershed protection through

partnerships outside of the Refuge boundary were successful. Increased watershed protection would improve water quality and associated habitat.

Efforts to acquire in-holdings within the existing boundary would continue under all alternatives. Acquisition of in-holdings in the estuarine habitat would eliminate the fragmented management of estuarine areas within the delta, contributing to improved water and intertidal habitat quality, potentially enhancing conditions for marine mammal foraging in the intertidal zones of the Refuge. In addition, disturbance associated with unregulated human activities in these areas would be reduced or controlled, benefitting all mammals that use these areas.

Public Use Program

Effects to Land and Marine Mammals

Under Alternative A, the recreational trail system would continue to be used for hiking and wildlife observation. Although this activity could disturb some land mammals, especially those using habitats adjacent to trails, it is not expected to be significant. Disturbance effects along trails have been found to alter land mammal behavior and may decrease fitness for disturbed animals (Bowles 1995). Research has also shown that larger bodied mammals are disturbed at greater distances than small (Knight and Cole 1995). In addition, the primitive trail in the surge plain (common to all alternatives) could have negative effects on land mammals, primarily deer mice, mink, beaver, and river otter, that occur in this habitat, especially if visitors wander off trail into the habitat. However, as described in Section 4.4.1.1, effects from trail use would be reduced by a variety of provisions, including a 100-car maximum parking lot, requirement to have visitors stay on trails, designated sanctuary areas, and vegetative screening (plantings). Refuge outreach programs would emphasize responsible behavior of Refuge visitors and thus could lessen wildlife disturbance effects (DeLong and Schmidt 1998; Larson 1995).

Under all alternatives, the restriction of fruit harvesting would benefit some land mammals that use these resources for forage. The EE program under Alternative A would be limited, serving up to 5,000 students. Since activities associated with this program would focus on trails or within the Environmental Education Center, no significant effects to land mammals would be expected. However, as described above, some disturbance to land mammals can occur when large educational groups are using trails.

Under this alternative, hunting would occur as it does currently in the WDFW and Refuge tideflats. Hunting-based disruptions can disturb terrestrial mammals that use wetlands and estuary areas such as mink, beaver, and river otter. Boating activity associated with hunting could disturb marine mammals. Harbor seals are susceptible to disturbance and are easily scared from haul-out areas (Brueggeman 1992; Chapman and Feldhamer 1982). Human disturbance is one of the major causes of pup mortality and is believed to be among the reasons why the historical harbor seal breeding area at Nisqually is currently inactive (Boulva and McLaren 1979; Klotz et al. 1978). Harbor seal haul-out areas are a WDFW priority habitat and should be protected at Nisqually NWR. Human use of the Refuge as outlined under Alternative A could have higher incidents of haul-out site disruption than other alternatives. In addition, since this alternative would allow for continued access to the RNA, boating, unauthorized hunting, and fishing activities could affect marine mammals that use this area.

Human presence and disturbance associated with fishing may also limit the use of some areas by terrestrial mammals near the McAllister Creek fishing area. PWC use would continue under Alternative A. This activity would disturb species that use the rivers and estuarine areas such as mink and river otters. As described above (Section 4.4.1), many studies have shown that boating can have negative effects on wildlife through disruption of feeding and breeding activities (DeLong and Schmidt 1998).

4.4.2.2 Alternative B

Habitat Restoration

Effects to Land Mammals

Alternative B would create a limited amount of both muted estuarine and full estuarine habitats. In addition, freshwater wetlands and ponds would be increased and habitat quality improved in all Refuge freshwater wetlands.

The shift from freshwater to estuarine habitat would also shift species composition to favor estuarine-associated species. Initially, however, newly restored estuarine areas may be primarily composed of mudflats, providing minimal habitat for land mammals. Eventually, as salt marsh habitat becomes established, mammals such as river otter are expected to use the restored areas. However, as described above (Section 4.4.1), the ability of muted estuarine habitat to mimic the structure and function of a natural estuary is unknown; consequently, the benefits to these mammals are uncertain. In addition, under this alternative, fragmentation of the restored estuarine areas could interrupt small mammal passage through the habitat edges. The conversion of the diked area to estuarine habitat would negatively affect mammals that primarily use the grassland habitat, such as coyotes, deer, and shrews. Alternative B (and C) would have a somewhat smaller effect on land mammals that exclusively occur in the grassland or freshwater habitats because it has less area of estuarine restoration as compared Alternative D.

In the areas where freshwater wetlands would be converted to saltwater, a short-term vegetation die-back would decrease habitat availability temporarily until the system can convert to saltwater regimes (Harris and Marshall 1963). This would temporarily affect land mammals such as Townsend voles, deer mice, and river otters that are expected to use the estuaries, but eliminate habitat for those species that almost exclusively use freshwater and grassland habitats, such as beavers and deer. The freshwater habitat improvements would benefit mammal species that use this habitat, such as river otter, mink, and beaver.

Effects to Marine Mammals

Estuarine restoration under Alternative B would create a mix of full and muted estuarine habitats. This limited estuarine restoration would improve habitats used by marine mammals, especially harbor seal haul-out sites. It is uncertain how often seals and sea lions would use the muted estuary area. It would be expected that they would find and use breach sites if food resources were present inside the muted estuarine area. However, dikes would make access more difficult, requiring marine mammals to travel greater distances. Although harbor seals have been observed in McAllister Creek, it is uncertain how often marine mammals would utilize the restored full

estuary area due to its inland location. However, estuary improvements would extend into the full estuary areas connected to Puget Sound and thus benefit sea lions and seals to some degree.

Apart from estuary restoration, habitat management actions taken under Alternative B would not significantly affect marine mammals. Riparian and freshwater wetland improvements would slightly improve water quality entering into the tidal systems and thus could provide some benefit to marine mammals or their prey.

Refuge Expansion

Effects to Land and Marine Mammals

The expansion actions under Alternative B would include the proposed acquisition of lands along the East Bluff and south of I-5. This would increase protected wetland and riparian habitat areas and benefit land mammals that use riparian and freshwater habitats, including such species as mink, Townsend vole, river otter, and beaver. Acquisition of these areas would decrease habitat fragmentation, provide more continuous corridors, facilitating movement and access to a variety of habitats, benefitting mammals. Acquisition and restoration in the Nisqually Valley south of I-5 would reduce the effects of the conversion of freshwater wetlands within the current Refuge, benefitting many land mammal species. The increase in overall watershed protection under partnership building and area expansion may improve overall intertidal zone habitat quality, including water quality, which may have slight positive effects on marine mammals in the area.

Public Use Program

Effects to Land and Marine Mammals

Under all action alternatives, the Service would manage the Luhr Beach area if a cooperative management agreement can be developed with the State. Since this is a major access point for boaters, especially hunters and anglers, the installation of a Visitor Contact Station would increase visitor awareness and thus decrease disturbances from these recreational activities to marine mammals and other species using the delta.

Effects to land mammals from activities associated with the recreational trail system would be similar to those described under Alternative A, especially since the trail system in Alternative B is only slightly larger than in Alternative A. However, under Alternative B, the newly created full estuarine area would be encircled on three sides by a recreation trail. High public activity could have negative effects on mammals that use this habitat, including seals, mink, beaver, and river otter. However, requirements to stay on trails would localize disturbance. In addition, the EE program would be increased to serve up to 20,000 students per year, the largest expansion of the education program of all the action alternatives. Disturbances to wildlife using habitats adjacent to the trail system would occur. As described above, disturbance effects along trails can alter land mammal behavior and decrease fitness for disturbed animals (Bowles 1995). However, as described above, provisions and Refuge outreach programs would restrict activities, emphasize responsible behavior, and minimize wildlife disturbance effects.

Waterfowl hunting areas, as defined in Alternative B, would draw hunters away from the far reaches of the tidflats compared to Alternatives A and C, where marine mammals are mostly located. This would reduce disturbances to haul-out and foraging activities. The removal of unauthorized hunting on Refuge lands would benefit marine mammals, as well as land mammals that would otherwise be disturbed by the activity. However, the unconsolidated WDFW lands would lead to fragmentation of hunting-free areas, which could isolate seals. Under all action alternatives, the RNA would be posted and a no-hunting policy enforced. This would be an improvement over Alternative A, as disturbances would decrease for seals, river otters, and minks. The restriction of public access into the estuarine habitat under Alternative B (and C and D) through the closure of the RNA and protection of restored areas would benefit land and marine mammals that utilize this habitat. Species commonly observed in estuary areas include Townsend vole, deer mice, river otter, mink, and harbor seals. The restriction of public access into the restored estuarine habitat under Alternative B (and C and D) would also benefit all of the species described above.

Continued bank fishing along McAllister Creek, as allowed under Alternative B (and C), could disturb some seals. Boating restrictions under all action alternatives are expected to have positive effects on marine mammals, primarily harbor seals, that use the estuary, Nisqually River, and McAllister Creek. Boating restrictions under all action alternatives would improve estuarine habitat and decrease wildlife disturbance.

4.4.2.3 Alternative C

Habitat Restoration

Effects to Land Mammals

Similar to Alternative B, the conversion of freshwater to estuarine habitat under Alternative C would shift species composition to favor estuary-associated species, but to a larger degree and with no muted estuarine areas. Land mammals, such as river otter, Townsend vole, and deer mice, that use a variety of habitats including the salt marsh would benefit from restoration actions. The combination of estuarine, improved freshwater, and grassland habitats would provide more cover and habitat for prey species. River otter would significantly benefit, as they are the most abundant in estuarine systems (Chapman and Feldhamer 1982). The estuary restoration under Alternative C would have fewer edges than under Alternative B and thus could be more beneficial to land mammals that are easily affected by edge effects.

As described under Alternative B, the conversion of the diked area to estuarine habitat would negatively affect mammals such as coyote, deer, beaver, and shrew. The management of the remaining wetlands would be more intensive under Alternative C and thus could lead to a somewhat higher quality habitat with higher carrying capacities for these mammals than Alternative B. In addition, riparian restoration in the freshwater units and also the 38-acre area along the Nisqually River would benefit these same species. Riparian habitat restoration along the Nisqually River would create higher quality riparian habitat that could be used by land mammals.

Effects to Marine Mammals

Effects of estuarine restoration under Alternative C would be similar to those described for Alternative B, but to a greater extent. The estuary restoration under Alternative C would create a larger amount of fully functional estuarine habitat, primarily in the intertidal and riparian interaction zones, increasing the potential for marine mammal use of the habitat. Dikes would be removed, improving marine mammal passage.

Apart from estuary restoration, habitat management actions under Alternative B would not significantly affect marine mammals. Riparian and freshwater wetland actions would improve water quality entering into the tidal systems and thus provide some benefit to marine mammals or their prey.

Refuge Expansion

Effects to Land and Marine Mammals

Refuge expansion would be identical in Alternatives B and C, so the effects to mammals would be the same.

Public Use Program

Effects to Land and Marine Mammals

Effects to mammal species from activities associated with the recreational trail system would be similar to those described in Alternative B, except for the new loop trail within the freshwater area. High public activity on this loop trail could have negative effects on land mammals using this area. This effect is expected to be larger than under Alternatives A or B because the area within the loop trail would be much smaller; thus, sanctuary areas away from human activity would be reduced in size. The EE program would be smaller than in Alternative B; thus, effects on mammals would be somewhat less.

The establishment of a new trail on the east side of the Nisqually River would cause localized disturbance to mammals using those habitats. This trail would affect wetland and upland mammal communities, possibly affecting such species as river otter, deer, coyote, mink, long-tailed weasel, and others. In addition, the introduction of a boardwalk trail near McAllister Creek would affect species utilizing the newly restored estuary, such as river otters and harbor seals. However, as described in Section 4.4.1.1, effects from trail use would be reduced by a variety of provisions and Refuge outreach programs.

Human presence and disturbance associated with hunting under Alternative C would be restricted to a rectangular block north of the diked area. These hunting areas would have the least potential effects to marine mammals compared to all other alternatives because of the limited area and improved ability to post and delineate boundaries. Boating restrictions under Alternative C would be similar to those outlined under Alternative B, decreasing habitat disturbance and benefitting marine mammals.

4.4.2.4 Alternative D (Preferred Alternative)

Habitat Restoration

Effects to Land Mammals

Effects to land mammals under this alternative would be similar to those described in Alternative C. However, Alternative D would convert the largest amount of diked area to estuarine habitat. Land mammals that largely use freshwater and grassland areas would be most negatively affected under Alternative D, including coyotes and deer. Edge effects and habitat fragmentation are limited under this alternative and thus would benefit mammal species.

The remaining 263 acres of freshwater wetlands would benefit from intensive management and thus would have a higher carrying capacity (per acre) than under current conditions. Higher capacities would reduce effects on terrestrial mammal productivity for beaver and mink, among other species.

Effects to Marine Mammals

Effects to marine mammals in Alternative D would be the most beneficial because it would provide the largest area of estuary restoration, without dikes to act as potential barriers. The restoration of full tidal conditions in this larger area would provide a larger and more productive foraging area.

Habitat management actions other than estuary restoration activities would have limited effects on marine mammals. Riparian and freshwater wetland improvements would improve water quality entering the tidal systems and thus could provide some benefit to marine mammals or their prey.

Refuge Expansion

Effects to Land and Marine Mammals

In addition to effects described in Alternatives B and C, 3,479 acres are proposed for Refuge expansion. This expansion would protect additional floodplain habitat and Nisqually River riparian corridor south of I-5. This would provide the greatest benefit to land mammals that use riparian and freshwater habitats, including species such as mink, Townsend vole, river otter, and beaver. Acquisition of these areas would decrease habitat fragmentation and have larger potential benefits to mammalian species. The increase in acreage under this alternative would be especially beneficial to large-bodied terrestrial mammals such as deer and coyote as they have larger territorial ranges. Expansion actions in Alternative D would have minor positive effects for marine mammals. The increase in overall watershed protection under partnership building and area expansion may improve overall intertidal zone habitat quality, including water quality, which may have slight positive effects on marine mammals in the area. For example, the increased protection of the Nisqually River corridor may improve conditions for large woody

debris recruitment and subsequent deposition on Refuge mudflats. This type of woody debris could be utilized by marine mammals, particularly as harbor seal haul-out sites.

Public Use Program

Effects to Land and Marine Mammals

Effects to mammal species from activities associated with the recreational trail system would be similar as described in Alternative C but to a lesser extent, because the main trail in this alternative is the shortest and is located along the edge of the freshwater and restored estuarine habitat. Since there is no loop trail in the freshwater or estuarine habitats, disturbance from trail users would not be as great. The effects from the proposed trail on the eastside and East Bluff are the same as described in Alternative C, as well as the effects of the EE program.

Alternative D proposes to open a limited amount of Refuge lands (191 acres) to waterfowl hunting. Although this alternative has less acres of Refuge lands open to hunting, all three State parcels would still be open to hunting, similar to Alternative B. This would not eliminate the patchwork of State hunting lands across the delta, contributing to disturbances to marine mammals. Like Alternative A, the tideflats would be open to hunting and would focus along the primary marine mammal haul-out habitat. As described under Alternative B, enforcement of the RNA closures would be an improvement over Alternative A, decreasing disturbance to marine mammals. However, the modification of the western RNA boundary would reduce the RNA from 829 acres to 756 acres, decreasing sanctuary area for marine mammals using the tideflats and salt marsh areas at the mouth of the Nisqually River.

Boating restrictions under Alternative D would be similar to those outlined under Alternative B, decreasing habitat disturbance and benefitting marine mammals. Fishing and shellfishing effects on mammals under Alternative D would be similar to Alternative C, except that disturbance to mammals associated with bank fishing along McAllister Creek would not occur.

4.4.3 Effects to Reptiles and Amphibians

4.4.3.1 Alternative A

Habitat Restoration

The retention of the freshwater and estuary wetlands under existing conditions would support existing amphibian and reptile species. However, the continued conversion of shallow wetlands to scrub-shrub habitat would decrease open water and seasonal wetlands, adversely affecting many species of frogs and salamanders that rely on open freshwater for breeding habitat. Dike repair work may increase short-term sedimentation and negatively affect amphibians, which are very sensitive to water quality (Kauffman et al. 2001). Grassland areas would continue to support reptiles currently using these habitats, although habitat quality would deteriorate as reed canary grass spreads. Estuary and freshwater wetland habitats would be expected to deteriorate under this alternative and would negatively affect amphibian and reptile species in the long term.

Refuge Expansion

Under Alternative A, no expansion of the Refuge boundary would occur. Indirect benefits to amphibians and reptiles would occur if efforts to strengthen watershed protection through partnerships outside of the Refuge boundary were successful. Increased watershed protection would improve water quality and associated habitat.

Efforts to acquire in-holdings within the existing boundary would continue under all alternatives. These actions would benefit reptiles and amphibians through a decrease in habitat fragmentation and edge effects caused by different land management practices.

Public Use Program

The current trail system would remain under Alternative A. In addition, a ½-mile surge plain trail would be developed. Activity on trails may result in minor effects to amphibians and reptiles in several ways, including noise interruptions and disturbances to habitat on some trails. However, as described above, provisions and Refuge outreach programs would restrict trail users and emphasize responsible behavior, minimizing wildlife disturbance effects (DeLong and Schmidt 1998; Larson 1995).

Boating and PWC use under Alternative A would not be expected to affect amphibians and reptiles as boating occurs primarily in saltwater areas, habitat not used by these species.

4.4.3.2 Alternative B

Habitat Restoration

The shift from freshwater to estuarine habitat would decrease habitat for amphibians, which are associated with seasonal freshwater ponds. A total of 458 acres of potential amphibian and reptile habitat would be lost, including breeding habitat for many salamanders and frogs.

The 542 acres of freshwater habitat improvements would benefit amphibian and reptile species. The extent of benefits for amphibians would depend on the flow and fluctuation regime, which determines species richness in Puget Sound wetlands (Richter and Azous 1995). Generally, lower flow and smaller fluctuation events increase species diversity (Richter and Azous 1995). If high and permanent flows are allowed under the wetland management actions of Alternative B (or C or D), bullfrogs may have an advantage (Adams 1999). Bullfrog abundance in freshwater wetlands may have significant adverse effects on native frogs due to predation (Leonard et al. 1993). Control of water flow and levels would be limited in Alternative B and may not provide high quality habitat for amphibians.

In addition to flow and water regimes, the quality of vegetation in and around freshwater wetlands managed under Alternative B (and C and D) would affect amphibians. This is because vegetation affects water temperature, which influences the breeding success of frogs and salamanders (Richter 1995). Specific plant species are associated with spawning activities of

particular amphibian species (Richter 1995). The ability to restore or mimic natural conditions would determine the benefits for amphibian species.

Refuge Expansion

The expansion actions under Alternative B would include the proposed acquisition of lands along the East Bluff and south of I-5. This would increase protected wetland and riparian habitat areas and benefit amphibians that use riparian and freshwater wetland habitats, including red-legged frogs and salamanders. Acquisition and restoration of these areas would decrease habitat fragmentation and have larger potential benefits to amphibians. Furthermore, additional protection in areas outside of the current Refuge boundary may allow for the conservation of smaller wetlands that would not otherwise receive protection. Small wetlands are important to local amphibian diversity and abundance (Richter and Azous 1995). Management of these small wetlands could include maintaining open seasonal wetland habitats similar to agricultural lands that are currently grazed with a higher proportion of seasonal ponding. In addition, acquisition and protection of freshwater wetland habitats would support potential re-introduction projects associated with the western pond turtle or Oregon spotted frog.

Public Use Program

The trail system would change slightly in Alternative B. As described above, activity on trails may affect amphibians and reptiles in several ways; however, effects are expected to be minor. Boating restrictions under Alternative B would not be expected to affect amphibians and reptiles as these activities occur in saltwater areas.

4.4.3.3 Alternative C

Habitat Restoration

Effects from restoration activities under Alternative C would be similar but greater than described for Alternative B since a larger amount of diked area would be converted to estuarine habitat. Remaining freshwater wetlands and riparian areas would be significantly improved over current conditions.

The larger shift from freshwater to estuarine habitat under Alternative C would decrease habitat acreage for amphibians. The management of the remaining wetlands would be more intensive under Alternative C and may lead to higher carrying capacities for amphibians and reptiles using this habitat. Better control of water flow and levels, resulting in a higher proportion of seasonal wetlands, would provide higher quality habitat for native amphibians instead of bullfrogs. Riparian restoration along the Nisqually River would create higher quality riparian habitat for species such as red-legged frogs, Pacific tree frogs, and garter snakes.

Refuge Expansion

Refuge expansion would be identical in Alternatives B and C; the effects to reptiles and amphibians would be the same.

Public Use Program

As described above, activity on trails may affect amphibians and reptiles in several ways. The effects from trails in Alternative C would be similar but fewer than under Alternative B. However, the potential development of a trail on the eastside and East Bluff trail would cause localized disturbance to species using those habitats.

4.4.3.4 Alternative D (Preferred Alternative)

Habitat Restoration

Restoration and management actions under Alternative D would provide the largest area of estuarine habitat and the greatest reduction of freshwater wetlands, representing the greatest decrease in habitat for amphibians and reptiles. A total of 699 acres of amphibian and reptile habitat would be lost, including breeding habitat for many salamanders, frogs, and garter snakes. Across the region, the isolation and loss of wetlands is thought to have led to decreases in many amphibian species (Richter and Azous 1995).

Management of the remaining freshwater wetlands would be the most intensive under Alternative D and may lead to higher carrying capacities for amphibians and reptiles using this habitat. Better control of water flow and levels, resulting in a higher proportion of seasonal wetlands, would provide higher quality habitat for native amphibians instead of non-native bullfrogs. Freshwater wetlands and riparian areas would be significantly improved over current conditions. Similar effects would result from the riparian restoration along the Nisqually River, as described in Alternative C.

Refuge Expansion

Alternative D proposes a 3,479-acre Refuge expansion, which would provide the greatest benefit to reptiles and amphibians of the action alternatives. Benefits include decreased habitat fragmentation as well as increased habitat protection, especially along the Nisqually River corridor. Habitat connectivity within riparian corridors is especially beneficial to amphibian species (Richter 1995). Protection and restoration of freshwater wetlands in the Nisqually Valley would also significantly benefit native amphibians and reptiles.

Public Use Program

Effects from recreational activity associated with trails would be similar to all other alternatives but with fewer effects because Alternative D proposes the smallest trail system.

4.4.4 Effects to Invertebrates

4.4.4.1 Alternative A

Habitat Restoration

Although invertebrate species composition is not well known, many species occur in freshwater habitats, providing food for a variety of wildlife; these species would benefit from the continued existence of freshwater wetlands within current the Refuge boundary. Freshwater wetlands would likely deteriorate over time due to current and ongoing exotic species invasions and slow gradual conversion to scrub-shrub communities. This gradual reduction in habitat diversity would reduce habitat quality for terrestrial invertebrates.

In addition, the current dike system is not stable and would require major repairs. Repair work may increase short-term sedimentation and thus negatively affect invertebrates that are very sensitive to water quality (Karr et al. 1986).

Refuge Expansion

Under Alternative A, no expansion of the Refuge boundary would occur. Indirect benefits to invertebrates would occur if efforts to strengthen watershed protection through partnerships outside of the Refuge boundary were successful. Increased watershed protection would improve water quality and associated habitat.

Efforts to acquire in-holdings within the existing boundary would continue under all alternatives. These actions would benefit invertebrates through the decrease in habitat fragmentation and edge effects caused by different land management practices.

Public Use Program

The current trail system would remain under Alternative A. In addition, a ½-mile surge plain trail would be developed. Trails and associated activity may have some minor localized effects on invertebrates due to soil compaction, trampling, and barriers to movement.

Boating, PWC use, hunters, and anglers moving through the Refuge could cause localized disturbance, particularly to aquatic invertebrates in the mudflats. Negative effects on aquatic invertebrates may also be caused by water pollution and turbidity from boats and PWC. In addition, shellfishing directly affects marine invertebrates through collection and habitat disturbance. This would especially affect the RNA area, which is an important area for marine invertebrate production.

4.4.4.2 Alternative B

Habitat Restoration

Invertebrate species that use estuarine habitats would benefit from restoration actions. The extent of this benefit would depend on the use of the muted estuarine area. Similar to other wildlife species, there is uncertainty regarding relative abundance in muted estuarine habitat. Amphipods use both fresh and saltwater systems in the Pacific Northwest and would be expected to use the muted habitat (Cordell et al. 1999). Species that may use the fully restored estuary include ghost shrimp, bivalves, polychaetes, spionids, and nematodes. The benefits from all estuarine restoration, both muted and full, under Alternative B would not be as great as those under Alternatives C and D.

The conversion of fresh to saltwater systems would shift invertebrate species composition to those that favor estuary systems. Invertebrate species exclusively found in freshwater and grassland habitats would be affected by the elimination of habitat. However, the freshwater habitat improvements for areas that remain would provide a higher quality of habitat for various invertebrate species.

The management of current grassland habitat would benefit terrestrial invertebrates, such as insect populations. These species currently concentrate in Refuge pastures and upland habitats and would continue to do so under this alternative. The maintenance and creation of dike systems and other management actions may increase sedimentation in the short term immediately after construction activities. This could negatively affect aquatic invertebrates through decline in water quality (Waters 1995).

Refuge Expansion

Expansion under Alternative B would include the proposed acquisition of lands along the East Bluff and south of I-5. This would benefit invertebrates that use riparian and freshwater habitats. Acquisition and restoration of these areas would decrease habitat fragmentation and increase habitat quality. Improved protection of the East Bluff forest may improve water quality (see Section 4.2.4) and thus benefit the diversity of marine invertebrates that use estuarine habitats.

Public Use Program

Under all action alternatives, the Service would manage the Luhr Beach area if a cooperative management agreement is developed with the State. Since this is the major access point for boaters, including hunters, anglers, and shellfishermen, the installation of a Visitor Contact Station here would decrease disturbances to invertebrates and their habitat through education.

Public access restrictions in the RNA and the closure of restored areas under Alternatives B (and C and D) would lessen disturbance to marine invertebrates and their habitat. Alternative B would provide trail access similar to Alternative A and thus would have similar effects on invertebrates. Boating, hunting, and fishing could cause localized disturbance to marine invertebrates through trampling, direct collection, and soil compaction. In addition, under all the

action alternatives, the RNA would be posted, and a no consumptive use policy and winter boat closures would be enforced. This would decrease disturbance to marine invertebrates. Boating restrictions under Alternative B would benefit marine invertebrates by decreasing effects to water quality.

4.4.4.3 Alternative C

Habitat Restoration

Alternative C would establish a larger (515-acre) area of estuarine habitat than Alternatives A and B, while maintaining and enhancing 447 acres of freshwater wetlands.

The restoration of full tidal conditions in the intertidal and river delta habitats would benefit marine invertebrates that use this area, such as bivalves and gastropods, opisthobranchs, and amphipods. This alternative would restore a continuous estuary, eliminating fragmentation associated with the muted estuary provided in Alternative B.

Effects to invertebrates associated with freshwater wetlands and grasslands in Alternative C would be similar to those described in Alternative B. The decrease in edge and increase in habitat connectivity under Alternative C may lead to higher quality habitat than under Alternative B. Riparian restoration along the Nisqually River would create higher quality riparian habitat that could be utilized by terrestrial and aquatic invertebrates.

Refuge Expansion

The environmental consequences for Refuge expansion under Alternative C would be the same as those described for Alternative B.

Public Use Program

Effects of the public use program would be similar to Alternative B. Trail-based effects on invertebrates would be less under this alternative than under Alternatives A or B, as the trail system would be reduced from 5½ miles to 3¾ miles. The additional boardwalk trail may have localized effects on marine invertebrates due to shading under the boardwalk; however, the effects are not well known.

Fishing and shellfishing effects on invertebrates under Alternative C would be similar to Alternative B. Localized effects by hunting activity would be over a single block of lands and not in McAllister Creek, compared to Alternative B.

4.4.4.4 Alternative D (Preferred Alternative)

Habitat Restoration

Alternative D would involve the largest area (699 acres) of estuarine habitat restoration and greatest reduction of freshwater wetlands. The inclusion of the McAllister Creek area would

improve the diversity and function of estuarine habitat compared to Alternative C, leading to greater positive effects to marine invertebrates. Estuary systems are considered some of the most productive habitats in the world, largely due to the abundance of invertebrates. Increases in marine invertebrates would provide more food for many fish and wildlife species.

The conversion of freshwater wetlands under Alternative D would be the largest of all alternatives, causing the largest shift in the invertebrate community. Invertebrates exclusively dependent on freshwater and grassland habitats would be most affected by this alternative, thereby reducing potential food sources for wildlife that forage heavily on those invertebrate species. The effects of riparian management under Alternative D would be similar to those described for Alternative C.

Refuge Expansion

The proposed expansion area in Alternative D would provide the greatest benefit to invertebrate species compared to the other alternatives, especially in areas south of I-5 in the Nisqually Valley and along the Nisqually River. Land protection and restoration could increase invertebrate abundance and diversity.

Public Use Program

Effects of the public use program would be similar to Alternatives B and C. Effects from trails under Alternative D would be somewhat less in localized areas due to the reduced length of trails.

Human presence and disturbance associated with resource harvesting (hunting, fishing, and shellfishing) are expected to be similar to Alternative B, except for a slightly larger hunting area that includes the mouth of the Nisqually River.

4.4.5 Effects to Invasive and Exotic Wildlife Species

4.4.5.1 Alternative A

Habitat Restoration

Long-term resource monitoring under all alternatives would help control exotic species by better documenting species presence and abundance. Conservation planning requires a long-term commitment to ecological monitoring (Noss et al. 1997). With these data in hand, the Service could manage invasive species more effectively.

Restoration of the West Bluff parcel (under all alternatives) would improve native vegetation diversity and habitat quality, potentially reducing the use by non-native wildlife species that tend to use disturbed areas.

Mitten and green crabs would continue to pose a potential threat if they eventually invade the estuary. The limited improvements in freshwater habitats under this alternative would allow

bullfrogs to continue to increase, causing direct negative effects on native amphibian production. Large numbers of European starlings would continue to roost, feed, and nest on the Refuge, competing with native birds for feeding and nesting habitat.

Refuge Expansion

Completion of acquisition within the boundary and strengthened partnerships within the watershed under all alternatives would reduce habitat fragmentation and improve connectivity between habitats. These characteristics would otherwise make habitats more susceptible to exotic species invasions (Meffe and Carroll 1994). However, these actions taken under Alternative A would have small adverse and/or neutral effects on exotic species, such as bullfrogs and European starlings resulting in less benefit to native species compared to the action alternatives.

Public Use Program

The public use program would not be expected to significantly affect exotic wildlife species under Alternative A, except that some low potential would exist for undesirable releases of non-native species onto the Refuge. Boats or PWC could inadvertently introduce or speed the spread of aquatic wildlife exotics, such as crab and other invertebrate species.

4.4.5.2 Alternative B

Habitat Restoration

Under Alternative B, 45% of the currently diked wetlands would be converted to estuarine habitat. The reduction in grasslands may provide less habitat for European starlings, but the effect may not significantly change numbers. Increased estuarine habitat would provide a greater area for potential invasion and spread of mitten and green crabs. Improved freshwater habitat quality and a higher proportion of seasonal wetlands could reduce bullfrog habitat, benefitting native amphibians. The extent of this benefit would depend on water flow and fluctuation levels. For example, bullfrogs in western Washington have been documented to benefit from the increase in protection of permanent water wetlands (Adams 1999). Thus, the permanence of the water in the managed wetlands created under Alternative B (and C and D) would affect the success of bullfrogs at Nisqually NWR.

Refuge Expansion

Expanded acquisition and restoration proposed in Alternative B would encourage native wildlife species and reduce habitat for exotic wildlife species, including bullfrogs and starlings, on a greater scale than in Alternative A. Native species would benefit.

Public Use Program

Effects from the public use program are similar to those described under Alternative A.

4.4.5.3 Alternative C

Habitat Restoration

Estuary restoration under Alternative C would be larger than Alternative B; thus, the potential for mitten and green crab establishment would be increased.

The reduction in grasslands under Alternative C would provide the same effects as described in Alternative B. Improved freshwater habitat quality and a higher proportion of seasonal wetlands could reduce bullfrog habitat, benefitting native amphibians.

Refuge Expansion

Effects to exotic species would be the same as those described under Alternative B.

Public Use Program

Effects to exotic wildlife species under this alternative would be similar to those described for Alternative B.

4.4.5.4 Alternative D (Preferred Alternative)

Habitat Restoration

Effects from restoration activities would be similar to Alternative C, except that the amount of estuarine restoration would be the greatest of all the alternatives. Restoration of the estuary under Alternative D would greatly benefit native species that use this habitat. There would be a larger area that mitten and green crabs could invade, but the higher habitat quality in Alternative D may slow the spread. The remaining freshwater wetlands would have the most intensive restoration and management of all alternatives considered. The reduction in grasslands may reduce habitat for starlings. Less permanent freshwater areas would discourage bullfrogs and benefit native amphibians.

Refuge Expansion

The proposed expansion area in Alternative D would provide the largest potential for exotic species reduction of all alternatives, the result of improved riparian and freshwater wetland protection and restoration (see Section 4.2.1). This alternative would include habitat quality improvements that would enhance conditions for native species and strengthen competitive abilities against exotic species. Habitat expansion and improved habitat quality could improve conditions for native cavity-nesting birds in riparian habitat along the Nisqually River, which may lessen the effects of European starlings. Acquisition, restoration, and management of freshwater wetlands south of I-5 would be greatest under Alternative D, which could reduce bullfrog populations and benefit native amphibians.

Public Use Program

Effects of the public use program would be similar to Alternatives B and C.

4.4.6 Effects to Threatened and Endangered Species and Selected Birds of Conservation Concern

See Section 4.3.5 for details on the effects to fish species.

4.4.6.1 Alternative A

Habitat Restoration

The restoration of the West Bluff parcel under all alternatives would enhance bald eagle nesting habitat quality (see Section 4.4.1.1). As described in Section 4.2.1, the persistence of the current dike system may still affect the existing estuary due to tidal mudflat erosion, artificial sediment accretion patterns, and reduced tidal prism. Degradation of estuarine habitat over time and lack of restoration would provide no new benefits to Steller sea lions, brown pelicans, or marbled murrelets.

Freshwater wetland improvements under this alternative are not expected to enhance current wetland habitat quality over the long-term. Seasonal freshwater wetlands would deteriorate over time due to exotic species invasion, resulting in a conversion to scrub-shrub communities. Increased conversion to reed canary grass infringement would significantly decrease seasonal wetland habitat used by waterfowl and waterbirds. This would provide lower food resources for eagles and not contribute to meeting Refuge goals.

Refuge Expansion

All threatened and endangered species (TES) would benefit, although not significantly, from more uniform land protection and conservation within the Refuge. Strengthened partnerships would increase water and intertidal habitat quality, providing some benefits in foraging conditions for salmon, bull trout, sea lion, pelican, and murrelet. See Section 4.4.1.1 for a description of effects on bald eagles.

Public Use Program

Under Alternative A, the trail system would continue to be used for hiking and wildlife observation. Although these activities could have negative effects on TES, especially those using habitats adjacent to trails, they would not be expected to be significant. The reduction in human disturbance along the western shoreline of McAllister Creek would benefit bald eagles. Since activities associated with the EE program would be focused on trails or within the Environmental Education Center, no significant effects to TES are expected.

Under this alternative, hunting would occur as it does currently in the WDFW and Refuge tideflats. The presence and associated activity of hunters, anglers, and boating activity in the

estuary, including the RNA, would disturb TES species that use this habitat and are sensitive to disturbance. TES seabirds and marine mammals concentrate in the outer reaches of the Refuge; thus, the lack of closure of the RNA to resource harvesting and winter boating would allow these disturbances to continue. See Sections 4.4.1.1 and 4.4.2.1 for a description of the effects to bald eagles, seabirds, and marine mammals.

Under Alternative A, boat and PWC use would continue. Many TES species, including Steller sea lions and marbled murrelets, are known to be affected by boats (Boersma and Parrish 1998; Brueggeman 1992). High speed watercraft would have the greatest effects.

4.4.6.2 Alternative B

Habitat Restoration

Estuarine restoration under Alternative B would improve the quality and increase the quantity of estuarine habitats along the northern edge of the diked area and McAllister Creek, benefitting Steller sea lions, marbled murrelets, bald eagles, and brown pelicans. However, short-term adverse effects associated with reduced water quality resulting from construction activities, such as dike breaching and bridge construction, may occur. Estuarine restoration would also benefit shorebirds of conservation concern, such as the whimbrel, marbled godwit, red knot, and short-billed dowitcher (USFWS 2001). See Sections 4.4.1.2, 4.4.2.2, and 4.3.2 for a description of the effects to bald eagles, seabirds, shorebirds, marine mammals, and fish. The benefits from estuary restoration (both muted and full) under Alternative B would not be as great as under Alternatives C and D because the restoration areas would be fragmented with edges. In addition, it would be more difficult for marine mammals and fish to move in and out of diked restoration sites. Improved management of the freshwater wetland and riparian areas would benefit bald eagles, great blue herons, and Birds of Conservation Concern (BCC) listed shorebirds and landbirds (e.g., rufous hummingbird, olive-sided flycatcher).

Refuge Expansion

Effects of increased watershed protection would be the same as described under Alternative A. However, Alternative B expansion activities would benefit TES species more than under Alternative A. The protection of additional habitat along the East Bluff and floodplains south of I-5 would benefit bald eagles as well as shorebirds and landbirds on the BCC list (USFWS 2001). See Sections 4.4.1.2, 4.4.2.2, and 4.3.2 for a description of effects to bald eagles, seabirds, shorebirds, marine mammals, and fish.

Public Use Program

Under all action alternatives, the Service would manage the Luhr Beach area, if a cooperative management agreement can be developed with the State. Since this is a primary access point for boaters, especially hunters and anglers, the installation of a Visitor Contact Station would increase visitor awareness and thus could decrease disturbances from these recreational activities to TES using the delta.

Effects to various TES from activities associated with the recreational trail system would be similar as described in Alternative A. See Sections 4.4.1.2, 4.4.2.2, and 4.3.2 for a description of effects to bald eagles, seabirds, and marine mammals. High public access of the trail adjacent to the restored estuarine areas along McAllister Creek could have negative effects on shorebirds on the BCC list, but disturbance would be localized to the vicinity of the trail (see Section 4.4.1.2). In addition, since the EE program would be increased to serve up to 20,000 students, disturbances to wildlife using habitats adjacent to the trail system could increase. This includes a number of birds that use riparian habitats such as rufous hummingbird and olive-sided flycatcher, both on the BCC list (USFWS 2001). However, effects would be localized to trails and study sites. As described above, Refuge outreach programs would emphasize responsible behavior, which can reduce disturbance.

Waterfowl hunting would be limited to WDFW lands. The removal of unauthorized hunting on Refuge lands would benefit estuarine-dependent TES, as well as BCC shorebird species that could also be disturbed by the activity (see Sections 4.4.1.2 and 4.4.2.2). Under all action alternatives, the RNA would be posted, and a no consumptive use policy would be enforced. This, along with winter boat closures, would provide increased sanctuary to TES species. Additionally, the closure of shellfishing in the RNA would benefit shellfish populations, which could contribute to shorebird prey availability. Decreased disturbance to these species in the estuary could also benefit bald eagles and peregrine falcons. The restriction of public access into the restored estuarine habitat under Alternative B (and C and D) would also benefit all TES that use this habitat.

Continued bank fishing along McAllister Creek, allowed under Alternatives B and C, could cause disturbance to eagles, including nesting birds. Boating restrictions under all action alternatives are expected to have positive effects on TES that use the estuary, Nisqually River, and McAllister Creek.

4.4.6.3 Alternative C

Habitat Restoration

The effects of restoration actions from Alternative C would be similar but greater than described in Alternative B. The restoration of full tidal conditions in the intertidal and river delta habitats would benefit marbled murrelets, bald eagles, brown pelicans, Steller sea lions, and shorebirds on the BCC list to varying degrees through improvements in forage abundance and diversity. See Sections 4.4.1.2, 4.4.2.2, and 4.3.2 for a description of effects to bald eagles, seabirds, fish, and marine mammals.

Effects from intensive management of the remaining freshwater wetland areas under this alternative would be similar to Alternative B, improving habitat quality and benefitting shorebird and landbird species identified on the BCC list (see Section 4.4.6.2). The additional 38 acres of riparian restoration would also benefit BCC-listed landbird species.

Refuge Expansion

Effects from Refuge expansion under Alternative C would be the same as described under Alternative B.

Public Use Program

Effects from the public use program in Alternative C would be similar to Alternative B. However, there would be no seasonal closure of the boardwalk extension during hunting season, resulting in some localized disturbance in that area during the winter months. The consolidated hunting area would reduce disturbance to bald eagles, great blue heron, and BCC-listed shorebird species in McAllister Creek. The 3 day/week hunting restriction would reduce the frequency of disturbance to some TES species. In contrast, the change in the western boundary of the RNA would remove some sanctuary areas at the mouth of the river for TES and BCC-listed shorebirds that frequent estuarine habitats.

4.4.6.4 Alternative D (Preferred Alternative)

Habitat Restoration

Alternative D would provide the largest area of estuarine restoration (699 acres), resulting in the greatest benefit to TES dependent on estuarine habitat, including bald eagle and marbled murrelets. Improved quality and quantity of estuarine habitat would also benefit the great blue heron and BCC-listed shorebirds. The potential short-term adverse effects associated with dike construction activities would be greater in this alternative, compared to Alternatives B and C, because of the higher amount of dike removal. Effects from improved freshwater wetland management and riparian restoration are similar to those described in Alternative C. See Sections 4.4.1.2, 4.4.2.2, and 4.3.2 for descriptions of effects to bald eagle, seabirds, shorebirds, fish, and marine mammals. Alternative D is the alternative that would best allow the Refuge to meet its goals.

Refuge Expansion

The proposed expansion area in Alternative D would provide the largest potential for increased habitat protection, the result of improving overall Refuge habitat quantity and quality, which would benefit TES species. Effects would be similar to those described in Alternatives B and C. The increase in watershed protection provided through acquisition and partnership building would increase water and tideland habitat quality, benefitting TES dependent on estuarine habitat. In addition, the slightly increased protection and restoration of the Nisqually River riparian corridor would benefit eagles and BCC-listed landbird species through improved riparian habitat and increased foraging opportunities (see Section 4.4.6.3).

Public Use Program

Effects to TES from the public use program would be similar to those described in Alternative C. Trail effects would be the least in this alternative because of the decreased trail length. Effects from activities associated with hunting would be similar to Alternative B, with the exception of opening 73 acres of the RNA to hunting. This would reduce the amount of sanctuary in the delta. Fishing effects on bald eagles would be reduced with the removal of bank fishing in the McAllister Creek.

4.4.7 Effects to State-Listed Species

Effects to the Washington State endangered western pond turtle and Oregon spotted frog are discussed in more detail in Section 4.4.3, Effects to Reptiles and Amphibians. These are the only Washington State-listed species with potential habitat in the study area. Effects to Washington State candidates species (Townsend's big-eared bat, common loon, merlin, pileated woodpecker, Lewis' woodpecker, and purple martin) are discussed in Effects to Birds or Mammals (Sections 4.4.1 and 4.4.2).

4.5 Effects to Special Uses

4.5.1 Alternative A

4.5.1.1 *Habitat Restoration*

Effects to Haying

Under this status quo alternative, no significant changes to the haying program are anticipated. The approximately 250 acres of Refuge grasslands would continue to be hayed under a Special Use Permit by a local farmer each year. In lieu of cash payment, a cooperative management agreement may be developed, and the cooperator would agree to provide services or materials to enhance the habitat in exchange for the hay removed, directly benefitting Refuge habitat. Haying operations would be conducted under current conditions (see Chapter 3).

Effects to Scientific Research

No significant changes would be expected to Refuge research opportunities. Researchers would be required to submit study proposals; once approved, projects would be conducted under Special Use Permits with special conditions identified to minimize effects on wildlife and habitat.

4.5.1.2 *Refuge Expansion*

Effects to Haying and Scientific Research

No effects would be expected since this alternative does not include acquisition of properties outside of the currently approved Refuge boundary.

4.5.1.3 *Public Use Program*

Effects to Haying and Scientific Research

Special conditions (zoning and timing) on research projects would continue to occur, as necessary, to avoid conflicts between public uses and research projects. No effects from the public use program on haying are anticipated.

4.5.2 Alternative B

4.5.2.1 *Habitat Restoration*

Effects to Haying

As a result of estuarine restoration and freshwater enhancement activities, the haying program would be reduced as the proportion of freshwater wetlands within the remaining diked area increases. In this alternative, a small amount of currently hayed grasslands, approximately 5

acres, would be restored to estuarine habitat. In addition, remaining grassland areas would be managed differently to enhance freshwater wetland habitats, reducing the total amount of grasslands that would remain for haying. All other aspects of the haying program would be the same as Alternative A.

Effects to Scientific Research

Effects would be the same as Alternative A, except that there would be an increased opportunity for researchers to study and compare muted and full estuarine restoration processes.

4.5.2.2 Refuge Expansion

Effects to Haying and Scientific Research

Acquisition of property within the expansion area may contain lands that could be included in the haying program. In addition, Refuge expansion would also increase the opportunities for research in the Nisqually delta because of increased accessibility.

4.5.2.3 Public Use Program

Effects to Haying and Scientific Research

Effects would be the same as Alternative A. Additional special conditions may be considered when evaluating research proposals because of changes in trail configurations.

4.5.3 Alternative C

4.5.3.1 Habitat Restoration

Effects to Haying

Effects would be the same as Alternative B, except the acreage of currently hayed grasslands lost to estuarine restoration would be higher under Alternative C, approximately 69 acres. In addition, the grassland acreage within the dike would be reduced to a much larger degree, reducing the haying program.

Effects to Scientific Research

Effects would be the same as Alternative B, except that the new opportunities for research would focus on a larger amount of estuarine restoration.

4.5.3.2 Refuge Expansion

Effects to Haying and Scientific Research

Same as Alternative B.

4.5.3.3 Public Use Program

Effects to Haying and Scientific Research

Same as Alternative B.

4.5.4 Alternative D (Preferred Alternative)

4.5.4.1 Habitat Restoration

Effects to Haying

As a result of estuarine restoration and freshwater enhancement activities, the haying program would be greatly reduced. Once major restoration activities are completed, less than 100 acres of grasslands would be managed on the Refuge, interspersed among permanent and seasonal freshwater wetlands. Once restoration is complete, haying on this reduced acreage may not be cost effective for a cooperators. If this is the case, the management of the remaining grasslands would become part of routine Refuge habitat management activities.

Effects to Scientific Research

Effects would be the same as Alternative B, except that research opportunities would include studying a larger estuarine restoration area (699 acres).

4.5.4.2 Refuge Expansion

Effects to Haying and Scientific Research

Effects would be the same as Alternatives B and C, except that the proposed acquisition includes more land; therefore, new opportunities for haying and research are greater.

4.5.4.3 Public Use Program

Effects to Haying and Scientific Research

Effects would be the same as Alternative B, except that more measures may need to be included in research permits to avoid conflicts with public use.

4.5.5 Effects to Tribal Fishing

The fishing rights of the Nisqually Indian Tribe and its members are provided for by the Medicine Creek Treaty Act of 1854. The Nisqually Indian Tribe directly manages and enforces activities associated with their commercial fisheries. Tribal fishing activities would continue under all alternatives.

4.6 Effects to Public Access, Education, and Recreational Opportunities

4.6.1 Alternative A

4.6.1.1 Habitat Restoration

Effects to Environmental Education, Wildlife Observation, Interpretation, Wildlife Photography, Waterfowl Hunting, Fishing and Shellfishing, and Boating

This alternative calls for continued management efforts, including the retention of 1,000 acres of freshwater wetlands and grasslands within the Brown Farm Dike, limited enhancement of these freshwater habitats, and some control of reed canary grass. Although there would be no change in public access, these management efforts would likely have a minor positive effect on recreational opportunities at the Nisqually NWR by improving wildlife viewing, interpretation, and photography associated with the wildlife species that prefer this habitat. However, these changes would deteriorate over time as reed canary grass continues to spread due to management limitations. Major dike repairs would have a short-term negative effect on trail access and wildlife viewing opportunities.

4.6.1.2 Refuge Expansion

Effects to Environmental Education, Wildlife Observation, Interpretation, Wildlife Photography, Waterfowl Hunting, Fishing and Shellfishing, and Boating

Other than the completion of the Refuge within the existing approved boundary, no Refuge expansion is proposed in this alternative. Nevertheless, acquiring or protecting lands within the existing boundary would likely have a positive indirect effect on recreational opportunities due to the improved management and habitat conditions anticipated on some of the acquired/protected lands, thus affording the public increased or improved wildlife-dependent recreational opportunities.

4.6.1.3 Public Use Program

Although most of the current features of recreation and public use at Nisqually NWR would remain unchanged under this alternative, there are several actions proposed in this alternative that would have an effect on public access, education, and recreational opportunities available at Nisqually NWR. These effects are discussed below.

Effects to Environmental Education

Under Alternative A, the Service would continue to provide a limited EE program, serving up to 5,000 students per year. The program is typically completely booked in the busy spring period. The increased demand for outdoor environmental education and a growing population base in the vicinity of Nisqually NWR would leave this high priority need unmet, and the program

quality would also not be improved as in all action alternatives. Although the program would continue to provide benefits, it would remain inadequate for serving the needs of the region for the type of environmental education offered at the Refuge, and Refuge goals would not be fully met.

One action common to all alternatives would be the construction of a new Environmental Education Center. The EE program was temporarily moved to a trailer near the maintenance compound after the Twin Barns Education Center was severely damaged by the February 2001 Nisqually Earthquake. A new and upgraded facility would ensure a safe, quality experience for school children participating in the Refuge's environmental program, and would therefore greatly benefit this program and its participating students.

The seasonal closure of a portion of the trail during the waterfowl hunting season would continue to affect some EE groups that would otherwise be interested in using the trail to observe salt marsh habitats. Continued unrestricted use of PWC and associated noise and disturbance to wildlife would continue to disturb EE groups and other trail users.

Effects to Wildlife Observation, Interpretation, and Wildlife Photography

Under Alternative A, the Refuge would continue to provide 7 miles of trails (primarily using the existing dike system), including an accessible and interpreted 1-mile loop boardwalk trail. This long-established and extremely well-used trail system is highly valued by many Refuge visitors. Many commentors during scoping for this CCP/EIS and subsequent public involvement efforts indicated their desire to keep the dike trail network in place. Therefore, retaining this length and type of trail system would continue to benefit public access and the recreational opportunities at Nisqually NWR. However, quality of the trail experience would not improve significantly since habitat improvements and increased wildlife use would be limited. The existing hunting would require that portions of the 5½-mile loop trail continue to be seasonally closed during the waterfowl hunting season to ensure visitor safety and provide wildlife sanctuary. This is the largest conflict among users in the delta, and most of the public comments received during scoping for this CCP/EIS stated that they preferred that the loop trail not be seasonally closed. Therefore, it is anticipated that the experience of many trail users would continue to be negatively affected by continued seasonal closures of the dike trail. Trespass problems on the trail by trail users unhappy with the closure would continue.

In addition to the continuation of the existing trail system, under Alternative A (and an action common to all of the alternatives), an unimproved, primitive ½-mile trail would be developed in the Nisqually River surge plain forest, connected to the existing boardwalk spur. This trail would be minimally maintained and would not provide full access for people with disabilities. Provision of this additional trail would have a positive effect on public access and recreational opportunities by providing more of an exposure to the surge plain habitat than currently exists. However, since this would be a primitive trail, access would be limited, especially during wetter periods of the year.

The Visitor Center would continue to be provided, including interpretive displays focusing on existing habitats and wildlife, thus providing a quality interpretive experience for many visitors. Interpretive panels would also continue to be provided along the 1-mile boardwalk loop.

Two existing photoblinds along the Brown Farm Dike Trail would continue to be maintained and upgraded as resources allow.

Effects to Waterfowl Hunting

Under Alternative A, the Refuge would continue to be closed to waterfowl hunting. However, the current unauthorized hunting on Refuge lands would continue. Thus, the current pattern of hunting activities would continue to result in insufficient sanctuary for waterfowl. Under Alternative A, unsigned areas would continue to be administratively uncontrollable, and closures in these areas would not be enforced.

Continuation of the current hunting activities under this alternative would result in more hunting access than any other alternative, although confusion over boundaries would continue. Many waterfowl hunters commented on the confusion and requested that jurisdiction and boundary problems be resolved and made consistent. Almost no comments were received supporting retaining the current situation. There would be no increase in public outreach or education for the hunting program by the Refuge.

Effects to Fishing and Shellfishing

Under this alternative, the Service would continue to allow fishing by boat. All State regulations would apply. The Refuge would maintain the McAllister Creek Bank Fishing Area, and allow fishing in this area by foot or boat. However, seasonal closures on the northern portion of this bank fishing area would still occur during the waterfowl hunting season. Fishing opportunity is expected to decrease in response to the closure of the McAllister Creek Hatchery (July 2002). Closures of the RNA to consumptive uses, including fishing and shellfishing, would not be enforced. The allowance of fishing on the Refuge would continue to benefit public fishing opportunities available at Nisqually NWR, especially by continuing provision of bank fishing on McAllister Creek. There are no other public access locations via foot traffic on McAllister Creek outside of the Refuge, although fishing opportunity is expected to decrease with the closure of the McAllister Fish Hatchery (July 2002). Because no new fishing opportunities would be created under this alternative, fishing activities on the Refuge would not be improved, thus resulting in lost or fewer opportunities for quality fishing.

Under this and all other alternatives, recreational shellfishing would continue to be allowed outside the Brown Farm Dike according to County and State regulations. However, shellfishing would remain closed in the tideflats as currently directed by the Washington State Department of Health. These shellfish beds may re-open for recreational harvest after fecal coliform bacteria levels reach approved levels. Additionally, recreational and commercial geoduck harvest would continue under State regulation in waters in or adjacent to the Refuge. The allowance of recreational shellfishing and geoduck harvest on the Refuge would provide a continued benefit for shellfishing opportunities available at Nisqually NWR.

Effects to Boating and Personal Watercraft (PWC)

Under this alternative, motorized and non-motorized recreational boating would continue to be allowed in all waters of the Refuge outside of the Brown Farm Dike. Thurston County

regulations would apply, requiring a speed limit for all watercraft of 5 mph within 200 feet of any shoreline. However, because of limited staff and funding, this regulation would not be enforced by the Service. The allowance of the various boating activities would have a continued benefit on boating opportunities in south Puget Sound.

PWC use on the Refuge would also continue. However, continued use of PWC within the Refuge would result in continued conflicts (e.g., noise, wildlife disturbance, safety) between PWC users and other Refuge visitors (e.g., canoers, kayakers, anglers, motorized boaters, trail users, and wildlife observers) causing a negative effect on these recreationists. In addition, there would continue to be a lack of Refuge information readily available to most boaters due to the absence of a contact station at Luhr Beach.

Effects to Other Non-Wildlife Dependent Recreational Activities

Under this and all other alternatives, the collection of apples and blackberries for off-site consumption would no longer be allowed. Picking would be restricted to trails only and for consumption only while on the Refuge. Additionally, to protect sensitive wildlife habitat and maintain established wildlife sanctuary areas closed to public entry, other plant material and mushroom picking would continue to be prohibited. This limit on fruit collecting would benefit those participating in wildlife observation by reducing off-trail wildlife disturbance. Prohibiting and/or reducing fruit and plant collection would have a negative effect on those persons participating in these activities. However, due to the availability of numerous and similar opportunities in the vicinity of Nisqually NWR and elsewhere, this would be expected to result in a only a minor negative effect to these recreationists.

4.6.2 Alternative B

4.6.2.1 Habitat Restoration

Effects to Environmental Education, Waterfowl Hunting, Fishing and Shellfishing, and Boating

Under Alternative B, 318 acres of muted and 140 acres of full estuarine habitat would be restored, which would reduce the total amount of freshwater habitat on the Refuge. However, improved management of freshwater habitat would improve habitat quality within the diked area, although not as effectively as in Alternative D. Improved habitat quality for both estuarine and freshwater habitats would improve wildlife use of these areas (see Effects to Wildlife, Section 4.4). However, since this alternative contains the smallest degree of estuarine restoration and freshwater management improvements, it would result in the smallest improvement of wildlife use in both the estuarine and freshwater habitats. These limited improvements would still enhance environmental education opportunities, particularly the opportunity to observe active habitat restoration/management activities. In addition, enhanced waterfowl habitats may encourage more waterfowl to use the delta, improving waterfowl hunting opportunities. A similar effect would be expected on fish populations inhabiting estuarine habitat, with some long-term benefits for fishing opportunities in the delta, Nisqually River, and McAllister Creek.

Effects to Wildlife Observation, Interpretation, and Wildlife Photography

Overall, it is anticipated that the habitat restoration activities would have a positive effect on wildlife observation, interpretation, and photography opportunities at the Refuge by making limited improvements to habitat quality (see above), potentially increasing the number and diversity of associated wildlife species. The trail experience would be diversified, in that sections of the trail would be surrounded on both sides by estuarine habitat (muted on one side), giving visitors a chance to be within the estuarine habitat instead of just along the edge. Although there is some change in trail configuration because of estuarine restoration in Alternative B, the trail would remain relatively the same as Alternative A. Therefore, this is the only action alternative that would provide some estuarine restoration and improved freshwater habitat quality with very little change to trail length and configuration.

4.6.2.2 Refuge Expansion

Effects to Environmental Education, Wildlife Observation, Interpretation, and Wildlife Photography, Waterfowl Hunting, Fishing and Shellfishing, and Boating

This alternative would continue efforts to acquire interests in the remaining 1,011 acres of State and privately owned lands within the existing approved boundary, including pursuit of a cooperative management agreement with the State to allow the Service to manage the Luhr Beach boat landing area. Effects from this action would be the same as described in Alternative A, but would also include an expanded EE program in partnership with the Nisqually Reach Nature Center. In addition, a new visitor contact station at Luhr Beach would improve opportunities for wildlife interpretation and provide helpful regulatory information for boaters, hunters, and anglers that launch at this location.

Alternative B would also provide for expansion of the Refuge boundary (2,407 acres), including upland habitat along the East Bluff and McAllister Creek, as well as floodplain, riparian, and wetland habitat within portions of the Nisqually Valley floodplain, creeks, and sloughs. This expansion area would include a Service-managed fishing opportunity in the Trotter's Woods area. Refuge management of this site would improve the quality of fishing experience by providing law enforcement and improved facilities. In addition, an accessible fishing site would be explored at Luhr Beach. New opportunities for quality wildlife observation (trails), hunting, and fishing would potentially be created if sufficient and appropriate areas are acquired that would also provide adequate wildlife sanctuary. East Bluff trails would potentially link to other trails in the area, providing additional recreational benefits.

4.6.2.3 Public Use Program

Effects to Environmental Education

Construction of a new Environmental Education Center with upgraded facilities would have a beneficial effect on this educational opportunity at Nisqually NWR.

The EE program would be improved and expanded to serve up to 20,000 students (compared to 5,000 under Alternative A). Additional materials and curricula would be developed, teacher training and field trip support provided, staff support increased, and partnerships strengthened, including with the Nisqually Reach Nature Center. This partnership would provide an even stronger program to educate the public on the marine resources of the Nisqually delta and disseminate a consistent theme and message related to environmental education on the Refuge.

Program improvements, increased capacity, and staff support would increase the quality of the program, providing a model for other environmental programs in the Puget Sound area. This alternative would greatly strengthen and maximize the EE program on the Refuge, resulting in a significant positive effect on the environmental opportunities available in south Puget Sound.

Effects to Wildlife Observation, Interpretation, and Wildlife Photography

Effects would be similar to Alternative A, since the majority of the trail would remain unchanged. As noted under Alternative A, this trail system is highly valued by numerous Refuge visitors, many of whom have stated their preference for leaving the dike loop trail intact. Therefore, since only minor modifications would be made to the configuration of the loop trail, and the overall trail length would remain the same, this alternative would provide a continued benefit for wildlife observation, interpretation, and photography opportunities available at Nisqually NWR. However, a portion of the trail would still need to be seasonally closed during the waterfowl hunting season, negatively affecting trail users (see Section 4.7.1).

Effects from facilities would also continue to be the same as described in Alternative A, except for the additional Visitor Contact Station at Luhr Beach. This new Visitor Contact Station would improve opportunities for wildlife interpretation of Refuge resources. Effects from the new trail in the surge plain would be the same as described under Alternative A.

Effects to Waterfowl Hunting

Under Alternative B, a waterfowl hunting program would not be implemented on the Refuge, and the Refuge boundary would be clearly signed to delineate it from WDFW property where hunting would continue to be allowed. WDFW would continue to have jurisdiction and management responsibility over WDFW lands. However, the Service (through increased staffing) would actively enforce the no hunting regulations, eliminating the previous unauthorized hunting that has occurred in unsigned portions of the Refuge.

Continued use of the WDFW property for waterfowl hunting would continue to provide hunting opportunities in the Puget Sound area. Eliminating unauthorized hunting on the Refuge would end the current situation which provides insufficient wildlife sanctuary and would meet the majority of the (commenting) public's desire that hunting be discontinued. However, by enforcing the closure on the Refuge it would also mean eliminating a portion of the area currently available to hunters resulting in a negative effect on hunting opportunities in the delta. This would reduce confusion for hunters and clarify legal hunting areas. Posting and restricting hunting to State lands would also clarify boundaries for other boaters, reducing conflicts with hunters, including kayakers who could then easily avoid hunting areas. Boat speed restrictions

would positively affect hunters by reducing waterfowl disturbance and noise in the hunting area. At the same time, speed restrictions would increase travel time slightly for hunters when traveling to and from the hunting areas.

Effects to Fishing and Shellfishing

Effects would be the same as Alternative A. Under Alternative B, the Trotter's Woods area south of I-5, if acquired or under a cooperative management agreement, would be managed to provide a quality bank fishing area along the Nisqually River. Also proposed is an accessible fishing site at Luhr Beach. These new or improved fishing areas would positively affect fishing opportunities in the area. In contrast, the closure of the RNA to fishing, as well as other consumptive uses, would negatively affect fishing opportunities on the Refuge. Boat speed restrictions would positively affect anglers by reducing disturbance, noise, and wakes in the fishing areas. However, speed restrictions would increase travel time for anglers traveling through the area. A portion of the McAllister Creek bank fishing area would continue to be seasonally closed due to waterfowl hunting on adjacent State lands. Fishing opportunity is expected to decrease along McAllister Creek, in response to the closure of the McAllister Creek Hatchery (July 2002).

Shellfishing opportunities and the subsequent effects would be the same as described under Alternative A. A Visitor Contact Station at Luhr Beach would alert shellfishermen to current restrictions, helping to ensure safety and a quality experience.

Effects to Boating and Personal Watercraft (PWC)

Under Alternative B, and all other action alternatives, a boat speed limit of 5 mph would be established in all Refuge waters. Additionally, under Alternative B (and all other action alternatives), all restored areas, as well the RNA from October 1 to March 31, would be closed to boating to provide additional sanctuary for migratory birds and other wildlife. These actions would have a negative effect on boating within the Refuge, particularly motorized watercraft. However, it is anticipated that the effects would be minor due to the continuance of boating in the Refuge (albeit at lower speeds) and because of the availability of numerous and similar water bodies in proximity to Nisqually NWR. In addition, 5 mph boat speed restrictions already exist within 200 feet of any shoreline by Thurston County regulation. It would be expected that boat speed restrictions would largely preclude PWC use in Refuge waters. However, due to the availability of numerous and similar water bodies in proximity to Nisqually NWR, this would not be expected to result in a significant negative effect. Speed restrictions would improve safety and the quality of wildlife viewing for nonmotorized boaters, including kayakers and canoeists.

Effects to Other Non-Wildlife Dependent Recreational Activities

Other non-wildlife dependent opportunities (berry and apple picking, plant material and mushroom harvest) and the subsequent effects would be the same as described under Alternative A.

4.6.3 Alternative C

4.6.3.1 Habitat Restoration

Effects to Environmental Education, Wildlife Observation, Interpretation, Wildlife Photography, Waterfowl Hunting, Fishing and Shellfishing, and Boating

Under Alternative C, 50% of the diked interior would be restored to estuarine habitat through dike removal, and 38 acres of riparian habitat would be restored along the Nisqually River. The total amount of freshwater habitat would be reduced on the Refuge, more than in Alternative B. However, improved habitat quality of estuarine, riparian, and freshwater habitats would improve wildlife use of these areas (see Effects to Wildlife, Section 4.4). These improvements would also enhance environmental education opportunities, particularly the opportunity to observe and learn about active habitat restoration/management activities and estuaries. In addition, enhanced waterfowl and fish habitats would be expected to support more waterfowl and fish in the delta, improving viewing opportunities for school groups. Waterfowl hunting and fishing opportunities would also be enhanced due to increased waterfowl and fish use in the delta.

Habitat restoration activities would have a positive effect on wildlife observation, interpretation, and photography opportunities at the Refuge by improving habitat quality (see above), potentially increasing numbers and diversity of associated wildlife species. However, the current 5½-mile loop trail would be reduced to a 3¾-mile loop trail including a boardwalk spur into the estuary. This reduction of the 5½-mile loop trail would have a negative effect on trail use at the Refuge by eliminating the unique experience provided by a loop trail of this length in south Puget Sound. However, quality of the experience would be improved by increased wildlife viewing opportunities and improved access to estuarine habitats. The boardwalk spur would allow visitors to be within the estuary, instead of along the edge.

4.6.3.2 Refuge Expansion

Effects to Environmental Education, Wildlife Observation, Interpretation, Wildlife Photography, Waterfowl Hunting, Fishing and Shellfishing, and Boating

Effects from proposed Refuge expansion under this alternative would be the same as described for Alternative B.

4.6.3.3 Public Use Program

Effects to Environmental Education

Construction of a new Environmental Education Center with upgraded facilities would have a beneficial effect on this educational opportunity at Nisqually NWR.

The EE program under this alternative would be the same as Alternative B, except that the program would serve up to 15,000 students each year (instead of 20,000). As in Alternative B, a partnership with the Nisqually Reach Nature Center would provide a stronger program to

educate the public on marine resources of the Nisqually delta and disseminate a consistent theme and message related to environmental education on the Refuge.

As in Alternative B, program improvements would increase the quality of the program, providing a model for other environmental programs in the Puget Sound area, resulting in a significant positive effect on the environmental opportunities available in south Puget Sound. However, this alternative would not serve as many students as Alternative B because the Service-managed hunting program would divert staff time that could otherwise be used for a larger EE program. The significantly increased law enforcement, sign maintenance, administration, and public outreach associated with the hunting program would result in an EE program below maximum potential.

Effects to Wildlife Observation, Interpretation, and Wildlife Photography

Dike removal associated with estuarine restoration would reduce the current 5½-mile loop trail to a 3¾-mile loop trail including a boardwalk spur along McAllister Creek. As noted under Alternative A, the dike trail is highly valued by numerous Refuge visitors, many of whom stated their preference for leaving the dike trail intact. Therefore, since approximately 30% of the trail length would be lost, this alternative would negatively affect trail users by eliminating the unique experience provided by a loop trail of this length. At the same time, the majority of comments received stated that fish, wildlife, and habitat needs should take priority in making trail decisions. The effect to trail length is not expected to significantly reduce wildlife observation opportunities or access to all habitat types because improved habitat management would result in higher habitat quality and wildlife use. Trails would be expected to provide equal, if not improved, wildlife observation, interpretation, and photography opportunities currently available at Nisqually NWR. Many respondents also expressed a strong desire for trail access to all habitat types, even if trail length was reduced. The reconfigured dike trail loop and new trails (see below) in this alternative would provide access to estuarine, riparian, freshwater, and grassland habitats. This trail would also allow visitors that were not physically able to hike the length of the 5½-mile loop to see the estuary and Puget Sound within a shorter distance, thereby making this experience available to a wider group of the public. The shorter trail may potentially create a crowding problem, particularly on busy weekends in the spring and summer. However, this problem could be alleviated by the new trail east of the Nisqually River (see below). The hunting program proposed in this alternative would not require seasonal closure of the main dike trail, including the new boardwalk extension. This would be very beneficial to trail users as this is a current conflict (see discussion in Alternatives A and B). Effects from the new trail in the surge plain would be the same as described under Alternative A.

A new 2½-mile loop trail on tribal and Refuge property east of the Nisqually River would provide new wildlife observation opportunities and compensate for the loss of part of the main dike trail. This trail would take visitors through seasonally flooded pastures, the Nisqually River, Red Salmon Creek, and associated salt marshes, providing a loop trail within the estuary. This is a wildlife observation experience that has never been available on the Refuge. This trail would be seasonally closed during the waterfowl hunting season until the private hunt club ceases operation. In the future, this trail could be opened year-round, providing good wildlife viewing when winter migratory birds are present. If lands are acquired on the East Bluff, as proposed in this alternative, another new trail option would be possible, linking with planned Pierce County trails.

Effects from facilities would be the same as those described under Alternative B, except for an additional Visitor Contact Station, trail and boardwalk, signs, and parking area associated with the proposed 2½-mile loop trail on tribal and Refuge property east of the Nisqually River. Development of these facilities would be necessary to open this east side trail, and would directly benefit visitors observing wildlife and students participating in environmental education.

Effects to Waterfowl Hunting

In Alternative C, the Service would manage a quality hunting program on 1,170 acres of Refuge and WDFW lands. Provisions for this program would include: 3 day/week hunting, 25-shell limit, and no restriction on the number of hunters. Management of the hunting program by the Service would increase outreach, education, and enforcement efforts, which would improve the quality of the program for hunters. Reducing the number of hunting days per week would reduce hunting opportunity but would increase quality. No hunting days would encourage more birds to return to the hunting area, improving harvest opportunities on hunting days. Birds would benefit by being able to make more use of hunted areas for feeding and resting. The 25-shell limit would also contribute to increased hunt quality, reducing wildlife crippling and disturbance caused by out-of-range shooting. Consolidating the hunting area into a single rectangular block north of the Brown Farm Dike at Nisqually would reduce confusing boundary issues and consolidate hunting activity in the delta, reducing disturbance in McAllister Creek, making the hunting area more manageable.

This hunting program would eliminate unauthorized hunting on the Refuge. This would be consistent with the Service's determination that waterfowl hunting as it currently occurs does not provide sufficient wildlife sanctuary. However, as described in Alternative B, enforcing this closure would negatively affect waterfowl hunting opportunities in the delta, primarily by closing McAllister Creek to hunting and eliminating unauthorized hunting. Hunting in McAllister Creek is considered a different experience than in the tideflats because it is more sheltered in stormy weather. The loss of 3 to 4 hunting sites in McAllister Creek would be offset by officially opening the Refuge lands north of the dike and at the mouth of the Nisqually River. These new areas are heavily used by waterfowl and would provide desirable hunting locations. Boat speed restrictions would positively affect hunters by reducing waterfowl disturbance and noise in the hunting area. However, travel time would be increased somewhat for hunters going to and from the hunting area.

Effects to Fishing and Shellfishing

Fishing opportunities provided under Alternative C would be the same as described in Alternative B, except under Alternative C an additional fishing area would be provided off a new loop trail east of the Nisqually River north of I-5 on tribal and Refuge lands. However, this access would be seasonally closed during the waterfowl hunting season, until the private hunt club ceases operation.

The continuation of and additional fishing opportunities afforded under this alternative would have a positive effect on fishing opportunities on the Refuge by expanding the area available for bank fishing on the Nisqually River. A positive effect, occurring in this alternative only, is the

ability to keep the entire McAllister Creek bank fishing area open during the hunting season. This is possible because the hunting area would be located north of the fishing area.

Shellfishing opportunities and the subsequent effects would be the same as described under Alternative A.

Effects to Boating and Personal Watercraft (PWC)

Boating opportunities and PWC use and the subsequent effects would be the same as described under Alternative B.

Effects to Other Non-Wildlife Dependent Recreational Activities

Other non-wildlife dependent opportunities (berry and apple picking, plant material and mushroom harvest) and the subsequent effects would be the same as described under Alternative A.

4.6.4 Alternative D (Preferred Alternative)

4.6.4.1 Habitat Restoration

Effects to Environmental Education, Wildlife Observation, Interpretation, Wildlife Photography, Waterfowl Hunting, Fishing and Shellfishing, and Boating

Under this alternative, 70% of the diked interior would be restored to estuarine habitat through dike removal, creating 699 acres of this habitat type. This alternative also calls for new dikes to protect 263 acres of improved freshwater and riparian habitat. As in Alternative C, 38 acres of riparian habitat along the Nisqually River would be restored.

Estuarine restoration actions would reduce the total amount of freshwater habitat on the Refuge more than any other alternative. However, intensified management of this area, as well as riparian areas, would increase habitat quality and improve wildlife use (see Effects to Wildlife, Section 4.4). This would result in positive effects on wildlife observation, interpretation, and photography opportunities at the Refuge. Recent freshwater restoration projects in 2000 and 2001 in the headquarters area, with greatly increased and diversified bird use as a result, provide examples of the potential benefits for wildlife viewing. These improvements would also enhance environmental education opportunities, particularly the opportunity to observe active habitat restoration/management activities. In addition, enhanced waterfowl and fish habitats may encourage more waterfowl and fish to use the delta, improving waterfowl hunting and fishing opportunities.

Habitat restoration activities would negatively affect the Refuge trail system. The current 5½-mile loop trail would be reduced to a 3½-mile round-trip (no loop) trail, including a ½-mile boardwalk into the estuary. As described in Alternative C, eliminating a loop trail of this length would have a negative effect on trail users in south Puget Sound. However, it is anticipated that the opportunities to view wildlife and still experience diverse habitats on the remaining trails

would be retained and improved due to habitat improvements and greater accessibility to estuarine habitats (see above). In addition, new trails would be developed in expansion areas to provide new wildlife observation opportunities (see below).

4.6.4.2 Refuge Expansion

Effects to Environmental Education, Wildlife Observation, Interpretation, Wildlife Photography, Waterfowl Hunting, Fishing and Shellfishing, and Boating

The effects from acquiring interests in lands remaining within the approved boundary and from proposed expansion would be the same as described in Alternative B. However, proposed expansion in this alternative would add 1,011 acres along the Nisqually River corridor and 1,952 acres in the Nisqually Valley. Effects described under Alternative B would also apply here. In addition, this would provide the highest level of improved habitat conditions and future protection among all the alternatives. This increased protection would be expected to result in an indirect positive effect on recreational opportunities, such as fishing and hunting. In addition, bank fishing opportunities would be developed along McAllister Creek south of I-5, if appropriate sites were acquired. This would provide new bank fishing access to compensate for the loss of McAllister Creek bank fishing north of I-5, as a result of estuarine restoration. However, the closure of the McAllister Creek Hatchery in July 2002 is expected to reduce fishing opportunity along McAllister Creek.

4.6.4.3 Public Use Program

Effects to Environmental Education

Similar to all alternatives, construction of a new Environmental Education Center with upgraded facilities would have a beneficial effect at Nisqually NWR.

Effects to the EE program under this alternative would be similar to those described in Alternative C. The differences in effects in Alternative D include the seasonal closure of the boardwalk extension and the 7 day/week hunting program. As described in Alternative C, the expansion of environmental education in this alternative is lower than in Alternative B, due to the staffing and funding that would be directed toward the hunting program. However, since the hunting program in this alternative would cover approximately 55 to 60 more days (7 day/week instead of 3 day/week) than Alternative C, slightly more staff time and funds would be directed toward hunting and away from the EE program. The EE program, however, would still strive to serve 15,000 students. The seasonally closed boardwalk extension would limit the amount of trail that can be used to view or study estuarine habitats.

Effects to Wildlife Observation, Interpretation, and Wildlife Photography

Effects from proposed new trails in the surge plain, east of the Nisqually River, and on the East Bluff would be the same as for Alternative C. Dike removal associated with estuarine restoration would reduce the current 5½-mile loop trail to a 3½-mile round trip (non-loop) trail with a boardwalk extension along McAllister Creek. Effects from this trail change are similar to

those described in Alternative C; however, the reduction of trail length is the greatest (37% decrease in round trip length) among all of the alternatives. This represents the largest negative effect to trail users among all of the alternatives. In addition, the trail would no longer be a loop, a major effect for Refuge visitors that prefer a loop experience. The new loop trail east of the Nisqually River (as described in Alternative C) would provide new wildlife observation opportunities and help reduce the effects of the loss of a loop configuration, as well as length, on the main dike trail.

Despite effects to trail length and configuration, proposed changes to the trail in this alternative are not expected to significantly negatively affect wildlife observation. As explained in Alternative C, improved habitat management would result in higher habitat quality and wildlife use. In addition, the remaining trail would provide easier access to a variety of habitats for a larger sector of the public because of the shorter distance. The shorter trail, however, may create a crowding problem, especially on busy weekends in the spring and summer. Because the trail would no longer be a loop, crowding would be a greater potential problem in Alternative D. However, this problem could be alleviated in part by the new trail east of the Nisqually River and the potential trail on the East Bluff (see Alternative C for additional effects).

Because of hunting on WDFW lands in McAllister Creek, the boardwalk extension would be seasonally closed during the waterfowl hunting season. As described in Alternatives A and B, most of the public comments received stated that they preferred that the trail not be seasonally closed. Therefore, it is anticipated that the experience of most trail users would continue to be negatively affected by the continuation of seasonal closures of the dike trail. This negative effect is increased by the reduction in overall trail length in Alternative D, reducing the amount of trail area available during the hunting season as compared to other alternatives. Effects from facilities would be the same as described in Alternative C.

Effects to Waterfowl Hunting

Under this alternative, the Refuge would officially open 191 acres to a 7 day/week waterfowl hunting program. These lands would be adjacent to the WDFW lands north of the Brown Farm Dike, creating a block of land and eliminating confusing boundary issues in this area. The RNA would be reduced to allow for an area at the mouth of the Nisqually River to be opened to hunting.

The opening of Refuge lands to hunting would have a positive effect on waterfowl hunting opportunities in south Puget Sound, similar to the effects described under Alternative C. Although there would be a negative effect caused by eliminating unauthorized hunting on other parts of the Refuge, there would still be hunting available on WDFW lands in McAllister Creek, and waterfowl hunting would continue to occur on a 7 day/week schedule.

Effects to Fishing and Shellfishing

Fishing opportunities would be the same under this alternative as described in Alternative C, except that the bank fishing area along McAllister Creek would no longer be available. However, in addition to the two proposed bank fishing locations on the Nisqually River, the Refuge would investigate an additional accessible bank fishing area at the Nisqually River Overlook off the Twin Barns Loop Boardwalk Trail. However, a stationary fishing platform

may not offer a constant opportunity if river dynamics change, as has happened in other locations. Thus, design of this accessible site would need to ensure long-term use. The loss of the McAllister Creek bank fishing area would be a large effect to anglers in the area because there is no other public bank fishing access on McAllister Creek, although some limited bank fishing does occur south of I-5 on private property. However, WDFW closed the McAllister Creek Hatchery (July 2002). The fishing opportunities in McAllister Creek will consequently decline and thus, loss of the bank fishing area would be limited because fishing for fall chinook (the predominant angling opportunity) will decline dramatically. In either case, the Service would create a new public access south of I-5 along McAllister Creek if appropriate properties can be acquired. Overall, fishing opportunities at Nisqually NWR are not expected to decrease. The experience for anglers would shift from a focus on the McAllister Creek to the Nisqually River, which would mean a loss of fishing experience in slower flowing waters.

Shellfishing opportunities and the subsequent effects would be the same as described under Alternative A.

Effects to Boating and Personal Watercraft (PWC)

Boating and PWC opportunities and the subsequent effects would be the same as described under Alternative B.

Effects to Other Non-Wildlife Dependent Recreational Activities

Other non-wildlife dependent opportunities (berry and apple picking, plant material and mushroom harvest) and the subsequent effects would be the same as described under Alternative A.

4.7 Effects to Cultural Resources

Cultural resources have the potential to be directly affected by ground-disturbing activities such as facilities construction, dike repairs, or dike removal, as well as indirectly by activities that increase public access to sensitive cultural areas. Watercraft wakes and erosion threaten archaeological sites along the banks of McAllister Creek. Activities such as wildlife observation, interpretation, photography, and environmental education, when confined to non-sensitive cultural areas, can be perceived as having a neutral effect, in that they result in minimal to no effect on cultural resources; moreover, public programs that include interpretation of the cultural history of the Refuge provide an indirect educational benefit.

The management of cultural resource values of Nisqually NWR would comply with the regulations of Section 106 of the National Historic Preservation Act (NHPA). Therefore, determining whether a particular action within an alternative has the potential to affect cultural resources is an ongoing process that occurs within the planning stages of each project.

4.7.1 Alternative A

4.7.1.1 *Habitat Restoration, Refuge Expansion, and Public Use Program*

Under Alternative A, minor effects to cultural resources on the Refuge would be anticipated. The Brown Farm Dike has been determined eligible for listing on the NRHP; therefore, extensive dike repairs needed would be considered an undertaking with the potential to negatively affect the significant historical resource as per the NHPA. Mitigation for modification of the dike would entail, at a minimum, Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) documentation to National Park Service standards. Archaeological sites on the banks of McAllister Creek would continue to be eroded by natural tidal influence and watercraft wakes. Continued boating and waterfowl hunting throughout much of McAllister Creek may potentially expose these sites to more vandalism or damage. Interpretive benefits would continue to be provided under all alternatives in exhibits in the Visitor Center and panels along the 1-mile boardwalk loop that include information about cultural resources.

4.7.2 Alternative B

4.7.2.1 *Habitat Restoration, Refuge Expansion, and Public Use Program*

The dike breaching and extensive dike repairs proposed in Alternative B would have an effect on the dike, an NRHP-eligible historic property. The majority of the Brown Farm Dike would remain. Mitigation for modification or removal of the dike would entail, at a minimum, HABS/HAER documentation to National Park Service standards.

Federal acquisition would have a positive effect on those resources that are currently located on private land, by providing the protection afforded by the NHPA to resources located on Federal property. Depending on the areas acquired, expansion of the Refuge boundary, especially in the

East Bluff area, would bring several known archaeological sites under the jurisdiction of the Service, providing protection under the NHPA. The majority of the sites in the study area, however, are found on the Fort Lewis Military Reservation owned by the U.S. Army. Transferring them to Service ownership would have a neutral effect. Inventory for cultural resources within the expanded boundary prior to construction of public use facilities and habitat restoration projects would prevent damage to sites.

Expanding the EE program would offer an opportunity to include more of the cultural heritage of the Nisqually delta. The largest number of students would benefit from the EE program of all alternatives. Incorporating information about how the land has been used and changed by people would not only partially mitigate for modifications to cultural properties such as the dike, but would also improve public knowledge and appreciation of the resources. Environmental study site locations would be selected to avoid effects on sensitive sites. Boat speed restrictions would have a positive effect by reducing wake effects on sensitive sites. Enforcement of areas closed to waterfowl hunting, shellfishing, boating, and PWC would decrease negative effects to creek bank archaeological sites.

4.7.3 Alternative C

4.7.3.1 Habitat Restoration, Refuge Expansion, and Public Use Program

Effects to cultural resources under Alternative C would be similar to Alternative B except for the greater degree of dike removal, increasing effects on the dike; however, portions of the dike would remain. As in Alternative B, a cultural resource inventory would be conducted prior to the development of trails on the east side of the river as well as all public use facilities and habitat restoration projects within the expanded Refuge boundary, to identify and protect cultural resources potentially affected. A smaller number of students would benefit from the EE program, including cultural heritage topics, compared to Alternative B. All other effects would be the same as described in Alternative B.

4.7.4 Alternative D (Preferred Alternative)

4.7.4.1 Habitat Restoration, Refuge Expansion, and Public Use Program

This alternative would have the same effects as Alternative C, except for increased effects on the dike due to dike removal and the larger expansion area; however, portions of the dike would remain. The expansion area in the Nisqually River corridor may include cultural resources. Inventory for cultural resources within the expanded boundary would occur as described in Alternative B. The same number of students would benefit from the environmental education programs, including cultural heritage topics, as in Alternative C.

4.8 Effects to Socioeconomics

This section analyzes effects to the economy of the area in the general vicinity of the Nisqually River Valley associated with each of the alternatives. Effects to six topics are described: environmental justice, land use, Refuge management, economics on the regional economy, recreation economics, and commercial shellfishing.

4.8.1 Effects to Environmental Justice

This section analyzes potential disproportionately high and adverse human health or environmental effects of each of the CCP alternatives on minority populations and low-income populations living in the vicinity of the Nisqually River Valley. As discussed in Chapter 3, the population of the region does not meet HUD's definition of low income; however, the Nisqually Indian Tribe is one minority group that could be disproportionately affected. Specific effects to the Nisqually Indian Tribe are discussed below.

Under all alternatives, the Nisqually Indian Tribe would continue to fish, hunt, and gather as described in Article 3 of the Treaty of Medicine Creek of 1854 (10 Stat. 1132). A strengthened partnership between the Nisqually Indian Tribe and the Service is anticipated from the development of a Cooperative Agreement for the management of the tribe's 325-acre Braget parcel as part of the Refuge and due to mutual goals of protecting the watershed, river corridor, and fish habitats. There are no anticipated adverse health or environmental effects to the Nisqually Indian Tribe from any of the alternatives.

4.8.1.1 *Alternative A*

Under this alternative, tribal fishing, hunting, and gathering opportunities are expected to remain the same.

4.8.1.2 *Alternatives B - D*

Under the action alternatives, tribal fishing opportunities are expected to improve in the long-term due to estuarine restoration, which would improve fish habitat particularly for chinook and chum salmon and other estuarine-dependent fish species. Anticipated effects are minimum (Alternative B), moderate (Alternative C), and maximum (Alternative D) improvements to fisheries resources available for tribal fishing. Significant benefits would be expected, particularly from the effects of Alternative D, because tribal members depend heavily on natural resources, both culturally and economically (D. Troutt, pers. comm.). Refuge boundary expansion may affect the Nisqually Indian Tribally owned lands or trust lands, but protective methods would be restricted to cooperative agreement and lands would continue to be managed consistent with tribal priorities of protecting the watershed and river corridor. Some indirect benefits to the Nisqually Indian Tribe are also anticipated from Refuge visitors being better informed about Native American culture, which is an important component of the expanded EE program in each of these alternatives.

4.8.2 Effects to Land Use

This section analyzes potential land use effects associated with each alternative. In addition to general land use and management, special status lands within the study area such as the Research Natural Area, Nisqually Public Use Natural Area, Shorelines of Statewide Significance, and National Recreation Trail are evaluated for consistency with policies and directives.

4.8.2.1 Alternative A

General Land Use and Management

No significant effects to land use and management are anticipated under this status quo alternative. No additional acreage would be added to the existing approved Refuge boundary, which would remain at 3,936 acres. Refuge acquisition of the remaining 1,011 acres within the existing boundary would continue as land and funding become available on a willing seller basis. Thurston and Pierce counties would continue to receive Refuge revenue payments in lieu of property taxes for Federal Refuge lands.

Housing developments would continue to increase under existing County regulations. In Pierce County, approximately 240 acres in single- and multi-family units would be developed along the top of the bluff, adjacent to the eastern boundary of the Refuge. Future zoning changes could occur as a result of area growth.

Under this alternative, it is expected that recreational fishing and agricultural use would continue along existing trends. Agricultural lands outside of the Thurston County's Purchase of Development Rights (PDR) program could be developed in the future as permitted under existing County regulations.

It is anticipated that Fort Lewis will continue to use the lower Nisqually River Valley as a buffer between civilian land in Thurston County and high impact military uses.

Special Status Lands

There are no anticipated effects to special status land designations under the No Action Alternative.

4.8.2.2 Alternative B

General Land Use and Management

Implementing Alternative B would result in approximately 2,407 acres in Thurston and Pierce counties being added to the existing approved Refuge boundary. This addition could include approximately 512 acres of bluff habitat and 1,891 acres of floodplain, riparian, and wetland habitat.

This alternative would significantly expand the boundary of the Refuge to include large areas of land in the Nisqually Basin south of I-5. The majority of this land remains in large parcels used for agriculture. The central portion is protected from development through Thurston County's PDR program. Refuge acquisition could result in the reduction of some grazing opportunities and conversion of some agricultural lands to wetlands and riparian habitats, some of which could provide new public access areas. Since the goals of Refuge expansion are not incompatible with the PDR program, no significant adverse land use effects are anticipated. Nevertheless, the Service would have to comply with the terms of the easements, such as notification to Thurston County prior to initiation of certain permitted activities, if it acquires property within the PDR area.

In Thurston County, approximately 1,100 acres of agricultural land could be acquired for conservation purposes if Refuge acquisition is accomplished. Within the current agricultural component, approximately 840 acres are within the existing PDR program. As the Service acquires lands from willing sellers, lands would likely be converted to native habitats in support of migratory waterfowl, waterbirds, and a variety of other migratory birds. Crop production less favorable to wildlife and grazing would be replaced with a mosaic of freshwater wetland, riparian, and other native habitats. The impact to the overall agricultural economy would be minor.

In Pierce County, up to approximately 190 acres of agricultural land and approximately 100 acres on the East Bluff proposed for residential development could be acquired for conservation purposes. This could reduce planned housing in the area by up to approximately 150 units. This potential change would occur primarily in the area between Puget Sound and the City of DuPont, Washington.

The City of Olympia's McAllister Springs area contains approximately 256 acres of forested hillside, the Springs, and the wetlands headwaters of McAllister Creek. If acquired by the Refuge, this area would continue to be managed and protected as a water source for the City of Olympia.

Fort Lewis Military Reservation owns approximately 150 acres along the Nisqually River corridor in the Trotter's Woods area. If acquired by the Service or managed through a cooperative management agreement, Trotter's Woods would be managed to provide quality recreational fishing and protect and restore riparian habitat there. Cooperative efforts could also involve key partners, including the Nisqually Indian Tribe. A boat launching site in the area would continue to be available for use by the Nisqually Indian Tribe.

The Burlington Northern-Sante Fe right-of-way comprises approximately 110 acres of right-of-way within the East Bluff area. No change of ownership would be pursued with this landowner.

Thurston and Pierce counties would receive revenue payments in lieu of property taxes. This revenue sharing would be an additive process as more lands are acquired within the approved Refuge boundary. Based on assessed land values, annual payment would be approximately \$36,000 to Pierce County and \$101,600 to Thurston County if all properties in Alternative D were acquired in fee and sufficient funds are available to cover 100% of the payments.

Incorporating additional lands within a new Refuge boundary would not affect private property rights unless the Service acquires lands from willing sellers. Landowners within the Refuge boundary retain all rights, privileges, and responsibilities of private land ownership including rights to access, control trespass, sell to any party, and develop their properties. Development of private land would continue to be subject to local regulations and land use zoning.

Special Status Lands

This alternative would increase the acreage of estuarine habitat in the Nisqually delta through restoration. This relatively small increase would not affect the National Natural Landmark designation. Although limited, parts of the Brown Farm Dike Trail would be breached and removed, the National Recreation Trail status would not change.

Enforcement of the closure of the current RNA to consumptive uses and winter boat activities would be compatible with national RNA policies and would benefit the RNA designation by providing stronger protection for natural processes.

There would be no changes in the public use program that would affect the PUNA area, shoreline designation, or National Recreation Trail.

4.8.2.3 Alternative C

General Land Use and Management

Effects would be the same as Alternative B.

Special Status Lands

Effects would be the same as Alternative B, with the exception that the amount of estuarine restoration and change in the Brown Farm Dike Trail would be greater and the RNA would be reduced in size. Benefits would be gained to the National Natural Landmark designation because it was based on the coastal salt marsh system in the delta, and restoration would enlarge and improve this biologically significant habitat. The loop trail would be shortened, but it is expected that this special designation would be retained. The National Recreation Trail would be re-described to reflect changes in trail configuration. The RNA would be reduced by 166 acres, to 671 acres total, to accommodate waterfowl hunting. This would remove the added protections provided by the RNA designation to portions of tideflats and open water, requiring the RNA to be redefined.

4.8.2.4 Alternative D (Preferred Alternative)

General Land Use and Management

Implementing Alternative D could result in approximately 3,479 acres within Thurston and Pierce counties being added to the existing approved Refuge boundary. This addition could include approximately 512 acres of bluff habitat and 2,963 acres of floodplain, riparian, and

wetlands. The effects of land use changes on agricultural, residential development, the City of Olympia, and military lands would be the same as for Alternatives B and C, with additional changes described below.

This alternative would expand the Refuge's boundary more extensively than any of the other alternatives. A 2.9-mile stretch of the lower Nisqually River could potentially be added to the Refuge. If a cooperative management agreement or other land protection measures were developed on Fort Lewis lands, it would be designed to accommodate or complement the Army's mission. The remainder of this land in private ownership consists of the river's natural floodplain, comprised of meander loops and wetlands. Since habitat restoration would enhance and complement existing land use, rather than displace current use, land use effects from this alternative are expected to be positive.

Within the Nisqually Valley, the Holroyd Gravel operation, encompassing approximately 300 acres within two permit areas, could eventually be reclaimed and changed from mineral overlay to conservation purposes. Land use effects would vary depending on whether and at what stage acquisition were to occur. For example, if gravel resources were already removed, land use changes would be minimal.

Under Alternative D, Thurston and Pierce counties' revenue sharing payments in lieu of property taxes would be greater since the potential for acquired lands is greater. Based on assessed land values, annual payment would be approximately \$36,000 to Pierce County and \$170,400 to Thurston County if all properties in Alternative D were acquired and sufficient funds are available to cover 100% of the payments. Private property rights would remain the same as described for Alternatives B and C.

Special Status Lands

Effects would be the same as Alternative B, with the exception that the amount of estuarine restoration and change in the Brown Farm Dike Trail under Alternative D would be greatest among all alternatives. In addition, the RNA would be reduced by 73 acres to accommodate hunting, removing added protections to sensitive river mouth habitats, but areas east of the river channel would be retained as RNA. The RNA boundary would need to be redefined. The National Natural Landmark designation would benefit the most due to the largest increase in restored tidal salt marsh area. A limited amount of dike trail would remain, augmented by a boardwalk trail extension, providing access to a variety of habitats, including estuarine and Puget Sound habitats. The National Recreation Trail would be negatively affected due to the dike removal and reduction in trail length; however, the Service retains full latitude to control or restrict public uses in favor of wildlife resources (Waddell 1981; Watt 1981; Heritage Conservation and Recreation Service undated). The National Recreation Trail would be retained, but re-described to reflect the new trail configuration. No changes to other designations are expected.

4.8.3 Effects of Refuge Management Economics on the Regional Economy

This section discusses direct economic effects on the regional economy resulting from local economic contributions by the Refuge. The Refuge's annual base budget comprises most of the Refuge's annual funding. In typical years, approximately 85 to 90% of this budget is spent on salaries and employee benefits. Since staff salaries comprise the most significant portion of revenue expenditure, Refuge staffing levels are generally proportional to the annual budget. The remainder is usually spent on routine operating expenses, equipment, supplies, contractors, vendors, travel, and training. Other revenue sources include supplemental annual funding such as non-game migratory bird funding and challenge cost-share grants, both of which are used to fund special projects and wildlife investigations. Since these funding sources are competitively awarded and fluctuate from year to year, they cannot be accurately factored into an economic analysis. In addition, the Refuge generates a small amount of income from visitors through entrance fees. Entrance fee revenue is spent on visitor services and facilities and would likely continue to be proportional to visitation.

Because most Refuge funding comes from the Federal government and other sources external to the local economy, the Refuge's payroll and other expenditures comprise net revenue for the local economy. Thus, every Federally supported job at the Refuge results in local expenditures and indirectly supports additional employment in the region. The relative number of jobs in the local economy that are generated by each externally funded job is known as the multiplier. According to the Washington State Economic Model used by the State's Department of Revenue, the economic multiplier for Service employment is 1.9; thus, each Refuge job generates an additional 0.9 jobs in the local economy (Bertoun, pers. comm.).

Unlike other resource areas, effects on the regional economy are not expected to differ between alternative actions for Refuge expansion, restoration, or public use program. This is because the principal economic driver - the Refuge's annual budget - is mostly derived from staff salaries. Since staffing needs are not specifically tied to alternative actions for the separate programs involving Refuge expansion, restoration, or public use program, there is no accurate way to distribute the analysis by these individual topics. Instead, effects to the regional economy can only accurately be evaluated for each alternative as a whole, as presented below.

4.8.3.1 Alternative A

Under the No Action Alternative, the Refuge's annual base budget and staffing are expected to remain comparable to historical funding and staffing levels. In 2000, the Refuge's base budget was \$565,840, sufficient to support the equivalent of approximately 8 full time equivalent (FTE) employees. Due to supplemental annual funding secured that year by the Refuge, actual staffing was closer to 10 FTEs, but supplemental funding is variable and thus cannot be used as a base for future projections. Under this alternative, staffing would likely remain evenly distributed among management, administrative, biology, public use, and maintenance functions. Assuming no change in the Refuge's base budget, the Refuge would continue to indirectly support at least 7.2 jobs and therefore continue to have minor positive effects on the regional economy.

4.8.3.2 Alternative B

This alternative would triple staffing to 24 FTEs, compared to the No Action Alternative, and almost triple funding to \$1,615,000. Each staffing category would be increased with major increases to biology (four new employees) and public use (five new employees). This alternative would also indirectly maintain approximately 21.6 jobs, resulting in a positive effect on the regional economy.

4.8.3.3 Alternative C

Funding and staffing would more than triple under Alternative C to 26 FTEs and \$1,763,750, compared to the No Action Alternative. Employment would increase in each staffing category similar to Alternative B; however, an additional Environmental Education Specialist would be added to the payroll. This alternative would be expected to indirectly support at least 23.4 jobs, resulting in a positive effect on the regional economy.

4.8.3.4 Alternative D (the Preferred Alternative)

In terms of financial contribution and job creation, Alternative D would have the largest positive effect on the regional economy of the four alternatives. The salary and operating costs would be approximately \$1,828,750, representing an increase of \$1,262,910 in expenditure over the No Action Alternative, most of which would be directed to the Refuge's payroll and contribute directly to the regional economy. One major staffing difference between this alternative and Alternative C is the addition of two biology positions, for a total of 29 FTEs. This alternative would indirectly support approximately 26.1 jobs in the regional economy.

4.8.4 Effects to Recreation Economics

The following analysis assumes no change in the Refuge's fee structure (\$3.00 per family daily entrance fee or admission by Golden Eagle, Golden Age, Golden Access Passport, Refuge Annual Pass, or a Federal Duck stamp). In 2000, the Refuge collected \$39,781 in entrance fees. The sales outlet operated in the Visitor Center is run by a non-profit partner, the Nisqually Refuge Cooperating Association, which covers a portion of its operating costs from limited sales of literature and related products. In 2000, the sales outlet earned approximately \$20,000. Prior to construction of new visitor facilities, the Refuge averaged approximately 80,000 visitors per year who participated in a variety of wildlife-dependent recreational and educational activities, including wildlife observation, photography, interpretation, environmental education, and fishing. The main activities are trail use and wildlife observation. Visitation increased to approximately 100,000 in 2000, with the increase primarily attributed to the new visitor facilities.

Analysis of data collected through the Service's National Survey of Fishing, Hunting, and Wildlife Associated Recreation has shown that recreational visits to National Wildlife Refuges generate substantial economic activity. In 1995, people visited refuges more than 27.7 million times for recreation and environmental education. They spent more than \$401 million in sales which employed an estimated 10,000 people and generated an additional \$162.9 million in

employment income (Laughland and Caudill 1997). Non-residents spend about 3 times more than local visitors for recreational activities due to spending more on transportation, restaurants, lodging, and other purchases. (Laughland and Caudill 1997). The Service estimates that 75% of Nisqually NWR visitors travel less than 50 miles, 20% are Washington State residents who travel more than 50 miles, and the remaining 5% live out of state. Per person, per day expenditures are estimated to be low since the average visitor lives in relative proximity to the Refuge; however, the number of visitors is substantial enough to have a positive effect on the local economy. For example, using regional factors calculated by Laughland and Caudill (1997), 100,000 annual visitors to Nisqually NWR could have spent between \$1.7 and \$2.3 million at local businesses, depending on the proportion of those traveling from out of the area.

4.8.4.1 Alternative A

Refuge Expansion

Since no Refuge expansion would occur under this alternative, there would be no economic effects directly related to recreation or public access. Changes to recreation and recreation-derived economics at Nisqually NWR would be driven by factors other than Refuge expansion, such as regional population growth, economic development, or changes within the existing Refuge boundary.

Habitat Restoration

Recreation and public use could increase slightly as a consequence of enhanced freshwater habitats under this alternative, but the effect would not be expected to be significant, particularly since long-term, freshwater habitats would be expected to deteriorate as reed canary grass spreads.

Public Use Program

Alternative A is expected to generate relatively neutral effects on recreation; hence, minor positive recreation-derived economic effects should balance negative ones. New facilities, which were a major factor in increases in visitation in 2000 and 2001, would continue to be provided in all alternatives, and a continued upward trend in visitation resulting in increased economic benefits would be expected.

4.8.4.2 Alternative B

Refuge Expansion

Moderate Refuge expansion under this alternative would be expected to provide additional areas and new habitats open to visitor use, potentially increasing visitation and revenues for the Refuge. No negative effects to recreation economics would be anticipated. Related positive economic effects such as increased revenue for the Refuge and region would be expected to be proportionate with increased visitation, and would depend on what areas were acquired.

Habitat Restoration

Minor positive recreation and public use effects resulting from restoration of muted estuarine habitat under this alternative would be expected to translate into minor positive recreation economic effects, if visitation increases in response to habitat restoration and management enhancements.

Public Use Program

Economic effects derived from recreation expenditures are not expected to be significant under this alternative, and minor positive and negative effects would likely offset one another. A small amount of increased expenditure may result from 15,000 additional student visits (20,000 total) each year. Elimination of unauthorized hunting throughout the Refuge and RNA closures to consumptive uses may slightly depress visitation, but these changes would be expected to be very small, especially since hunter visits are a very small percentage of annual visitation. Because other large, adjacent Refuge or State areas are available, significant changes in visitation and local expenditures as a result of these restrictions would not be expected. In addition, increased visitation observed with the opening of new facilities would be expected to continue, and a continued upward trend in visitation resulting in increased economic benefits would be expected.

4.8.4.3 Alternative C

Refuge Expansion

Refuge expansion under this alternative would be the same as Alternative B, as would recreation economic effects, such as increased revenue for the Refuge and region, proportionate with increased visitation.

Habitat Restoration

Restoration of 50% of the diked interior to estuarine habitat under this alternative would have a mixed effect on recreation and public use and indirectly on recreation economics. The reduction in trail length may have a minor effect on visitation, resulting in some decrease in expenditures. However, the effects of the new facilities, new trails, improved habitat, and more student visits would be expected to contribute to an increasing trend in visitation, increasing economic benefits. Thus, long-term recreation economic effects would improve as visitation to the Refuge increases over time. In the long run, recreation economic effects would likely be positive under this alternative as a result of habitat restoration, new public facilities, and management changes.

Public Use Program

New facilities would continue to be provided, which would be expected to produce a continued increasing trend in visitation over time, increasing expenditures. Increases in visitation may be dampened somewhat by the reduced trail length; however, new trails, particularly on the east side of the river, would attract visitation, providing access to a new area and contributing to

increased expenditures. The addition of 10,000 student visits over Alternative A would also contribute to increased economic benefits.

4.8.4.4 Alternative D (Preferred Alternative)

Refuge Expansion

Of all the alternatives under consideration, Alternative D would provide for the maximum amount of Refuge expansion. Recreation economic expansion is expected to be proportionate to increased recreation and public access resulting from this expansion. Increased revenue for the Refuge and region would be greater under Alternative D than for the other alternatives and would depend on what areas were acquired.

Habitat Restoration

This alternative would be similar to Alternative C except that an additional 20% of the Refuge would be restored to estuarine habitat, resulting in a similar mix of recreation-based economic effects. Freshwater areas would be reduced; however, management would be most intensive, providing greater wildlife densities, which may attract visitors. In addition, these more substantial estuarine restoration efforts could become a draw for visitors interested in environmental restoration, attracting visitors from other areas who would spend time and money in the area, potentially resulting in some regional economic gains.

Public Use Program

Recreation-related economic effects under this alternative are expected to be comparable to Alternative C, except that the reduction in trail length would be greater and the main trail would no longer be a loop, resulting in some decrease in visitation. However, the effects of new facilities, new trails, improved habitat, and more student visits would be expected to increase visitation and related economic benefits.

4.8.5 Effects to Commercial Shellfishing

4.8.5.1 Alternative A

Under the No Action Alternative, there are no anticipated effects to commercial shellfishing.

4.8.5.2 Alternative B-D

Since commercial shellfishing is currently closed in the Nisqually Reach, effects from habitat restoration, Refuge expansion, and public use program activities proposed in the action alternatives are expected to be negligible. In the event that commercial shellfishing is reestablished in the area after implementation of Alternative B, C, or D, there could be a temporary negative effect from siltation associated with dike removal. The anticipated long-term effects are a healthier estuary, which should improve commercial shellfishing.

4.9 Summary of Effects

Table 4.9-1 summarizes potential effects for each of the four alternatives.

This page intentionally left blank.

Table 4.9-1. Summary of Potential Effects of Alternatives A, B, C, and D.				
Resource Issue or Concern	Alternative A	Alternative B	Alternative C	Alternative D
PHYSICAL ENVIRONMENT				
Hydrological connection between restored areas and Puget Sound, Nisqually River, and McAllister Creek.	EC	SH	MH	CH: The Nisqually River would be allowed to move more freely, the entire McAllister Creek system would be restored, and less flood waters would flow into the diked area during flood events.
HABITATS				
Estuarine	EC	MH: 318 acres muted estuarine and 140 acres of full estuarine habitat with a connection to McAllister Creek.	MH: 515 acres with a full tidal connection to Puget Sound, and some of Nisqually River and McAllister Creek.	CH: 699 acres with full tidal connection to Puget Sound, Nisqually River, and all of McAllister Creek.
Freshwater Wetland	SH: Limited improvements.	MH: 542 acres improved management of diked area and protection of some areas south of I-5.	CH: 447 acres improved management with a higher proportion of freshwater wetlands than grasslands and protection of some areas south of I-5.	MH: 263 acres improved management with a high proportion of freshwater wetlands and some grasslands and protection of some areas south of I-5.
Riverine and Riparian Restoration Increased protection	SH EC	SH MH: Additional 325 acres.	MH: Additional 38 acres. MH: Additional 325 acres.	MH: Additional 38 acres. MH: Additional 1,011 acres.
Upland Upland Forests	EC	MH: Increased protection of 803 acres.	MH: Increased protection of 803 acres.	MH: Increased protection of 1,262 acres.
Grasslands	SL	ML: Some loss of grasslands within diked area, but some increased protection in expansion area.	CL: Loss of grasslands within diked area, but some increased protection in expansion area.	CL: Loss of grasslands within diked area, but some increased protection in expansion area.

EC = existing conditions; SH = slightly higher (or improved) than existing conditions; MH = moderately higher (or improved) than existing conditions; CH = considerably higher (or improved) than existing conditions; SL = slightly lower (or decreased) than existing conditions; ML = moderately lower (or decreased) than existing conditions; CL = considerably lower (or decreased) than existing conditions.

Table 4.9-1. Summary of Potential Effects of Alternatives A, B, C, and D.				
Resource Issue or Concern	Alternative A	Alternative B	Alternative C	Alternative D
EXOTIC PLANTS				
Reed canary grass	SL: Continued dominance and spread within diked area.	MH: Improved control within diked area and elimination in restored estuarine areas.	CH: Improved control within diked area and elimination in restored estuarine areas.	CH: Improved control within diked area and elimination in restored estuarine areas.
FISHERIES HABITATS AND RESOURCES	EC	SH	MH	CH: Greatest estuarine restoration and riparian restoration and protection, contributing to salmon recovery.
BIRDS				
General Effects	EC	Slightly more estuary; somewhat improved freshwater wetlands; increased habitat protection in expansion area; and more sanctuary.	More estuary; improved freshwater wetlands; restored riparian; increased habitat protection in expansion area; and most sanctuary, including McAllister Creek.	More estuary; improved freshwater wetlands; restored riparian; largest increased habitat protection in expansion area, particularly riparian; and more sanctuary.
Waterfowl	EC	MH	MH - CH	CH
Waterbirds	EC	MH	SH - MH	SH - MH
Seabirds	EC	SH	MH	CH
Shorebirds	EC	SH	MH - CH	CH
Landbirds	EC	SL	SH - MH	SH - MH
MAMMALS				
Marine	EC	SH	MH	MH
Land	EC	SL: Slight decrease in diked areas; increased upland forest and freshwater wetland protection in expansion area.	ML: Some decrease in diked areas; increased upland forest and freshwater wetland protection in expansion area.	ML: Largest decrease in diked areas; largest upland forest and freshwater wetland protection in expansion area.

EC = existing conditions; SH = slightly higher (or improved) than existing conditions; MH = moderately higher (or improved) than existing conditions; CH = considerably higher (or improved) than existing conditions; SL = slightly lower (or decreased) than existing conditions; ML = moderately lower (or decreased) than existing conditions; CL = considerably lower (or decreased) than existing conditions.

Table 4.9-1. Summary of Potential Effects of Alternatives A, B, C, and D.				
Resource Issue or Concern	Alternative A	Alternative B	Alternative C	Alternative D
REPTILES AND AMPHIBIANS	EC	SL	SL	SL
INVERTEBRATES				
Marine Terrestrial	EC EC	SH SL: Slight decrease in diked areas; increased upland forest and freshwater wetland protection in expansion area.	MH ML: Some decrease in diked areas; increased upland forest and freshwater wetland protection in expansion area.	CH ML: Largest decrease in diked areas; largest upland forest and freshwater wetland protection in expansion area.
ENDANGERED & THREATENED SPECIES	EC	SH	MH	CH
SPECIAL USES				
Haying	EC	SL: Haying area reduced by 5 acres.	ML: Haying area reduced by 69 acres.	CL: Haying area reduced by 118 acres.
EDUCATIONAL AND RECREATIONAL OPPORTUNITIES				
Environmental Education	EC	CH	MH	MH
Wildlife Observation, Interpretation, and Photography	EC	SH	MH: Trail length is shortened but improved quality with diversified viewing opportunities; new eastside trail.	MH: Trail length is shortened but improved quality with diversified viewing opportunities; new eastside trail.

EC = existing conditions; SH = slightly higher (or improved) than existing conditions; MH = moderately higher (or improved) than existing conditions; CH = considerably higher (or improved) than existing conditions; SL = slightly lower (or decreased) than existing conditions; ML = moderately lower (or decreased) than existing conditions; CL = considerably lower (or decreased) than existing conditions.

Table 4.9-1. Summary of Potential Effects of Alternatives A, B, C, and D.				
Resource Issue or Concern	Alternative A	Alternative B	Alternative C	Alternative D
Waterfowl Hunting Acreage	EC	CL: Refuge land posted closed to hunting	CH: 713 acres of Refuge land (1,170 acres consolidated hunt area with State lands).	MH: 191 acres of Refuge land (total 808 acres hunt area with State lands)
Quality	EC	SH: Eliminate boundary confusions	CH: 3 day/wk hunt, 25-shell limit, eliminate boundary confusions.	MH: Eliminate boundary confusions, 25-shell limit.
Conflict with other users Available Sanctuary	EC EC	SL - ML MH	CL CH: Hunting removed from McAllister Creek.	SL - ML MH
Fishing and Shellfishing	EC	MH: Additional location at Trotter's Woods and disabled access location at Luhr Beach.	CH: Additional locations at Trotter's Woods, eastside property, and disabled access location at Luhr Beach.	MH: Additional locations at Trotter's Woods, eastside property, and disabled access locations at Luhr Beach and Nisqually, but loss of McAllister Creek site with possible replacement if lands acquired south of I-5.
Boating	EC	ML: 5 mph speed limit, seasonal closure of RNA.	ML: 5 mph speed limit, seasonal closure of RNA.	ML: 5 mph speed limit, seasonal closure of RNA.
CULTURAL RESOURCES				
	EC: Some effects to Brown Farm Dike from needed repairs.	MH: Some modification and removal of Brown Farm Dike; majority of dike remains; improved interpretation and EE of cultural resources; and improved protection of sites in expansion areas.	SH: Portions of Brown Farm Dike removed; improved interpretation and EE of cultural resources; improved protection of sites in expansion areas.	SL - SH: Majority of Brown Farm Dike removed; improved interpretation and EE of cultural resources; largest protection of sites in expansion areas.

EC = existing conditions; SH = slightly higher (or improved) than existing conditions; MH = moderately higher (or improved) than existing conditions; CH = considerably higher (or improved) than existing conditions; SL = slightly lower (or decreased) than existing conditions; ML = moderately lower (or decreased) than existing conditions; CL = considerably lower (or decreased) than existing conditions.

Table 4.9-1. Summary of Potential Effects of Alternatives A, B, C, and D.

Resource Issue or Concern	Alternative A	Alternative B	Alternative C	Alternative D
SOCIOECONOMICS				
Special Status Lands Research Natural Area	EC	CH: Removal of consumptive uses and seasonal boat closure.	MH: Removal of consumptive uses and seasonal boat closure, but reduced by 166 acres.	MH: Removal of consumptive uses and seasonal boat closure, but reduced by 73 acres.
National Recreation Trail	No change in status.	No change in status.	SL: Retain status, but re-describe.	ML: Retain status, but re-describe.
National Natural Landmark	No change in status.	No change in status.	SH: Enlarged area of designated habitat.	MH: Enlarged area of designated habitat.
Regional Economy	EC	SH	MH	MH
Recreation Economics	EC	SH	MH	MH

EC = existing conditions; SH = slightly higher (or improved) than existing conditions; MH = moderately higher (or improved) than existing conditions; CH = considerably higher (or improved) than existing conditions; SL = slightly lower (or decreased) than existing conditions; ML = moderately lower (or decreased) than existing conditions; CL = considerably lower (or decreased) than existing conditions.

This page intentionally left blank.

4.10 Cumulative Effects

This section addresses the potential cumulative effects for all of the alternatives and is intended to consider the activities on Nisqually NWR in the context of other actions on a larger temporal and spatial scale.

There is a clear trend in western Washington, particularly in the Puget Sound region, of increasing development and associated habitat loss. Additional residential and commercial development is planned throughout much of the local area, as well as the south Puget Sound region. Within this context of increasing development, all of the alternatives would preserve existing habitat on the Refuge. By expanding the Refuge boundary, the action alternatives would also increase the amount of habitat that would be protected and restored in the lower Nisqually River watershed. Active restoration of the land acquired under the action alternatives would increase the carrying capacity of the Nisqually delta for fish and wildlife. Any of the action alternatives would also complement other regional habitat acquisition or protection programs under consideration by local and State agencies, Fort Lewis, the Nisqually Indian Tribe, the Nisqually River Council, and the Nisqually River Basin Land Trust, resulting in positive cumulative effects to fish and wildlife. Alternative D, which would potentially almost double the size of the Refuge by protecting an additional 3,479 acres of habitat, would also provide an improved, continuous wildlife corridor along part of the lower Nisqually River, including a portion of a proposed RNA on Fort Lewis (U.S. Army) property. In addition, this alternative would offer greater watershed protection by preventing erosion and contamination associated with development on steep slopes and in the riparian and floodplain areas.

Perhaps the most significant effect of the action alternatives is the restoration of historic estuarine wetlands on the Refuge. Over the last 150 years, up to 80% of estuarine habitat in Puget Sound has been lost, contributing to the decline of many fish and wildlife that depend on estuaries (Dean et al. 2000), including several salmon species. A number of Pacific salmonid species are now listed as threatened or endangered under the Endangered Species Act. In recent years, numerous programs in the Puget Sound area have been developed to protect and improve salmon habitat to meet the recovery requirements of the Endangered Species Act. Very few of these programs, however, involve major estuarine restoration, and none would substantially increase the amount of this habitat in the region. Few places exist where this can occur. Alternatives B, C, and D, would add 140, 515, and 699 acres of full estuarine wetland, respectively, to the Nisqually delta. Any of these alternatives represent a substantial increase in the amount of estuarine wetland in Puget Sound, with Alternative D providing the most significant contribution. Implementation of this alternative would increase this type of habitat by 46% in south Puget Sound. Combined with other ongoing programs to restore/improve salmon habitat, the action alternatives would represent substantial positive cumulative effects to fish and wildlife that use estuaries.

Cumulative effects involving the public use program would be an overall improvement in the quality of environmental education and wildlife-dependent recreation opportunities in south Puget Sound. Priority public use opportunities would increase or improve with the establishment of new or enhanced public facilities and access. Human disturbance and conflicts

between users would be reduced, and wildlife sanctuary would be greatly improved on the Refuge. These improvements would also help address the effects that will result as the human population continues to increase rapidly in the region and visitation grows over time.

4.11 Irretrievable and Irreversible Commitment of Resources

The restoration of historic estuarine habitat necessitates the removal of portions of dikes and the conversion of some freshwater wetlands under all action alternatives. Although it would be possible to reconstruct the dike system and reestablish freshwater wetlands, this would be unlikely to occur once estuarine habitat is restored. In addition, the establishment of new public facilities and trails represents an irreversible diminishment of biological productivity in those sites. Alternatives C and D would also reduce the size of the RNA on the Refuge to provide for a waterfowl hunting program, thus improving this public use, but reducing this area of greater protection. Reversing this change in the RNA would be possible but difficult in the future.

4.12 Short-term Uses and Long-term Productivity

The No Action Alternative would not effectively maintain or improve long-term productivity. All of the action alternatives are focused on the long-term enhancement and expansion of habitat for native species. The Preferred Alternative would be most effective at enhancing the long-term productivity of the Refuge ecosystem to contribute toward the maintenance and recovery of native fish and wildlife populations. There may be some short-term loss of freshwater wetlands from conversion to estuarine habitat if additional freshwater wetlands cannot be acquired at the same time and rate. However, the simultaneous improvement of remaining freshwater habitats on the Refuge would increase capacity within those areas. In the longer term, expansion under the action alternatives would result in additional opportunities for freshwater wetlands and benefit the fish and wildlife species that use these habitats.

4.13 Unavoidable Adverse Effects

The Preferred Alternative would result in unavoidable adverse effects to non-native grassland and shrub-scrub habitats due to the decrease in overall amounts of these habitat types. Refuge expansion and restoration would provide some of this kind of habitat; however, management in these areas would focus on freshwater wetland enhancement. A very limited number of relatively common wildlife species depend solely or largely on these two kinds of habitat and would be most affected by these reductions. The restoration of historic estuarine habitat would provide very positive overall environmental effects and would benefit many more species that are higher priority to recover or maintain. Freshwater wetland acreage would decrease within the diked area; however, improved management would provide wildlife benefits, and expansion would provide additional opportunities to increase the overall amount and quality of freshwater wetlands in the lower Nisqually River watershed.

Habitat restoration and reducing wildlife disturbance necessitates changes in the public use program that would have site-specific adverse effects, including changes in trail configuration, the elimination of the McAllister Creek bank fishing area, and new boating restrictions. However, new or improved opportunities would be provided as part of the Preferred Alternative, providing overall improvements in these programs.

Habitat and species monitoring undertaken as part of the Preferred Alternative would assist Refuge staff in adapting management approaches to maximize resource benefits.

This page intentionally left blank.

Chapter 5. Relationships to Federal, State, and Local Policies and Plans

This chapter contains an overview of policies and plans promulgated by public agencies with jurisdiction in the vicinity of the Nisqually Basin. A summary is included for each relevant policy and plan, as well as a brief discussion of its relevancy for planning at Nisqually NWR.

5.1 Federal Government

Two Federal agencies have jurisdictions over portions of the study area—the U.S. Fish and Wildlife Service and the U.S. Army. The Service’s plans and policies are relevant to the Refuge since the Service owns or manages the Refuge. Planning by the Army is relevant since Fort Lewis, a large Army installation, occupies a small portion of the study area on the eastern bank of the Nisqually River.

5.1.1 Fish and Wildlife Service Plans, Policies, and Programs

Nisqually NWR and its management and administrative activities are managed as part of the National Wildlife Refuge System within a framework provided by legal and policy guidelines reviewed in Sections 1.4 through 1.7 of this CCP/EIS. The role of the Service is introduced in Section 1.4, as well as the mission of the National Wildlife Refuge System. The Service’s policies on Compatibility, Planning, and Biological Integrity, Diversity, and Environmental Health mandated by the National Wildlife Refuge System Improvement Act of 1977 are the focus of Section 1.4, which also provides a general overview of regulatory context. The Comprehensive Conservation Planning process is discussed in Section 1.7.

Other relevant plans involving the Service not addressed in Chapter 1 include the Nisqually National Wildlife Refuge Conceptual Plan (CH2M Hill et al. 1978), and the 1996 Update of the Pacific Coast Joint Venture Strategic Plan for Washington State. The Nisqually National Wildlife Refuge Conceptual Plan was prepared in the late 1970s to summarize existing resources and provide a conceptual plan for future development and use of the Refuge. This document has served as the Refuge’s principal management guidance for over two decades and will be superseded by the CCP.

The Washington State component of the Pacific Coast Joint Venture Strategic Plan is the local component of the North American Waterfowl Management Plan, which addresses the conservation and restoration of waterfowl and migratory bird habitat in southern Puget Sound. It identified the Nisqually River delta as the largest remaining relatively undeveloped river delta in the area. Plan recommendations for the southern Puget Sound area include: (1) acquisition or protection of critical estuarine and freshwater wetlands, and important contiguous upland habitat; and (2) restoration of diked former estuarine habitat, where feasible and appropriate.

The Service is also actively involved in the development and implementation of a number of conservation plans for migratory bird species, including the Partners in Flight Conservation of Landbirds in the United States, North American Waterfowl Management Plan, United States Shorebird Conservation Plan, and the North American Waterbird Conservation Management Plan. Regional step-down plans specific to the Nisqually area are discussed below.

The United States Shorebird Conservation Plan was developed through a partnership effort by State and Federal agencies, non-government organizations (NGOs), academic institutions, and individuals committed to restoring and maintaining stable shorebird populations in the U.S. and throughout the Western Hemisphere (Brown et al. 2000). The Northern Pacific Coast Regional Shorebird Management Plan establishes regional goals and objectives for western Oregon and Washington. Important shorebird habitats identified under this plan include coastal estuaries, beaches, rocky shorelines, and pelagic and freshwater systems. Regional goals under the Plan are to: “(1) measurably increase populations, over the next 10 years, of species affected by current or recent declines at population or flyway levels; and (2) stabilize and maintain current levels of breeding, wintering, and migrating populations of other shorebird species within the region/flyway.” The habitat goal for the region is to protect, restore, and enhance habitat conditions necessary to achieve population goals. Specific habitat goals important to Nisqually NWR management include: (1) restoration of tidal regimes to diked wetlands in estuaries; (2) water level and moist soil management in degraded freshwater environments; (3) removal of exotic species and planting or encouraging native vegetation in both estuarine and freshwater areas; and (4) restoration of important roost areas.

The North American Waterbird Conservation Plan is currently under development. It is a collaborative effort by Federal and State agencies, NGOs, researchers, and other experts to formulate a plan that provides an overarching framework for conserving and managing seabirds and other aquatic birds throughout North America. It will facilitate continent-wide planning and monitoring, national-state-provincial conservation action, and local habitat protection and management that taken together will maintain healthy populations of these aquatic species. The goal of the plan is to ensure that the distribution, diversity, and abundance of populations, habitats, and important sites of seabirds and other waterbirds are sustained or restored and maintained throughout their ranges in North America. A regional stepdown plan for western Oregon and Washington will focus on the key species and habitats of the coastal northwest and develop specific goals and objectives for management, monitoring, research, and outreach.

A national plan for the conservation of North American landbirds was developed through a partnership effort by State and Federal agencies, NGOs, academic institutions, and private citizens. The Conservation Plan for Landbirds in Lowlands and Valleys of Western Oregon and Washington is one of 5 habitat-based plans produced by the Oregon-Washington chapter of Partners in Flight for the two-state area, and the plan applies to Nisqually NWR. Similar to the other bird conservation plans already mentioned, the goal of this plan is to improve the extent and condition of habitats, with a particular focus on stabilizing or increasing populations of declining species within a 10- or 15-year timeframe. The plan describes habitat conditions that favor the productivity of focal species that typify specific habitats in the area, and makes

recommendations for how to improve those habitats. The Nisqually River was identified in the plan as being a potential Bird Conservation Area for its riparian habitat value. Many species breeding in the riparian habitat within the Nisqually River surge plain (e.g., Swainson's thrush, yellow warbler, and downy woodpecker) are focal species in the plan. Thus, this plan will be of particular value when designing management or restoration plans for riparian habitats under current or future refuge ownership.

The Service is developing a Regional Seabird Conservation Plan for the Pacific Region. The plan will include a review of the current Service seabird program and will present a coordinated strategy with specific goals and objectives for management, monitoring, research, and outreach. Key biological parameters will be reviewed and prioritized for inclusion in the monitoring plan. All seabird species will be prioritized by conservation need. Threats and conflicts will be discussed and recommendations for actions and stepdown plans will be included. This plan will provide an overarching review and discussion and identify regional priorities and needed stepdown documents.

5.1.2 Fort Lewis

Fort Lewis is the home of America's I Corps and one of America's power projection platforms. Its mission is to train, mobilize, and deploy combat-ready forces worldwide. Fort Lewis has a strategic and national security mission to support worldwide contingencies and respond to global peacekeeping efforts and disasters with trained and ready soldiers. Fort Lewis is also the site of the Army's first two Initial Brigade Combat Teams for the Army's Transformation Program, the Army's reorganization to meet the requirements and challenges of the 21st century (Department of the Army [DOA] 2002).

Fort Lewis recently initiated planning for its Installation Sustainability Program to integrate environmental and resource planning into operational procedures in support of current and future installation missions. A workshop held in February 2002 brought together stakeholders from the Army, surrounding communities, environmental regulatory agencies, and other agencies to form a consensus on Fort Lewis' 25-year environmental goals.

Major land use categories include cantonment (urbanized), range, and training areas. Effect areas such as artillery ranges are surrounded by buffer areas to prevent noise and safety effects to surrounding areas. Fort Lewis lands between the bluff and the Nisqually River buffer the range, located on the prairie above the bluff. At this time, the range is expected to remain operational for the foreseeable future; the Army expects to continue to rely on its holdings between the range and the river as an unpopulated buffer area (W. Vanhoesen, pers. comm.).

A list of other Federal laws and executive orders that may affect the CCP for Nisqually NWR or the Service's implementation of the CCP is provided in Appendix D.

5.2 State of Washington

A number of State laws and regulations indirectly pertain to the Refuge, including enabling legislation such as the Watershed Planning Act, State's Growth Management Act, and Shoreline Management Act, as administered by local agencies and discussed below. These regulations are indirectly relevant to Refuge planning because they require that all planning by local jurisdictions be consistent with the jurisdiction's comprehensive plan, and that water resource planning be consistent with the jurisdiction's Shoreline Master Program. The plans of both jurisdictions (Pierce and Thurston counties) are discussed later in this chapter.

5.2.1 Watershed Planning Act

The 1998 legislature passed House Bill (HB) 2514, codified into The Revised Code of Washington (RCW) 90.82 to set a framework for addressing the State's water resource and water quality issues, as well as establishing instream flows and addressing salmon habitat needs. RCW 90.82 states: *The legislature finds that the local development of watershed plans for managing water resources and for protecting existing water rights is vital to both state and local interests. The local development of these plans serves vital local interests by placing it in the hands of people: Who have the greatest knowledge of both the resources and the aspirations of those who live and work in the watershed; and who have the greatest stake in the proper, long-term management resources. The development of such plans serves the state's vital interests by ensuring that the state's water resources are used wisely, by protecting existing water rights, by protecting instream flows for fish, and by providing for the economic well-being of the state's citizenry and communities. Therefore, the legislature believes it necessary for units of local government throughout the state to engage in orderly development of these watershed plans.*

5.2.2 Growth Management Act

Planning in Washington State is regulated by the state's Growth Management Act (GMA), a State law passed in 1990 to provide for growth and development while maintaining the state's quality of life. The GMA requires all cities and counties in the state to develop written comprehensive plans, and implement the plans through regulations and innovative techniques. All regulations including subarea plans and land use controls must be consistent with the adopted local comprehensive plan, which in turn must conform to 13 state goals. The most relevant of these include: *Appropriate Economic Development, Protection of Property Rights, Fair and Timely Permit Processing, Support for Open Space and Recreation, Environmental Protection, Participation by Citizens in the Planning Process, Provision of Adequate Public Facilities and Services, and Preservation of Historic Resources.*

5.2.3 Shoreline Management Act

The Washington Shoreline Management Act (RCW 90.58), administered by the Washington State Department of Ecology through Shoreline Master Programs adopted by each local jurisdiction, regulates the development of Washington shorelines. Shoreline Master Programs

use environmental area designations [WAC 173-16-040(4)(b)] to describe land uses. The two designations that apply to the Nisqually delta's marine and riverine shoreline are "Natural" and "Conservancy." The Natural designation is intended to preserve and restore natural resource systems, particularly those that are unique and/or valuable. The Conservancy designation is intended to protect, conserve, and manage existing natural resources, and valuable historic and cultural areas. Specific requirements are discussed in Sections 5.5.3 and 5.6.3.

The State of Washington has also created several specific planning mechanisms specific to the Nisqually River, as discussed below.

5.3 Nisqually Indian Tribe

The Nisqually Indian Tribe is a Federally recognized tribe with reservation, trust lands, and tribal land holdings within the Nisqually Valley. The Nisqually Tribe has strong historical cultural and economic ties to the river and watershed. Planning by the tribe is particularly relevant to the watershed for a variety of reasons: the tribe is the principal watershed planning entity; the tribe is a major advocate for habitat recovery; the tribe is a major land owner in the watershed, and owns approximately 325 acres within approved Refuge boundaries to be managed by the Service as part of the Refuge under a Cooperative Agreement; and the tribe is historically, culturally, economically, and spiritually dependent on its namesake river and watershed.

5.3.1 Nisqually Watershed Planning - Nisqually Water Resource Inventory Area (WRIA) 11

The Nisqually Indian Tribe is the designated lead for Watershed planning for the Nisqually Watershed (Nisqually WRIA 11). The Nisqually Planning Unit, a coalition of interested parties, is working on a draft watershed management plan which is anticipated to be adopted by Pierce, Thurston, and Lewis counties upon completion of the plan in 2003 (G. Walter, pers. comm.).

5.3.2 Nisqually Chinook Recovery Plan

A principal goal of this recovery plan is to restore chinook salmon habitat to the equivalent of properly functioning conditions. Strategic priorities include restoring the estuary, protecting the riparian corridor along the mainstem of the Nisqually River, and implementing instream enhancement in the river. The plan identifies estuarine restoration in the Nisqually delta as the top priority to recover chinook salmon in the Nisqually River Watershed.

5.3.3 Nisqually River Multi-Species Management Plan

The Nisqually Indian Tribe is currently completing the Nisqually River Fall Multi-Species Management Plan which will also focus on restoration of the Nisqually River Estuary (D. Troutt, pers. comm.).

5.3.4 Nisqually Community Vision Plan

The Nisqually Community Vision Plan (Nisqually Indian Tribe 1995) was prepared by Nisqually tribal members in 1995. The plan emphasizes community preservation and development based on tribal values and goals. The document is organized around three major resource planning areas: human, natural, and community resources. Because of the interconnectedness between the Nisqually people and their traditional territory, which includes the entire Nisqually watershed, all three resource areas have some relevance to the Refuge. For example, the human resources section addresses cultural resources, and the community resource section includes relevant economic development provisions such as fisheries. The natural resources section contains the most directly applicable topic areas such as water resources, fisheries, and wildlife. All three consist of 5-year goals and 3-year priorities that provide specific direction for further action.

5.4 Resource-Specific Plans

The Nisqually River Management Plan and Nisqually River Task Force are particularly relevant to Refuge planning since both are specific to management of Nisqually River resources.

5.4.1 Nisqually River Management Plan

The Nisqually River Management Plan (Canning 1986) was approved by the Washington legislature in 1987 to protect the Nisqually River Basin's economic, natural, and cultural resources. The management plan also established the Nisqually River Council to implement the plan and analyze policy issues in the Nisqually and associated watersheds.

The River Management Plan establishes a Core Management Zone, which includes the river and a 200-foot corridor along the river, and a Stewardship Management Zone, which includes "a viewshed corridor along the Nisqually River a minimum of ¼ mile and a maximum of ¾ mile each side of the river." The Nisqually Stewardship Management Zone follows the Nisqually River and the hydraulic drainage boundary for the lower river basin. While the Refuge is currently designated as part of the Core Management Zone, the bluffs next to the delta were not included in the Stewardship Management Zone (Boyer 1993). This plan was never amended even though it pre-dates the State's Growth Management Act. It is anticipated that the plan will be revisited in conjunction with 5-year revisions to comprehensive plans under GMA by local counties (P. Moulton, pers. comm.).

5.4.2 Nisqually River Task Force

In response to legislative direction to "establish advisory committees to provide technical assistance and policy guidance" in the preparation of an "overall management plan" for the Nisqually River, the Department of Ecology formed the Nisqually River Task Force (NRTF) in August 1985. As mandated by SHB 323, membership of the Task Force includes individuals "representing the interests of Federal, State, and local government entities, agriculture, forestry, the Nisqually Indian Tribe, other property owners, and environmentalists." The Phase 1 (1985)

Task Force was made up of two advisory committees, a policy advisory committee (the Steering Committee), and a Technical Advisory Committee composed of six technical subcommittees. The Steering Committee was retained for a two-phase planning process to develop complete and comprehensive management policy recommendations in response to legislative direction and public testimony (Nisqually River Task Force 1987).

5.5 Thurston County

The majority of the study area lies within the jurisdictional boundaries of Thurston County. This section discusses several planning documents prepared by Thurston County to guide local growth and protect critical resources.

5.5.1 County-Wide Planning Policies

The Thurston County County-Wide Planning Policies were adopted in 1992 following ratification by each of the cities and towns in Thurston County to comply with GMA. The County-Wide Planning Policies were intended to be used to frame and coordinate development of comprehensive plans by each local jurisdiction. The County-Wide Planning policies address urban growth areas, urban services, capital facilities siting, fiscal impact analysis, economic development and employment, affordable housing, transportation, environmental quality, and process. The Thurston County County-Wide planning Policies are very general and do not directly apply to specific areas such as the Refuge, but they do set the stage for coordinated comprehensive planning by individual jurisdictions such as Thurston County, as addressed below.

5.5.2 Comprehensive Plan

GMA requires that all development regulations and public expenditures on facilities and services by Thurston County be consistent with the comprehensive plan. Thurston County adopted its comprehensive plan to comply with GMA in 1995, updating the County's original comprehensive plan that was prepared in 1975 and overhauled in 1988. The updated plan is primarily a policy document to guide the County's physical and other development consistent with the County's vision statement. Nine of the plan's 13 chapters address specific GMA mandated and other elements. These include: land use, natural resource lands, housing, transportation, capital facilities, private utilities, economic development, natural environment, and historic resources. The comprehensive plan's "Important Green Spaces" map identifies the entire Nisqually River delta as "important habitats," which receive protection through a number of policies in the plan. In addition, one particularly relevant policy to the Refuge is the County's policy to coordinate with "other important green spaces stakeholders" including tribes, Federal agencies, State departments, and others.

5.5.3 Shoreline Master Program

The Nisqually Reach and the Nisqually River, from Alder Lake to Puget Sound, were designated in 1976 as shorelines of statewide significance by the Thurston County Shoreline Master Program (Giebelhaus 1998). The County Shoreline Master Program segments the shoreline into different overlay designations to regulate development. Three Shoreline designations cover the delta and valley. The natural designation, located outside the dike, is extremely restrictive and prohibits the harvesting of timber within the watershed. Much of the developed valley is designated as Rural with a density of two units per acre. Several acres of shoreline are designated Conservancy and allow for a density of one unit per acre (Thurston County Planning Department 1992). Shoreline regulatory criteria protect water quality, aquatic habitats and public health, and public access that preserves or enhances shoreline characteristics that existed prior to public access, and require preservation of aesthetic, scenic, historic, or ecological qualities (Thurston Regional Planning Council 1990).

5.5.4 Shellfish Protection Districts

Parts of the Nisqually Reach have been closed by the State Department of Health for commercial shellfish harvest. The closures are due to the presence of high levels of fecal coliform bacteria, which can come from one or many activities that take place anywhere on lands within the watershed that drains into the waters where the pollution is detected. State law required Thurston County to address the water quality problems within the framework of a "Shellfish Protection District" created in early 2001 (Thurston County homepage, 06/26/2001). The shellfish protection district is a geographic area designated by Thurston County to protect water quality and tideland resources. The district provides a mechanism to generate local funds and publicize information to control non-point sources of pollution (Thurston County homepage, 08/22/2001).

5.5.5 Nisqually Sub-Area Land Use and Zoning Plan

Of all the plans and policies addressed in Chapter 5 of this CCP/EIS, the Nisqually Sub-Area Land Use and Zoning Plan (Thurston County Planning Department 1992) has the most direct applicability to the Refuge as it regulates land use for the portions of the study area located in Thurston County, which comprise the greatest share of the study area. Policies covering Nisqually Agriculture lands and most of the McAllister Creek Basin are included in Thurston County's Nisqually Sub-Area Land Use and Zoning Plan adopted in 1992. One of the plan's goals for the Nisqually planning area is to "Promote and enhance the wildlife habitat throughout the planning area and protect the Nisqually Wildlife Refuge from adjacent developments." Some policies related to this goal are to restrict development in some areas, create opportunities for landowners to participate in wildlife enhancement projects, and support research into the restoration of salt marsh ecosystem within the Brown Farm Dike.

The plan establishes an overlay on the pre-existing zoning, permitting up to one residential dwelling unit per 5 acres. Residential density in the Nisqually agriculture district is one unit per 40 acres for individual lots, one unit per 5 acres for a clustered lot subdivision, and one unit per 5

acres for the purchase of development rights or transfer of development rights programs (Thurston County Planning Department 1992).

The Refuge and adjacent lands fall into the Rural lands category established by the Sub-area Plan. Designations were based on 1992 development densities. The Luhr Beach area west of the McAllister Creek mouth is zoned one unit per 2 acres. The Nisqually Indian Tribal offices on the east side of Reservation Road south of I-5, and the Meridian Heights subdivision on the east side of Meridian Road north of I-5, are zoned at densities of up to 2 units per acre. Commercially zoned lands include the corner of Old Nisqually and lands at Martin Way and McAllister Creek (Thurston County Planning Department 1992; Thurston County Department of Water and Waste Management 1993).

The Sub-area Plan established a regulatory buffer called the Nisqually Hillside Overlay district on the hillsides of the Nisqually River and McAllister Creek. The overlay is a Thurston County Critical Area Special Management Area (Thurston County Advance Planning and Historic Preservation 1994). The buffer reaches from the toe to the top of the bluff along both sides of the Valley. It is intended to reduce the risk of slope failure and maintain the visual integrity of the wooded valley. On the west side, the buffer extends from Luhr Beach to McAllister Springs along McAllister Creek, with a 200-foot buffer upland of the McAllister Bluffs. To the east, the overlay extends 100 feet east of Old Pacific Highway, from the Holroyd pit entrance near Durgin Road to McAllister Springs.

5.6 Pierce County

The eastern-most portion of the study area lies within the jurisdictional boundaries of Pierce County. This section discusses several planning documents prepared by Pierce County to guide local growth while protecting specific resources. These are most relevant to the portion of the Nisqually Valley on the east side of the river.

5.6.1 County-Wide Planning Policies

Pierce County adopted County-Wide Planning Policies in 1992 (Pierce County 1992, amended in 1996) in response to GMA goals that the comprehensive plans of adjacent jurisdictions be consistent with one another. Issues addressed include affordable housing; agricultural lands; economic development; education; fiscal impact; historic, archeological, and cultural preservation; natural resources; open space; protection of environmentally sensitive lands; siting of regional public capital facilities; transportation; and urban growth areas. The Pierce County County-Wide Planning Policies generally reiterate GMA goals intended to guide development of comprehensive plans prepared by each jurisdiction in the county.

5.6.2 Comprehensive Plan

Pierce County adopted its comprehensive plan under GMA in 1994, replacing the County's 1962 Generalized Comprehensive Plan. The comprehensive plan is a policy document to guide the

County's growth and future land use decision-making. The plan consists of nine specific elements addressing land use, rural, housing, transportation, utilities, capital facilities, economic development, environment including historic preservation, and community plans. GMA requires that all development regulations and public expenditures on facilities and services by Pierce County be consistent with the comprehensive plan.

5.6.3 Shoreline Master Program

All marine shorelines and the shorelines of larger streams and associated wetlands in Pierce County are regulated by Pierce County's Shoreline Management Regulations (Title 20). These regulations implement the goals and policies of the Pierce County Shoreline Master Program, by applying specific designations to each portion of the shoreline. The regulations designate all lands on the Nisqually delta that are waterward of the existing dikes as Natural and remaining lands comprising the surge plain as Conservancy. The Natural designation is intended to preserve dynamic natural systems in a manner relatively free of human influence and minimize alterations to natural characteristics that make such shorelines unique and valuable. The Conservancy environment is intended to protect, conserve, and manage natural, historic, and cultural resources to ensure continued public recreational benefits and sustained resource utilization.

5.6.4 Land Use Regulations

Development in Pierce County is regulated through Title 18 of the County Code. Applicable sections of the Code include Zoning (18A), development regulations on Critical Areas including wetlands (18E), and natural resource lands including agricultural land (18I). The upper northeast portion of the Nisqually delta is zoned "Rural 10" by Pierce County, which permits a variety of uses including residential at low to moderate densities.

The Pierce County Wetlands Ordinance requires natural stream buffers between 25 and 150 feet (Pierce County Public Works and Utilities 1997). The Nisqually River's designated buffer width is 150 feet. Lakes not urban in character are subject to a 35-foot buffer requirement (Pierce County Planning and Land Services 1993).

Pierce County designated critical fish and wildlife habitats as critically important through Ordinance 21.18. The ordinance is based on Priority Habitats and Species (PHS) maps produced by WDFW (Pierce County Public Works and Utilities 1997). Endangered or threatened species are to receive buffers of 100 feet from habitat areas or 1,000 feet from an identified species.

Chapter 6. Compliance, Consultation, and Coordination with Others

6.1 Compliance

In undertaking the Proposed Action, the Service must comply with a number of Federal laws, Executive Orders, regulations, or other guidance pertinent to a Federal action. These are listed and summarized in Appendix D.

6.2 Consultation and Coordination with Others

This section describes consultation and coordination efforts with the public, interested groups, other agencies, and tribes. A Public Involvement Plan was completed February 4, 1998 that described goals and procedures that would be used to ensure full public involvement in developing the CCP.

6.2.1 Public Outreach

The following summarizes public outreach, including public meetings/open houses, workshops, Planning Update mailings, and Federal Register notices.

6.2.1.1 Public Meetings / Open Houses

Date and Location of Outreach: July 25, 1996; Scoping Meeting, Lacey, Washington.

Purpose: To inform the public on habitat management concerns, solicit comments, and encourage participation in the planning process.

Number of Non-Service Participants: 30

Audience: Public

Topics Discussed:

- (1) Background Information: February 1996 flood, administrative site planning, and the Refuge System's goals.
- (2) Key Habitat and Public Use Issues: Habitat management concerns within the diked area, solicited comments on key management issues, identified partners.

Date and Location of Outreach: November 18 and 19, 1997; Open Houses, Lacey and Tacoma, Washington.

Purpose: To present an informal opportunity to all participants to learn about and comment on the CCP process.

Number of Non-Service Participants: 151

Audience: Public

Topics Discussed:

- (1) Values, Vision, and the Service's Role: Draft Refuge goals, Refuge purposes and existing activities, role of Nisqually NWR, concerns about the future of Nisqually NWR.
- (2) Major Issues Discussed: Changing the mix of habitat types at Nisqually NWR (eight draft alternatives presented), trail access and configuration, waterfowl hunting, Refuge expansion and acquisition, PWC use/disturbance and conflicts with other users, sanctuary areas, exotic species control, river restoration, environmental education, reforestation, special designated areas, croplands and haying, fishing access, boating, and cultural resources.

6.2.1.2 Workshops

Date and Location of Outreach: May 13, 1998; Grassland Workshop, USFWS Nisqually NWR, Olympia, Washington.

Purpose: To review historic and current grassland conditions and develop recommendations for improving grassland wildlife habitat.

Number of Participants: 8

Audience: Local and regional USFWS professionals, representatives of Ducks Unlimited and Natural Resources Conservation Service, plus a volunteer and former biologist.

Topics Discussed: Topics included grassland and shrubland objectives and strategies, noxious weed control, freshwater wetlands management, and monitoring methods. Several field site visits were conducted.

Date and Location of Outreach: June 2, 1998; Public Use Workshop, Service Western Washington Office, Lacey, Washington.

Purpose: To gather input for the planning of future public use, recreation, and education programs on the Refuge.

Number of Non-Service Participants: 65

Audience: Representatives of local groups or organizations with specific interest in public use, recreation, and education programs on the Refuge.

Topics Discussed: Workshop attendees participated in one of the following six focus groups in which they discussed topics specific to these groups: (1) boating and kayaking; (2) hunting and fishing; (3) hiking, photography, and birdwatching; (4) outdoor recreation providers and planners; (5) tourism; and (6) environmental education.

Date and Location of Outreach: June 29-30, 1998 and June 3, 1999; Estuarine and Freshwater Wetland Workshops, USFWS Nisqually NWR, Olympia, Washington.

Purpose: To review historic and current habitat conditions, wildlife use, and management activities to develop recommendations for future restoration and management of estuarine and freshwater wetlands.

Number of Participants: 15-18

Audience: Local and regional FWS professionals; ENSR consultants; scientists from the Universities of Washington and Wyoming; and representatives from Ducks Unlimited, Fisheries and Oceans Canada, Environmental Protection Agency, Montgomery Water Group, and University of Puget Sound.

Topics Discussed: Estuarine wetlands: lack of juvenile salmonid habitat and Brown Farm Dike influences including tidal loss, marsh erosion, and sediment loss. Freshwater wetlands: low quality habitat conditions due to deep water with low flow, reed canary grass, and vegetation succession. Several alternatives for habitat restoration, management, and monitoring as well as public access issues were discussed.

6.2.1.3 Planning Update Mailings

The Service published six Planning Updates and one Issues Workbook as part of the public outreach efforts. These were sent to everyone on the CCP mailing list. In addition, the Issues Workbook was handed out at the November 1997 public open houses. Planning Update #6 was also summarized in the April 2002 issue of the McAllister Water News published by the City of Olympia.

Planning Updates:

August 1996, November 1996, November 1997, April 1998, December 1998, June 2001

Issues workbook :

November 1997

6.2.1.4 Federal Register Notices

A formal “Notice of Intent to Prepare a Comprehensive Management Plan and Associated Environmental Document” was published in the Federal Register on October 9, 1997. Later in the process, the Service decided to prepare an Environmental Impact Statement for the Comprehensive Conservation Plan. For this, a second Notice of Intent was published in the Federal Register on February 9, 2000.

6.2.2 Interest Group and Other Agency Consultation/Coordination

Refuge staff gave more than 50 presentations to a variety of groups on- and off-Refuge, providing a summary and update on the CCP process, key issues, and soliciting public input. These groups included: local Audubon chapters, Evergreen College classes, Kiwanis Club of Olympia, Rotary Club in Tacoma, National Marine Fisheries Service technical group, U.S. Army Corps of Engineers wetland training classes, Pacific Coast Joint Venture, Sierra Club, Thurston County Leadership Council, Nisqually Summer Lecture Series, among others.

Service staff participated in panel discussions on estuarine wetland restoration at two Society of Wetland Scientists Northwest Chapter Meetings. The first took place on May 6, 1996 in Olympia, Washington in which approximately 45 people attended. The second took place on

May 21, 1998 in Tacoma, Washington with about 200 participants. The panelists included university scientists, agency and tribal representatives, and other restoration professionals. Discussions centered around the issues and challenges of estuarine restoration in Puget Sound as it relates to Nisqually NWR.

The Refuge Manager met individually with the three Thurston County Commissioners on May 17 and June 4, 2001, summarizing the CCP key issues and focusing on Refuge expansion. A meeting was held with representatives of Congressman Adam Smith's and Congressman Brian Baird's local offices on May 23, 2001 to summarize CCP key issues, the schedule, and focus on Refuge expansion.

Several meetings were held with major landowners within the expansion study area, including Fort Lewis, Weyerhaeuser, and some of the farmers with the largest land holdings in the Nisqually Valley, to summarize the CCP process, key issues, and schedule, with a focus on Refuge expansion, and solicit further comment. Fort Lewis was given the opportunity to comment on the internal review draft of the CCP/EIS.

The Service gave four presentations to the Nisqually River Council during the planning process. The Council includes more than 20 key partners and citizen participants. The following is a list of meeting dates:

November 19, 1999
May 18, 2001
August 17, 2001
April 19, 2002

The Service met with the WDFW seven times during the planning process. WDFW was given the opportunity to comment on an internal review draft of the CCP/EIS. The following is a list of meeting dates:

January 29, 1998
November 9, 2000
April 17, 2001
May 1, 2001
May 17, 2001
September 14, 2001
October 5, 2001

6.2.3 Tribal Consultation/Coordination

The Service met with the Nisqually Indian Tribe 14 times during the course of the planning process, and they were given the opportunity to comment on an internal review draft of the CCP/EIS. The following is a list of meeting dates:

June 23, 1999
July 20, 1999
January 25, 2000
February 29, 2000
April 24, 2000
June 9, 2000
August 10, 2000

January 31, 2001
August 27, 2001
October 1, 2001
October 15, 2001
February 14, 2002
March 19, 2002
April 18, 2002

This page intentionally left blank.