United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon State Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179 FAX: (503) 231-6195

Biological and Conference Opinions
for the
Columbia River Channel Improvements Project

Agency: U.S. Army Corps of Engineers

Consultation and Conferencing Conducted By: U.S. Fish and Wildlife Service

Approved By: _____
Kemper M. McMaster, State Supervisor, Oregon State Office

Date Issued: 5/20/02

Reply To:	8330.2055(02)
X-ref:	8330.2804(99), 8330.0563(01)
File Name:	ConfOpinion 02.wpd
Tracking Numbers:	02-1743, 02-4943

Table of Contents

1.0 Consultation and Conference History 2
1.1 1999 Terrestrial Species Consultation 2
1.2 2001-2002 Aquatic Species Conference and Consultation 5

2.0 Description of the Proposed Action 5
2.1 Introduction 5
2.2 Proposed Action 7
2.2.1 Navigation Channel Shoals that are Less than 48 Feet Deep 10
2.2.2 Construction and Maintenance Dredging 10
2.2.3 Construction and Maintenance Disposal Activities 12
2.2.4 Additional Provisions for Protection of Water Resources 14
2.2.5 Locations for Construction and Maintenance Dredging and Dredged Material Disposal 14
2.2.6 Monitoring Program and Adaptive Management Process 17
2.2.7 Ecosystem Restoration and Research Actions 23
2.2.7.1 Ecosystem Restoration Activities 23
2.2.7.2 Ecosystem Research Activities 25

3.0 Status of the Species 26
3.1 Southwestern Washington/Columbia River Coastal Cutthroat Trout 27
3.1.1 Overview 27
3.1.2 Status and Distribution 28
3.1.3 Early Life History 29
3.1.4 Migration 29
3.1.5 Spawning 30
3.2 Columbia River Bull Trout 31
3.2.1 Overview 31

4.0 Environmental Baseline 31
4.1 Lower Columbia River and Estuary Conditions 32
4.2 Coastal Cutthroat Trout and Bull Trout, Lower Columbia River and Estuary 34
4.2.1 Coastal Cutthroat Trout 34
4.2.2 Bull Trout 38
4.3 Description of Lower Columbia River and Estuary Baseline Conditions Using a Conceptual Ecosystem Model 38
4.3.1 Introduction 38
4.3.2 Habitat Forming Processes 42
4.3.3 Habitat Types 42

4.3.4 Habitat Primary Productivity Pathway 44
4.3.5 Food Web Pathway 44
4.3.6 Growth Pathway 46
4.3.7 Survival Pathway 46
4.4 Updated Environmental Baseline Information for Columbian White-tailed Deer and Bald Eagle 48
4.4.1 Columbian White-tailed Deer 48
4.4.2 Bald Eagle 49

5.0 Effects of Action 49
5.1 Introduction 49
5.2 Uncertainty Regarding Project-related Effects and Associated Risk to Ecosystem Indicators as Related to Monitoring Actions 52
5.3 Effects from Construction and Maintenance Activities 53
5.3.1 Immediate (Direct) Effects 54
5.3.2 Short- and Long-term (Indirect) Effects to Ecosystem Processes and Functions of Importance to Coastal Cutthroat Trout and Bull Trout 55
5.3.2.1 Ecosystem Indicator - Suspended Sediment (including an analysis of accretion and erosion) 57
5.3.2.2 Ecosystem Indicator - Bedload (including analysis of accretion and erosion) . . 58
5.3.2.3 Ecosystem Indicator -Turbidity 60
5.3.2.4 Ecosystem Indicator - Salinity 60
5.3.2.5 Ecosystem Indicator - Bathymetry (including an analysis of velocity field) . . . 61
5.3.2.6 Effects from Construction and Maintenance Activities on Key Salmonid Habitats 63
5.3.2.7 Tidal Marsh and Swamp 63
5.3.2.7.1 Insects 64
5.3.2.7.2 Macrodetritus and Microdetritus 65
5.3.2.7.3 Tidal Marsh and Swamp Summary 65
5.3.2.8 Shallow Water and Flats 65
5.3.2.8.1 Benthic Algae 67
5.3.2.8.2 Shallow Water and Flats Summary 68
5.3.2.9 Water Column 68
5.3.2.9.1 Deposit Feeders/Suspension-Deposit feeders/Suspension Feeders 69
5.3.2.9.2 Mobile Macroinvertebrates 70
5.3.2.9.3 Phytoplankton 70
5.3.2.9.4 Water Column Summary 71
5.3.2.10 Indicators that Occur in More Than One Key Habitat Type 71
5.3.2.11 Contaminants 72
5.4 Effects from Interrelated and Interdependent Activities 75

5.4.1 Willamette River Navigation Channel Deepening 75
5.4.2 Deepening and Maintenance of Project Berths 76
5.4.3 Development of Port Activities and Deep Draft Vessels 76
5.4.4 Non-indigenous Species Introductions 77
5.4.5 Summary 77
5.5 Effects Resulting from Proposed Monitoring, Ecosystem Restoration, and Research Activities 78
5.5.1 Monitoring Program 78
5.5.2 Ecosystem Restoration Activities 80
5.5.2.1 Lois Island Embayment 81
5.5.2.2 Purple Loosestrife Control 82
5.5.2.3 Miller/Pillar Habitat Creation 82
5.5.2.4 Tenasillahe Island Tidegate and Inlet Modifications 83
5.5.2.5 Tenasillahe Island Historical Habitat Restoration 83
5.5.2.6 Bachelor Slough 84
5.5.2.7 Columbia River Tidegate Retrofits 84
5.5.2.8 Walker/Lord and Hump/Fisher Islands Channel Connectivity Enhancements . 85
5.5.2.9 Martin Island Embayment Modification 85
5.5.3 Ecosystem Research Actions 86
5.6 Summary of Effects of the Proposed Action on the Biological Requirements of Coastal Cutthroat Trout and Bull Trout 86
5.7 Updated Analysis of Effects for Columbian White-tailed Deer and Bald Eagle 89
5.7.1 Columbian White-tailed Deer Effects 89
5.7.2 Bald Eagle Effects 90

6.0 Cumulative Effects 91
6.1 Introduction 91
6.2 State Actions 92
6.2.1 Oregon 93
6.2.2 Washington 95
6.3 Local Actions 96
6.4 Tribal Actions 97
6.5 Private Actions 98
6.6 Summary 98

7.0 Conclusion 100
7.1 Coastal Cutthroat Trout and Bull Trout 100
7.1.1 Effects Analysis 100
7.1.2 Monitoring Program and Adaptive Management Process 101

7.1.3 Ecosystem Research Actions 102
7.1.4 Ecosystem Restoration Features 103
7.1.5 Coastal Cutthroat Trout and Bull Trout Conclusion 103
7.2 Bald Eagle and Columbian White-tailed Deer Conclusion 103

8.0 Incidental Take Statement 105
8.1 Introduction 105
8.2 Amount or Extent of the Take 106
8.2.1 Coastal Cutthroat Trout and Bull Trout 106
8.2.2 Bald Eagle 108
8.2.2.1 Terrestrial species Opinion's Incidental Take Statement 108
8.2.2.2 Ecosystem Restoration Actions 108
8.2.2.3 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act 108
8.2.3 Columbian White-tailed Deer 109
8.2.3.1 Terrestrial species Opinion's Incidental Take Statement 109
8.2.3.2 Ecosystem Restoration Actions 109
8.3 Effect of the Take 109
8.4 Reasonable and Prudent Measures 109
8.4.1 Coastal Cutthroat Trout and Bull Trout Reasonable and Prudent Measures . 109
8.4.2 Bald Eagle Reasonable and Prudent Measures 110
8.4.3 Columbian White-tailed Deer Reasonable and Prudent Measures 111
8.5 Terms and Conditions 111
8.5.1 Coastal Cutthroat Trout and Bull Trout Terms and Conditions 111
8.5.2 Bald Eagle Terms and Conditions 120
8.5.3 Columbian White-tailed Deer Terms and Conditions 121
8.5.4 Salvage Requirements 122
8.5.5 Conclusion 124

9.0 Conservation Recommendations 124
9.1 Introduction 124
9.2 Coastal Cutthroat Trout and Bull Trout Conservation Recommendations . . . 124
9.2.1 Pile Dike Study 124
9.2.2 Ecosystem Conservation/Restoration 125
9.2.3 Sediment Budget for the Lower Columbia River and Estuary 125
9.2.4 Near-shore and Plume Study 125
9.2.5 Public Involvement in the Adaptive Management Process 126
9.2.6 Involvement of the Columbia River Tribes in Project Implementation 126
9.2.7 OHSU/OGI ELCIRC Modeling 126
9.2.8 Pipeline Dredge Disposal 127
9.3 Bald Eagle Conservation Recommendation 127

9.3.1 Provide Bald Eagle Perch Sites 127
9.4 Columbian White-tailed Deer Conservation Recommendations 127
9.4.1 Develop Columbian White-tailed Deer Habitat Management Plan for Cottonwood-Howard Islands 127
9.5 Conservation Recommendations Summary 129

10.0 Concluding Statement 129

11.0 Literature Cited 131

List of Tables

1 Species evaluated and the Corps' effects determinations in the 1999 and 2002 biological assessments 4
2.1 Dredging methods, descriptions, and associated Best Management Practices . . 10
2.2 Disposal methods, descriptions, and associated Best Management Practices . . 13
2.3 Additional provisions for protection of water resources 14
2.4 Proposed dredging locations, disposal locations, and types of disposal 16
2.5 Key components of monitoring program 19
2.6 Sediment testing locations and frequency minimums 21
2.7 Proposed ecosystem restoration activities 24
2.8 Proposed ecosystem research actions 25
4.1 Conceptual model pathways and indicators for juvenile salmonid production in the lower Columbia River, estuary, and river mouth 39
4.2. Estimated 2001 numbers and sex/age ratios of Columbian white-tailed deer, by geographic area/sub-population 48
5.1 Pathways and indicators to be addressed by the monitoring program 53
5.2 Proposed Project monitoring activities and effects of monitoring program implementation 80

Biological and Conference Opinions
for the
Columbia River Channel Improvements Project

INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) biological and conference opinions (Service opinions), based on our review of the U.S. Army Corps of Engineers (Corps) proposed Columbia River Channel Improvements Project (Project), located in and along river miles (RM) 3-106.5 of the Columbia River, Oregon and Washington. These Service opinions address the Project's effects on proposed Southwestern Washington/Columbia River distinct population segment (DPS) of coastal cutthroat trout (*Oncorhynchus clarki clarki* - hereafter referred to as coastal cutthroat trout) and Columbia River DPS of bull trout (*Salvelinus confluentus* - hereafter referred to as bull trout), in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). Critical habitat has not been proposed for coastal cutthroat trout or designated for Columbia River bull trout.

These Service opinions also incorporate the Service's December 6, 1999, Project biological opinion (terrestrial species opinion) for bald eagle (*Haliaeetus leucocephalus*) and Columbian white-tailed deer (*Odocoileus virginianus leucurus*). New information on Project Ecosystem Restoration actions and associated effects to bald eagle and Columbian white-tailed deer is updated in these Service opinions. An updated Incidental Take Statement for bald eagle and Columbian white-tailed deer also is provided, which supercedes the terrestrial species opinion's Incidental Take Statement.

Your January 3, 2002, request for formal consultation, and the December 28, 2001, Project biological assessment was received by the Service on January 3, 2002. Your April 22, 2002, biological assessment addendum was transmitted to the Service on April 22, 2002. These Corps documents are herein termed the aquatic species BA.

The aquatic species BA discusses baseline features that are periodically maintained by the Corps, as well as identifying future activities that will need future conference and/or consultation. These features include pile dikes or other river training features; future federal actions include maintenance dredging of 12 side channels below Bonneville Dam. These features and future federal actions are not part of the proposed action and therefore are not analyzed in this conference and consultation. All these future federal activities will require site-specific conference and/or consultation with the Service.

These Service opinions are based on information provided from many sources, including a number of collaborative efforts aimed at reaching a comprehensive understanding of the best available science, the appropriate conservation measures, and the effects of the proposed actions. These collaborative efforts are described in more detail in the Consultation and Conference History section, below. Specific information sources for these Service opinions include the aquatic species BA, the Service's December 6, 1999, terrestrial species opinion (file number 8330.2804[99]), the Service's June 8, 1999, Fish and Wildlife Coordination Act (FWCA) report (file number 7363.004 [99]), the Sustainable Ecosystem Institute's (SEI) Scientific Review Panel process, numerical and conceptual model outputs, Biological Review Team (BRT) deliberative process, numerous interagency meetings, and other sources of information. A complete administrative record of this consultation and conference is on file in the Service's Oregon Fish and Wildlife Office, Portland, Oregon.

1.0 CONSULTATION AND CONFERENCE HISTORY

The Corps' January 3, 2002, aquatic species BA represents the second Project consultation and conference process that has been reviewed by the Service. During the first Project consultation and conference, the Service only addressed listed terrestrial species, whereas the National Marine Fisheries Service (NMFS) addressed all proposed and listed aquatic species. The first consultation and conference process was completed by NMFS and the Service in December, 1999. The second consultation and conference process specifically addresses Project effects on listed and proposed aquatic species, with additional assessment of the Project ecosystem restoration action effects on bald eagle and Columbian white-tailed deer. The following paragraphs explain and/or reference the history for the Project's two consultation and conference processes.

1.1 1999 Terrestrial Species Consultation

The Consultation History section (pages 1-3) of the Service's terrestrial species biological opinion explains the Service's interactions with the Corps, and is incorporated herein by reference. Bull trout, although listed by the Service as a threatened species, was not addressed in the Service's terrestrial species opinion. The Corps made Project effects determinations for the Service's listed terrestrial species (Table 1). NMFS was also conferencing and consulting during 1999 on Project effects to 13 listed or proposed anadromous salmonid species, including coastal cutthroat trout. On November 26, 1999, the Service and NMFS (the Services) notified the Corps that the Service would assume sole regulatory jurisdiction for coastal cutthroat trout under the

Act. On August 25, 2000, NMFS withdrew their 1999 Project biological and conference opinions for all proposed and listed aquatic species. However, the Service's terrestrial species biological opinion was not withdrawn and remains in effect, except as amended herein.

During the 1999 interagency coordination and consultation process, the Service provided Project recommendations under the June 8, 1999, FWCA report. Many of those recommendations are now integrated into the Project's proposed action, as described in the aquatic species BA.

Table 1. Species evaluated and the Corps' effects determinations in the 1999 and 2002 biological assessments

Common Name	Species Name	Effects Determination	Analysis Documentation
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	May affect, likely to adversely affect	2002 Conference Opinion
Bull trout	*Salvelinus confluentus*	May affect, likely to adversely affect	2002 Biological Opinion
Bald eagle	*Haliaeetus leucocephalus*	May affect, likely to adversely affect	2002 Biological Opinion; 1999 terrestrial species opinion
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	May affect, likely to adversely affect	2002 Biological Opinion; 1999 terrestrial species opinion
Peregrine falcon	*Falco peregrinus*	May affect, not likely to adversely affect	Concurrence in 1999 terrestrial species opinion [1]
Aleutian Canada goose	*Branta canadensis leucopareia*	No effect	Not Analyzed Further
Brown pelican	*Pelecanus occidentalis*	No effect	Not Analyzed Further
Marbled murrelet	*Brachyramphus marmoratus*	No effect	Not Analyzed Further
Western snowy plover	*Charadrius alexandrinus nivosus*	No effect	Not Analyzed Further
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	No effect	Not Analyzed Further
Bradshaw's lomatium	*Lomatium bradshawii*	No effect	Not Analyzed Further
Golden paintbrush	*Castilleja levisecta*	No effect	Not Analyzed Further
Nelson's checkermallow	*Sidalcea nelsoniana*	No effect	Not Analyzed Further
Water howellia	*Howellia aquatilis*	No effect	Not Analyzed Further

[1] Peregrine falcon were delisted on August 25, 1999 (64 FR 46541).

1.2 2001-2002 Aquatic Species Conference and Consultation

On December 7, 2000, the Service, based on our new regulatory jurisdiction for coastal cutthroat trout, recommended that the Corps initiate a conferencing process for Project effects to coastal cutthroat trout, and also informed the Corps about historic records of bull trout in the lower Columbia River (file number 8330.0563[01]). In March, 2001, informal consultation was initiated between the Service, NMFS, Corps, and Ports. On July 11, 2001, the Corps designated the six lower Columbia River Ports as non-Federal representatives for purpose of conference and consultation. On January 3, 2002, the Corps transmitted an aquatic species BA that addresses all NMFS' listed species, as well as the Service's coastal cutthroat trout and bull trout (Table 1), with minor additional analysis of Project effects to bald eagle and Columbian white-tailed deer.

A history of specific informal consultation and conference activities under the Act, between the August 25, 2000, NMFS' withdrawal of their 1999 biological opinion to current date, is presented on pages 1-11 to 1-15, and 7-1 of the aquatic species BA, and is incorporated herein by reference. The reinitiation of conference and consultation resulted in a re-evaluation of aquatic species issues via an independent, scientific, peer-review panel and a series of five public workshops; additional analysis by a multi-agency biological review team; and development and use of new analytical tools including two numerical models and an ecosystem-based conceptual model. During the reinitiation process, the Corps, NMFS, the Service, and Ports participated in a mutual analysis of Project effects, and subsequently negotiated Project modifications to minimize or avoid potential Project effects. To provide further assurances that the Project was successful in minimizing or avoiding adverse effects to proposed and listed species, Project monitoring activities and adaptive management requirements were developed and incorporated into the Corps' proposed action. Finally, during this deliberative process, the Services recommended numerous ecosystem research and restoration activities to help fulfill the Corps' responsibilities under section 7(a)(1) of the Act.

BIOLOGICAL AND CONFERENCE OPINIONS

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 Introduction

Subsequent to NMFS' August 25, 2000, withdrawal of its December 1999 Opinion, the Corps, sponsoring Ports, NMFS, and the Service developed a "reinitiation" framework to address NMFS' major concerns and to re-define, as necessary, the Project's proposed action. Several steps were involved in the development of the current proposed action, including a re-evaluation of potential Project effects, an analysis of these potential effects within the framework of an ecosystem-based conceptual ecosystem model, and the development of compliance measures and monitoring conditions based on the effects analyses. As part of the reinitiation process, the Corps, NMFS, the Service and the Ports identified additional monitoring, research, and adaptive management components of the proposed action. The Corps, Service, and the Ports also identified additional ecosystem restoration features to be included in the proposed action for the Project. The Corps' aquatic species BA fully describes this reinitiation process, and those descriptions are incorporated herein by reference. The following is a brief overview of the steps that led to the current Project's proposed action.

To facilitate discussion of the scientific questions raised by NMFS in their August 25, 2000, withdrawal letter, the Corps, NMFS, Service, and the Ports retained Sustainable Ecosystems Institute (SEI), a public-benefit, science mediation group. Using a panel of seven nationally-prominent technical experts, SEI provided an independent, scientific process to evaluate the potential environmental issues surrounding improvement of the navigation channel. A series of SEI workshops helped frame major concerns raised in connection with the proposed Project, and identify best available science for additional analysis of Project effects.

Beginning in early spring 2001, the Corps, NMFS, Service, and the Ports formed a technical group called the Biological Review Team (BRT). The BRT engaged in regular meetings to further review and address technical issues associated with the proposed Project and its potential effects. These BRT technical meetings were occurring during and after the SEI workshops, and incorporated the SEI workshop proceedings.

During the SEI workshop process, a conceptual ecosystem model was designed to provide an integrated description of the major ecosystem links that affect ecosystem structure and/or function as related to juvenile salmonid production and ocean entry (see Chapter 5 of the aquatic species BA). The specific objectives of the model were to:

- Provide an ecosystem-level scientific framework for evaluating the Project;
- Identify links among physical-chemical and biological indicators;

- Aid in the identification of ecosystem-based processes that link salmonids and potential effects of the Project; and

- Develop a systematic methodology to evaluate monitoring and adaptive management opportunities.

The conceptual ecosystem model describes the physical and biological interactions of the lower Columbia River (from Bonneville Dam downstream to the upper end of the estuary at RM 40), estuary (RM 40 to RM 3), and river mouth (RM 3 to the deep water disposal site) in a manner that, when they are properly functioning, help to characterize a properly functioning ecosystem. The conceptual ecosystem model was used by the BRT as an analytical tool for Project effects analyses. The Corps also conducted additional numerical modeling of hydraulic parameters (i.e., salinity, velocity, depth, and temperature) for the Lower Columbia River, estuary, and river mouth. Modeling analysis was done by both the Oregon Health and Science University/Oregon Graduate Institute (OHSU/OGI) and the Corps' Waterways Experiment Station (WES). The OHSU/OGI modeling was conducted to verify the previous conclusion of the WES modeling from the Corps'1999 Final Environmental Impact Statement (FEIS; Corps 1999) and provide additional analyses on potential Project effects to habitat opportunity for juvenile salmonids (Bottom et at. 2001).

Ultimately, the Corps, NMFS, Service, and Ports reviewed each aspect of the original 1999 proposed action, and, using the best available science, including the SEI workshops, the numeric and conceptual models, and the BRT meetings, agreed upon the current proposed action for dredging and disposal activities. The BRT identified additional compliance measures and monitoring conditions in order to minimize or avoid Project effects. Finally, the BRT proposed an adaptive management process to review information from the compliance and monitoring activities and make necessary Project modifications to minimize and avoid impacts.

2.2 Proposed Action

The proposed action consists of several components that have been developed over the course of this consultation and conference. They include:

- The construction of the deeper navigation channel, employing a range of best management practices to avoid or minimize harm to species proposed and listed under the Act;

- Maintenance dredging to maintain navigation depths for the navigation channel and other associated features;

- The disposal of construction and maintenance dredged materials in suitable locations to avoid or minimize adverse effects on listed and proposed species and, where appropriate, improve ecological functions in the near shore area;

- The design and implementation of a robust Monitoring Program to evaluate implementation performance and ecological responses;

- Implementation of an adaptive management process to respond to future adverse effects.

- The implementation of ecosystem restoration efforts to improve ecological functions of significance to listed and proposed species in the Lower Columbia River and estuary; and

- The undertaking of an ecological research program to further reduce uncertainties and guide the adaptive management process over the life of the Project.

Each of these elements of the proposed action are summarized below. A more complete description of them is in the aquatic species BA (see Sections 3, 8, and 9) and are incorporated herein by reference.

The proposed action can be categorized into two distinct types of activities: deepening of the navigation channel (includes turning basins and berths that are interrelated and/or interdependent to the Project); and ecosystem restoration and research. Associated with the navigation channel improvements and ecosystem restoration and research activities are compliance, monitoring, and adaptive management actions.

Navigation channel improvements will require two main actions: Dredging and disposal of dredged materials. Dredging and disposal of dredged materials will occur in two stages: an initial construction program to deepen the existing navigation channel, turning basins, and berths that are interrelated and/or interdependent to the Project, and a subsequent program to maintain the deepened navigation channel and turning basins. The construction phase will last 2 years, and the maintenance phase will last the remainder of the authorized Project life.

Deepening of the lower Willamette River, which had been a component of the authorized Project and discussed in the 1999 FEIS, is not reasonably certain to occur. Portions of the Lower Willamette River have been designated as a federal National Priorities List site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Construction of the Project's lower Willamette River features has been deferred pending study

and selection of an appropriate remedy for cleanup under CERCLA. Because the lower Willamette River navigation channel deepening is not reasonably certain to occur, this potential future federal action is not addressed in these Service opinions.

Construction and maintenance dredging at lower Columbia River berths associated with three grain facilities, one gypsum plant, and one container terminal, represent actions that are interrelated and/or interdependent to the Project. Therefore, these Service opinions analyze the effects to coastal cutthroat trout and bull trout from these berth deepening and maintenance activities. However, these Service opinions do not provide incidental take coverage for berth dredging, as these activities will undergo future Act consultation. The future Act consultation will initiate upon the Service's receipt of applications for Federal permits, prior to berth dredging activities.

The Corps proposes to increase the depth of the Columbia River navigation channel, from its presently authorized -40 Columbia River Datum (CRD) feet, to -43 CRD feet. "Advanced maintenance" dredging will occur during the Project's construction and maintenance components, including advanced maintenance dredging for up to 100 feet overwidth and 5 feet overdepth for a maximum constructed navigation channel depth of 48 feet. This is a standard practice for operation and maintenance of the current 40-foot channel and is used to insure a safe operational depth between operation and maintenance dredging periods. The current navigation channel's 600-foot width will be maintained, with additional channel width at channel turns and areas of high-reoccurrence of shoaling. The improved navigation channel will exist in the same location as the current -40 foot navigation channel. In addition, a total of three existing turning basins would be deepened to -43 CRD feet and maintained as part of the proposed action. Currently existing lower Columbia River berths at three grain facilities, one gypsum plant, and one container terminal, interrelated and/or interdependent to the Project, will be deepened to -43 CRD feet and maintained.

The Corps proposes to deepen the navigation channel from River Mile (RM) 3 to RM 105.5 on the Columbia River (see section 1.2.1 of the aquatic species BA). An estimated total of 19 million cubic yards (mcy) of sand, 76,000 cubic yards (cy) of basalt rock, and 240,000 cy of cemented sand, gravel, and boulders would be initially removed from the navigation channel using hopper, clamshell, and pipeline dredges. Once the improvements are completed, the channel will require annual maintenance dredging. Over the initial 20 years, annual maintenance dredging is expected to decline from around 8 mcy to about 3 mcy of sand annually as the new channel reaches equilibrium. Annual maintenance will then continue at an average of about 3 mcy of sand per year for the succeeding 30-years. This amounts to a total Project dredging quantity of about

190 mcy for the Project. During this same 50 year period without the 43 foot project, approximately 160 mcy would be dredged to maintain the 40 foot channel.

The Corps is proposing to employ contractors, Federal and Port personnel, vessels, and equipment to implement the Project's dredging and disposal activities. Channel construction and maintenance will encompass a variety of dredging and dredged material disposal methods, as well as associated impact minimization measures. The Service has reviewed each component of the proposed action to develop additional impact minimization and best management practices (BMPs). These BMPs have been incorporated by the Corps as a component of the proposed action. The following is a general discussion of the pre-construction planning, dredging and disposal methods, locations, and impact minimization measures.

2.2.1 Navigation Channel Shoals that are Less than 48 Feet Deep

Construction and maintenance dredging activities will mainly focus on navigation channel shoals that are less than 48 feet deep. These channel features will be resurveyed prior to construction and maintenance dredging activities, and dredging activities will be localized and limited to these shallow shoal features.

2.2.2 Construction and Maintenance Dredging

The following best management practices (BMPs), including Project compliance activities, will apply to Project construction and maintenance dredging (Table 2.1). These BMPs for the dredging actions are designed to avoid or minimize potential for adverse effects upon or take of coastal cutthroat trout and bull trout. Construction and maintenance dredging BMPs will remain in effect during the life of the Project, or until new information becomes available that would warrant change (see Section 2.2.6, below).

Contractors or other construction and maintenance workers will employ the following methods described in Table 2.1, as appropriate, to most efficiently complete the construction and maintenance dredging activities. Contractors and other workers will be required to conduct dredging activities in compliance with the proposed action, including full implementation of BMPs, compliance monitoring, and reporting. Section 7.3 of the aquatic species BA contains a more complete description of the compliance monitoring program. It is incorporated herein by reference.

Table 2.1. Dredging Methods, Descriptions, and Associated Best Management Practices

Dredging Method	Description (also refer to Aquatic Species BA)	Best Management Practices
Hopper	Use dual dragarms to lower dragheads onto substrate. River bed materials are removed via suction to transport materials into the hold of the vessel. Generally used for small sand shoals in river and large sand shoals in estuary.	-Minimize entrainment by maintaining, to the extent possible, the draghead below substrate. Pumping must stop if dragarm is raised more than 3 feet above substrate. -Minimize turbidity by maintaining, to the extent possible, the draghead below substrate. -Contracts will specify compliance plans
Mechanical	Use bucket to remove materials and transfer to a barge for transport. Includes clamshell, dragline, and backhoe dredges. Mainly used during construction phase for removal of cemented sands, gravels, and fractured rock. Limited maintenance application, mainly in confined areas.	-Contractors will specify compliance plans -Future berth deepening and maintenance will occur within timing window of November 1-February 28
Pipeline	Use cutterhead on end of long arm to remove sediments. River bed materials are removed via suction to a floating pipeline. The pipeline delivers the river bed materials to the disposal location.	-Minimize entrainment by maintaining, to the extent possible, the draghead below substrate. Pumping must stop if cutterhead is raised more than 3 feet above substrate. -Minimize turbidity by maintaining, to the extent possible, the cutterhead below substrate. -Contractors will specify compliance plans
Drilling and Blasting	Associated with channel construction at basalt rock outcrops. Holes would be drilled in underwater rock formation, and charges set to create an implosion.	-A blasting plan would be developed for each site. -Implosion rather than explosion. -Over-pressure from blast less than ten psi. -Monitoring of blasts. -Fish " hazing" employed prior to blast. -Timing window of November 1-February 28.

Project construction dredging, using any of the aforementioned dredging methodologies, may occur year-round until the navigation channel and turning basin deepening is complete. Future berth deepening will occur within timing window of November 1-February 28. Another exception to the aforementioned in-water work window "waiver" is removal of rocks via blasting. Any rock blasting would have an in-water timing requirement from November 1 to February 28.

Project maintenance dredging for navigation channel or turning basin features will not have any in-water timing restrictions. However, the Corps has traditionally implemented navigation channel maintenance dredging from May through October, and anticipates Project maintenance dredging to occur during May 1 to October 31 annually. Future berth maintenance dredging will occur within timing window of November 1-February 28.

2.2.3 Construction and Maintenance Disposal Activities

Dredged materials from Project construction and maintenance will be disposed of in upland, flowlane, shoreline, mitigation sites, ecosystem restoration features, and one ocean disposal location. Most of the Project's dredged material would be disposed of on upland locations. All dredged materials destined for flowlane, shoreline, and ocean disposal will not exceed thresholds for sediment composition and quality, as identified in the Corps' and Environmental Protection Agency's Dredged Materials Evaluation Framework (DMEF).The following list shows the various disposal options and volumes of dredged material that could potentially be placed. Following the Corps' public process on the supplemental integrated feasibility report/EIS, the disposal plan will be finalized. Disposal options and the associated material volume for the first 20 years include:

- 29 upland locations covering 1,755 acres (71 mcy)
- ocean (16 mcy - the proposed Lois Island and Miller/Pillar ecosystem restoration actions may use dredged materials scheduled for ocean disposal, and would significantly reduce the total ocean disposal volume [L. Hicks, pers. comm.]);
- flowlane (23 mcy);
- shoreline (1 mcy);

- two ecosystem restoration features (15 mcy); and
- one mitigation site (1 mcy)

The following methods, and associated BMPs, will be used for dredged material disposal (Table 2.2). These BMPs will apply to Project disposal actions to avoid or minimize impacts to coastal cutthroat trout and bull trout. Material disposal BMPs will remain in effect throughout the Project, or until new information becomes available that would warrant change (see Section 2.2.6 below).

Table 2.2. Disposal Methods, Descriptions, and Associated Best Management Practices.

Disposal Method	Description (also refer to BA)	Best Management Practices
Upland	Materials pumped via slurry pipeline or hauled to upland site. Materials permanently held at upland site via earthen dikes. Any shoreline site associated with upland disposal will be restored. Existing upland disposal sites may not have habitat buffer; all new sites will have 300 foot habitat buffer.	-Upland sites bermed to maximize settling of fine materials. -New upland sites located a minimum of 300 feet from shoreline or other aquatic habitat feature. -Riparian vegetation will be protected. -Vegetative restoration will occur.
Flowlane	Either hopper or pipeline methods will use flowlane disposal. Dredged materials will be released into deep water sites within or adjacent to navigation channel.	-Maintain discharge pipe of pipeline dredge at depths greater than 20 feet. -Dispose of material in a manner that prevents in-water mounding.
Shoreline	Pipeline method primarily used for shoreline disposal. A sand and water slurry is pumped onto an existing beach or shoreline landing, and the beach is extended approximately 100-150 feet into and for varying distances along the river channel. Shoreline disposal occurs concurrently with dredging; timing restrictions therefore based on dredging methodology.	-Contour new beach to minimum steepness of 10-15% slope, to prevent fish stranding. -Only highly-erosive, and therefore lower habitat quality, shoreline sites will be used.
Ocean	A single, 200-300 foot deep ocean location, approximately 4.5 miles west of the Columbia River mouth, will be used for ocean disposal. Hopper dredges will release dredged materials in an 11,000 by 17,000 foot area.	-No ESA BMPs. -Dispose of material in accordance with the site monitoring and management plan which calls for a point dump placement of material from the project during construction. The plan is to place any construction material in the southwest corner of the deep water side.

Disposal Method	Description (also refer to BA)	Best Management Practices
In-water fill	In-water fills will be used to create intertidal marsh and flats, shallow sub-tidal habitat at Miller Pillar, Lois Island Embayment and the Martin Island mitigation site.	Historic elevations for tidal marsh and flats and shallow subtidal habitats at these locations will be constructed using clean dredged material.

Project disposal activities will not have any in-water timing restrictions. However, as disposal occurs at the same time as dredging activities, dredged material disposal associated with construction dredging will occur year round whereas disposal associated with maintenance dredging most likely will occur from May through October.

2.2.4 Additional Provisions for Protection of Water Resources

Additional provisions regarding release of trash, garbage, hazardous waste, or other contaminants will be implemented during dredging and disposal activities (Table 2.3).

Table 2.3. Additional Provisions for Protection of Water Resources

General Measure	Action
The contractor shall not release any trash, garbage, oil, grease, chemicals, or other contaminants into the waterway.	-If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. -Contaminated ground shall be excavated and removed and the area restored as directed. -Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.
The contractor, where possible, will use or propose for use, materials that may be considered environmentally-friendly in that waste from such materials is not regulated as a hazardous waste or is not considered harmful to the environment. If hazardous wastes are generated, disposal of this material shall be done in accordance with 40 CFR parts 260-272 and 49 CFR parts 100-177.	-If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. -Contaminated ground shall be excavated and removed and the area restored as directed. -Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.

2.2.5 Locations for Construction and Maintenance Dredging and Dredged Material Disposal

Construction and maintenance dredging and dredged material disposal locations are identified by river reach (Table 2.4). Dredged material removed from a reach of the river could be disposed in a location in a different reach of the river. The table is only intended to display the dredging location and disposal location within a given reach, not to infer material movement from a location to a location. Unrestrained open water (flow lane) disposal of suitable dredged materials may occur anywhere in or immediately adjacent to the navigation channel, and at any time in the Project area, RM 3-106.5.

Table 2.4. Proposed Dredging Locations, Disposal Locations, and Types of Disposal

River Reach	Dredge Locations	Disposal Locations, Type (U=upland, F=flowlane, S=shoreline, I=in-water)
Reach 1 RM 98-106.5	Lower Vancouver Bar (RM 101.3-104.6) Morgan Bar (RM 97.8-101.3) Vancouver Turning Basin (RM 105.5) Terminal 6 Berths (3 berths) (RM 100-101) United Harvest Berth (RM 105.2)	West Hayden Island (RM 105.0) **U** Gateway 3 (RM 101.0) **U** Entire Reach **F**
Reach 2 RM 84-98	Willow Bar (RM 93-9-97.8) Henrici Bar (RM 90.4-94.9) Warrior Rock Bar (RM 87.3-90.4) St. Helens Bar (RM 83.3-87.3)	Fazio Sand & Gravel (RM 96.9) **U** Adjacent Fazio (RM 96.9) **U** Lonestar (RM 91.5) **U** Railroad Corridor (RM 87.8) **U** Austin Point (RM 86.5) **U** Sand Island (RM 86.2) **S** Entire Reach **F**
Reach 3 RM 70-84	Upper Martin Island Bar (RM 80.3-83.8) Lower Martin Island Bar (RM 76.5-80.3) Kalama Ranges (RM 72.8-76.5) Upper Dobelbower Bar (RM 69.9-72.8) Kalama Export Grain Berth (RM 73.4) Port of Kalama Berth (RM 77.1) Kalama Turning Basin (RM 73.5)	Reichold (RM 82.6) **U** Martin Bar (RM 82.0) **U** Martin Island Lagoon (RM 80) **I** Lower Deer Island (RM 77.0) **U** Sandy Island (RM 75.8) **U** Northport (RM 71.9) **U** Cottonwood Island (RM 70.1) **U** Entire Reach **F**
Reach 4 RM 56-70	Lower Dobelbower Bar (RM 67.1-69.9) Slaughters Bar (RM 63.2-67.1) Walker Island Reach (RM 59.4-63.2) Stella-Fisher Bar (RM 55.6-59.4) U.S. Gypsum Berth (RM 65.7)	Howard Island (RM 68.7) **U** International (RM 67.5) **U** Rainier Beach (RM 67.0) **U** Rainier Industrial (RM 64.8) **U** Lord Island (RM 63.5) **U** Reynolds Aluminum (RM 63.5) **U** Mt. Solo (RM 63.5) **U** Hump Island (RM 59.7) **U** Crims Island (RM 57.0) **U** Entire Reach **F**
Reach 5 RM 40-56	Gull Island Bar (RM 51.9-55.6) Eureka Bar (RM 48.2-51.9) Westport Bar (RM 44.5-48.2) Wauna and Driscoll Ranges (RM 40.8-44.5)	Port Westward (RM 54.0) **U** Brown Island (RM 46.3) **U** Puget Island (RM 44.0) **U** James River (RM 42.9) **U** Entire Reach **F**

River Reach	Dredge Locations	Disposal Locations, Type (U=upland, F=flowlane, S=shoreline, I=in-water)
Reach 6 RM 29-40	Puget Island Bar (RM 36.6-40.8) Skamokawa Bar (RM 32.6-36.6) Brookfield-Welch Island Bar (RM 28.8-32.6)	Tenasillahe Island (RM 38.3) **U** Welch Island (RM 34.0) **U** Skamokawa (RM 33.4) **S** Entire Reach **F**
Reach 7 RM 3-29	Pillar Rock Ranges (RM 25.2-28.8) Miller Sands Channel (RM 21.4-25.2) Tongue Point Crossing (RM 17.5-21.4) Upper Sands (RM 13.6-17.5) Flavel Bar (RM 10.0-13.6) Upper Desdemona Shoal (RM 4.4-10.0) Lower Desdemona Shoal (RM 3.0-4.4) Astoria Turning Basin (RM 13)	Pillar Rock Island (RM 27.2) **U** Miller Sands (RM 23.5) **S** Rice Island (RM 21.0) **U** Entire Reach **F**
River Mouth RM 3-ocean	None	"Point dump" placement within southwest corner of deep water ocean site

2.2.6 Monitoring Program and Adaptive Management Process

As part of the Project, the Corps will implement a Monitoring Program. Monitoring actions were identified during the BRT's review and analysis of Project-related, short- and long-term, direct and indirect effects; discussions of relative risk of Project effects; and the certainty surrounding data used to determine risk. These monitoring activities will gather information to monitor and evaluate predicted effects to coastal cutthroat trout and bull trout, validate assumptions used in the aquatic species BA's effects analysis, and reduce overall risk and uncertainty associated with implementation of the Project's actions.

Table 2.5 provides a brief overview of the proposed Monitoring Program. The entire description of the Monitoring Program (see Chapter 7, Table 7-3 of the aquatic species BA) is incorporated by reference into these Service Opinions. Compliance monitoring will also occur during dredging and disposal activities for both construction and maintenance periods. Compliance monitoring was previously described in Construction and Maintenance Dredging section, above.

For this Project, the Corps will use the 1998 regional DMEF protocols governing testing and evaluation of sediment to be dredged. The DMEF establishes minimum guidelines for testing and evaluation. The DMEF guidelines require the use of available sediment and contaminants information to make a preliminary determination concerning the need for testing of material proposed for dredging. Where available information suggests additional testing is required,

sediments will be collected and analyzed prior to dredging and disposal. Otherwise, DMEF minimum sampling guidelines require a periodic testing of sediments for long term activities.

Table 2.5. Key Components of Monitoring Program

Monitoring Task	NMFS and Services' Concerns	Data Analysis	Duration	Management Trigger Points
MA-1: Maintain three hydraulic monitoring stations: One downstream of Astoria, one in Grays Bay, and one in Cathlamet Bay. Parameters measured would include salinity, water surface elevation, and water temperature.	Long-term physical parameter changes related to Project.	An analysis would be conducted to determine pre- and post-project relationships among flow, tide, salinity, water surface, and temperature.	7 years: 2 years before, 2 years during, and 3 years after construction.	Post-project monitoring data exceeds defined threshold values (to be developed by adaptive management team).
MA-2: Monitor annual dredging volumes; both from construction and O&M activities.	Dredging volumes may be larger than predicted.	Actual volumes will be compared to predicted.	Life of the project.	Actual dredging volumes exceed capacity of the disposal plan.
MA-3: Conduct main channel bathymetric surveys throughout Project area.	Side-slope adjustments may occur in other locations, and within sensitive aquatic habitats, than predicted.	Bathymetric changes will be tracked to determine if habitat is altered.	7 years: 2 years before, 2 years during, and 3 years after construction	Salmonid habitat alteration adjacent to navigation channel due to side-slope adjustment.
MA-4: Repeat estuary habitat surveys being conducted by NMFS.	Long term macro- and micro-habitat changes related to Project	Habitat mapping from aerial photos and ground surveys.	One time survey conducted 3 years after completion of the deepening.	Changes to individual habitat types that are based on defined threshold values. Determine need for other surveys.

Monitoring Task	NMFS and Services' Concerns	Data Analysis	Duration	Management Trigger Points
MA-5: The Corps, NMFS, and Service will annually review any new sediment chemistry from the lower Columbia River and estuary from sources such as the SEDQUAL database and known permit applications. These agencies will determine if these data exceed DMEF or NMFS contaminants guidelines for salmonid protection. If problems are found, additional sediment and contaminant sampling would be initiated in accordance with the DMEF manual. In addition, the Corps, NMFS, and Service will meet as new circumstances arise to review new data that indicates a changed condition that would trigger the need for additional sediment testing. Changed conditions include events such as spills, new listing of chemicals, changes in guidelines or threshold values, or any other indicator that suggests there is a reason to believe further testing may be required.	Ensure that channel construction and maintenance does not disturb undetected deposits of fine-grained material, potentially causing redistribution of contaminants that could pose a risk to salmon and trout.	New Corps sediment data, collected in response to the annual MA-5 monitoring action, will be reviewed in accordance with the DMEF manual and will be compared to the NMFS contaminants guidelines for the protection of salmon and trout.	Two years before construction, two years during construction, and annually during maintenance activities.	Any exceedance of NMFS or DMEF guidelines will be reported to the Adaptive Management Team to determine if consultation should be reinitiated.

Monitoring Task	NMFS and Services' Concerns	Data Analysis	Duration	Management Trigger Points
MA-6: Monitor the incidence of stranding of juvenile salmonids on beaches in action area. Field surveys will be made monthly at selected beaches (upper, mid, and lower river) during the April-August out-migration to measure the number of fish being stranded along beaches.	Concern that disposal sites and ship traffic may allow for juvenile salmonid stranding.	Compare pre- and post-project stranding counts.	One year before deepening and 1 year after deepening.	If there is an increase in the number of fish stranded, proposals would be developed and presented to adaptive management team.

The Corps' analysis of available lower Columbia River and estuary information revealed few samples with fine materials and no samples with contaminant concentrations that exceed the regional DMEF guidelines or NMFS guidelines protective of listed salmon and trout. The Corps will test channel sediments in accordance with the DMEF guidelines, at a minimum of every 10 years in the main channel for sandy areas, every seven years for fine grained areas with no history of contamination at all, and every seven years where there is reason to believe contaminants may be present (Table 2.6). As noted in the aquatic species BA Table 7-3, Monitoring Action MA 5, all information collected during these sediment and contaminant reviews will be reported to the adaptive management team.

Table 2.6. Sediment Testing Locations and Frequency Minimums

Dredging Location	**Frequency of Sampling (Yrs)**
Main Channel RM 3-106.5	10
Turning Basins	
Astoria Turning Basin (RM 13)	7
Kalama Turning Basin (RM 73.5)	10
Vancouver Turning Basin (RM 105.5)	10
Berths	
United Harvest at Port of Vancouver (RM 104.2)	10
Harvest States at Port of Kalama (RM 77.1)	10

Peavy Grain at Port of Kalama (RM 73.4)	10
Terminal 6 at Port of Portland	7
U.S. Gypsum at Port of Rainier (RM 65.3)	10

The Corps also proposed an Adaptive Management Process. The aquatic species BA (section 9.4) indicates: "Actions associated with dredging and disposal, and ecosystem restoration and research will be coordinated through the Adaptive Management Process to ensure that the Project will not jeopardize listed or proposed species or destroy or adversely modify their critical habitat". The proposed Adaptive Management Process involves review and management response to two types of Project monitoring data: Constant monitoring of Project effects during construction and maintenance activities (compliance monitoring), and annual review of monitoring data or other new information. In addition to annual review, any adverse finding from compliance monitoring would be addressed immediately by the adaptive management team. The proposed adaptive management review and response will ensure unanticipated Project effects are rapidly identified and effectively addressed. Finally, adaptive management will be used to evaluate whether the Project's environmental protection objectives are being met, and to ensure construction and/or maintenance actions are adjusted accordingly.

The Corps' proposed Adaptive Management Process requires establishment of an identified scope including goals, milestones for completion, check-in points, triggers for management changes (i.e., management decision points that include specific metrics), and sampling/testing protocols. The Corps, working with the Services, will further refine and develop goals and scope of the Adaptive Management Process. However, the following specific adaptive management actions are identified in the aquatic species BA (section 9.0):

- An adaptive management team, comprised of representatives from NMFS, Service, Corps, and sponsor Ports, will annually review results of Project compliance measures, monitoring, research, and restoration actions. On an annual basis the adaptive management team will determine:

    - if the Project is in compliance with these Service opinions,
    - if adverse Project effects have been found
    - if any modification to the Project's compliance, monitoring, research, and restoration actions are warranted

- If an unanticipated effect is identified, the adaptive management team will determine whether: (1) the Project should continue; (2) construction or maintenance should be altered; (3) additional ecosystem restoration should be completed; (4) construction or maintenance should be stopped until more data is collected; or (5) the construction activities should be halted.

The Corps will be responsible for determining how to implement the adaptive management team decisions on addressing adverse Project effects. Annual reviews by the adaptive management team will occur for the duration of monitoring actions proposed in the aquatic species BA. The adaptive management team shall make all monitoring and research data available for public review.

2.2.7 Ecosystem Restoration and Research Actions

The Corps has incorporated ecosystem restoration and research actions into the proposed action to assist with the recovery of coastal cutthroat trout and bull trout habitats, and to further our understanding of lower Columbia River and estuary ecosystem functions and processes. These actions are not proposed to directly mitigate or compensate for any Project-related impacts to coastal cutthroat trout and bull trout. The research and restoration components of the overall ecosystem restoration and research action are proposed as Conservation Measures under Section 7(a)(1) of the Act and have been included into the proposed action by the Corps. These actions are the Corps' commitment to fulfill their affirmative responsibility to assist with conservation and recovery of proposed and listed species, including coastal cutthroat trout and bull trout. These actions include those ecosystem restoration actions previously authorized under Section 101(b)(13) of the Water Resource Development Act of 1999, and additional ecosystem restoration actions developed during the reinitiation of consultation and BRT discussions.

2.2.7.1 Ecosystem Restoration Activities

As part of the Project's dual purpose and need, the Corps has proposed a total of 10 ecosystem restoration actions (Table 2.7). These projects are designed to create or improve salmonid habitat, specifically tidal marsh, swamp, and shallow water and flats habitat, and to improve fish access to these habitat features. In addition, one of the ecosystem restoration actions proposes to restore habitat and reintroduce Columbian white-tailed deer onto Cottonwood/Howard islands. The aquatic species BA (see Chapter 8 of these Service Opinions) provides a detailed description of these restoration activities. Those descriptions are incorporated herein by reference. All ecosystem restoration activities, except for the long-term Tenasillahe Island restoration feature, will be initiated during the Project construction period.

Table 2.7. Proposed Ecosystem Restoration Activities

Action	Purpose	Protective Measures	Monitoring
Lois Island Embayment Habitat Restoration	Restoration of 389 acres of estuarine, intertidal marsh habitat and shallow subtidal flats habitat	-Use of deep water sediment storage location without in-water work window -In-water work window for material placement at Lois Island restoration feature	Post-construction benthic productivity and fish species composition and density on restoration and adjacent control sites
Purple Loosestrife Control Program	Implement an Integrated Pest Management Plan for purple loosestrife in the estuary, RM 18-52	-Only an EPA-approved over-water herbicide will be used -Application via methods that minimize herbicide contact with water	Annual and final reports describing results of control efforts
Miller/Pillar Habitat Restoration	Re-establish 170 acres of shallow water and flats habitats	-Place dredged materials in a fashion to minimize fish and prey smothering -Bird excluders placed on pile dikes	Post-construction benthic productivity and fish species composition and density on restoration and adjacent control sites
Tenasillahe Island Interim Restoration (Tidegate and Inlet Improvements)	Improve fish passage and water circulation between sloughs and the river	-Contingent upon hydraulic analysis that ensure new features will protect Columbian white-tailed deer -August-September in-water work window	Post-construction benthic productivity and fish species composition and density on restoration and adjacent control sites, annual reporting
Tenasillahe Island Long-Term Restorations (Dike Breach)	Long-term restoration of historical habitat features, including	-Upon Columbian white-tailed deer delisting -Must be compatible with Refuge purposes and goals -No protective measures proposed	Post-construction benthic productivity and fish species composition and density on restoration and adjacent control sites, annual reporting
Cottonwood/Howard Island Proposal Columbian White-tailed Deer Introduction	Secure habitat and reintroduce Columbian white-tailed deer	-None proposed	Monitoring to assess success of translocation, and annual reports

Action	Purpose	Protective Measures	Monitoring
Bachelor Slough Enhancement	Restore aquatic and riparian habitat resources	-Inwater dredging window -Dredge and disposal plan to be developed -Sediment chemistry test to be conducted	Monitor fish use of Bachelor Slough for 5 years, and annual and final reports
Shillapoo Lake Restoration	Creation of interior wetland cells for waterfowl and other wildlife species	None proposed	None proposed
Columbia River Tidegate Retrofits	Improve fish passage at Columbia River and tributary tidegates	-Late summer installation -Short duration construction events	None proposed
Walker-Lord and Hump-Fisher Islands Improved Embayment Circulation	Dredge connecting channels between islands to increase water circulation	-Late summer installation -Minimal turbidity anticipated	None proposed
Martin Island Embayment[1]	Development of 32 acres of tidal marsh habitat.	-Utilize sand as fill material to minimize Project-related turbidity -Contain all turbidity within project area	None proposed

[1] The Martin Island embayment feature is a mitigation requirement from the 1999 FEIS. This action was designed to mitigate for upland disposal impacts. The Corps has requested consultation on this action, as construction of this beneficial feature could have impacts to ESA-listed salmonids

2.2.7.2 Ecosystem Research Activities

Ecosystem research actions are conservation measures proposed by the Corps as part of the proposed action to assist the efforts of the Corps, NMFS, Service, and others in the broader understanding the of Lower Columbia River ecosystem, and assist with the recovery of coastal cutthroat trout and bull trout (Table 2.8). The aquatic species BA (see Chapter 8, Table 8-1) provides a tabular description of these research actions, and is incorporated herein by reference. These research actions were negotiated and designed by the BRT to provide useful information to the recovery of the coastal cutthroat trout and bull trout. The proposed research activities also address specific ecosystem conceptual model indicators that are believed to be improperly functioning.

Table 2.8. Proposed Ecosystem Research Actions

Research Task	Justification	Duration	Data Analysis
Add two additional transects in different habitat types similar to those being done for the NMFS studies currently under way with annual fish evaluation process.	Provide additional habitat and salmonid distribution information for the estuary. Useful in establishing inventory information for future monitoring or restoration.	Begin before construction and for 3 years after completion of the Project construction phase.	Record value and use of different habitat types for juvenile salmonids and cutthroat trout.
Evaluate cutthroat trout use of the estuary and river areas.	Little is known about the species use of this habitat. Research to provide additional information regarding coastal cutthroat trout use of this habitat.	Conduct study for 2 years before construction and 2 years during construction.	Record value and use of different habitat types by cutthroat trout.
Conduct bank-to-bank hydrographic surveys of the estuary.	Has not been done in 20 years and is needed to assess available habitat and restoration actions.	Once, prior to construction.	Bathymetry will be available for shallow water areas in the estuary.
In conjunction with ongoing studies of juvenile salmonids habitat utilization in the Lower Columbia River, collect and analyze juvenile salmonids and their prey for concentrations of chemical contaminants.	Provide additional data on contaminants in listed salmonids and their prey. Useful in establishing inventory information for future monitoring or restoration.	Begin before Project construction and for 3 years after construction phase, depending on the results.	Record concentrations of persistent contaminants (e.g., DDTs, PCBs, PAHs, dioxin-like compounds) in juvenile salmonids and prey.
In conjunction with above contaminant study, assess sublethal effects of contaminants (e.g., growth, disease resistant) on salmonids.	Provide additional data for established contaminants thresholds effect levels to ensure that guidelines are Protective of salmonids; to better characterize performance of juvenile salmonids in the estuary.	Begin before construction and for 3 years after construction phase, depending on the results.	Record health status of juvenile salmonids collected above.
Estuarine Turbidity Maximum (ETM) workshop.	To further the knowledge of the ETM and the listed stocks.	Once.	Not required.

3.0 STATUS OF THE SPECIES

The terrestrial species opinion reviewed the rangewide status of bald eagle and Columbian white-tailed deer, and this information is incorporated herein by reference. No additional rangewide

status information for bald eagle or Columbia white-tailed deer is provided herein. However, updated site-specific information on bald eagle and Columbian white-tailed deer within the Project area is provided in the Environmental Baseline section, below. The following is a discussion of coastal cutthroat trout and bull trout status within their respective DPS areas.

3.1 Southwestern Washington/Columbia River Coastal Cutthroat Trout

3.1.1 Overview

A Status Review of coastal cutthroat trout from Washington, Oregon, and California was conducted by NMFS (Johnson et al. 1999). The status review determined there were six Evolutionary Significant Units (ESUs, the NMFS' equivalent to the Service's DPS) of coastal cutthroat trout along the coast of Washington, Oregon, and California. On April 5, 1999, the Services jointly proposed to list the anadromous form of coastal cutthroat trout as threatened in Southwestern Washington and the Columbia River, excluding the Willamette River above Willamette Falls (65 FR 16397). The proposal for listing was based upon perceived widespread decline in abundance and the small population sizes of anadromous coastal cutthroat trout throughout the lower Columbia River and southwestern Washington, and modifications to riverine and estuarine habitats. In April of 2000, the one-year listing deadline was extended by six months to obtain and review new information needed to resolve substantial scientific concerns about the status of the DPS, including information on above-barrier populations and influences of hatchery management (65 FR 20123). In 2000, the Service assumed sole jurisdiction over all extant subspecies of coastal cutthroat trout (65 FR 21376). Under a national settlement agreement, the Service has agreed to determine, by June 23, 2002, whether to list the Southwestern Washington/Columbia River Coastal Cutthroat Trout DPS.

The aquatic species BA, Appendix D, provides an excellent overview of anadromous coastal cutthroat trout biology and ecology; these descriptions are incorporated herein by reference. The following is a brief overview of coastal cutthroat trout biology and ecology.

Coastal cutthroat trout occupy a wide range of habitat types and display a diverse range of life history strategies, perhaps making them one of the more locally adapted species of the salmonid family (64 FR 16397). Their life history is complex, with considerable variation within and among populations. Life history strategies include fish with limited spawning and foraging migrations (resident form), fish that undertake longer-distance spawning and foraging migrations strictly within freshwater (freshwater migratory form), and those that undertake spawning and foraging migrations between freshwater and saltwater (saltwater migratory or anadromous form). Various life history forms frequently occur in the same streams (Johnson et al. 1999). There is

also evidence that life history patterns can change within individual fish over time (Johnson et al. 1999). This diversity in life histories exhibited by coastal cutthroat trout may reflect an adaptive strategy, allowing coastal cutthroat trout to exploit habitats not fully utilized by other salmonid species (Johnson et al.1999). Within the Southwestern Washington/Columbia River DPS, all three forms of coastal cutthroat trout have been identified.

Resident coastal cutthroat trout typically inhabit small streams, often in headwater areas. These non-migratory fish typically live their entire life within a small reach of stream, but may undertake local movements and migrations. These fish normally do not grow to more than 150mm to 200mm and seldom live more than three years (Trotter 1989). Resident forms may occur throughout a river basin, but generally are more prevalent in upstream locations.

Freshwater-migratory coastal cutthroat trout perform movement and migrations within freshwater only. Several migration strategies have been observed: populations that migrate from large streams to smaller ones to spawn (fluvial); fish that reside in lakes the majority of the time but migrate upstream to spawn (adfluvial); and fish that live in lakes the majority of the time but migrate downstream to spawn in the lake outlet (lacustrine) (Johnson et al. 1999).

Anadromous coastal cutthroat trout undertake migrations from freshwater natal areas to estuary and marine waters and back to freshwater areas. Generally, the period of saltwater residence is of shorter duration for coastal cutthroat trout than other anadromous salmonids, and it is believed that coastal cutthroat trout do not overwinter in the ocean (Trotter 1997).

The majority of available information on coastal cutthroat trout pertains to the anadromous life history form. There is limited information about the distribution, abundance, or status of resident forms of coastal cutthroat trout in this DPS, and almost no information about relative abundances or status of freshwater migratory forms. Because the Project is proposed in locations where the anadromous form of coastal cutthroat trout is known to occur, the following information pertains to the anadromous form of coastal cutthroat trout.

3.1.2 Status and Distribution

Anadromous coastal cutthroat trout numbers have declined in some portions of their range in recent years. Coastal cutthroat trout are widely distributed throughout the fresh and near shore marine waters of the Pacific Northwest. The distribution of coastal cutthroat trout is broader than any other cutthroat trout subspecies (Johnson et al. 1999). Anadromous forms range from the Eel River in northern California to the Kenai Peninsula in Alaska, and generally less than 90 km inland. However, some populations may occur inland up to 160 km (Johnson et al. 1999). In

portions of Washington, Oregon, and California, the Cascade Mountains appear to limit the species' inland distribution.

3.1.3 Early Life History

Cutthroat eggs require approximately 300 Fahrenheit temperature units (generally 6-7 weeks) during incubation until hatching, and an additional 150 to 200 temperature units for emergence to occur (Stolz and Schnell 1991). Newly-emerged cutthroat trout are very small (<2.5 cm Total Length [TL]). Peak emergence is generally mid-April, but may range from March through June (Trotter 1997). At emergence, coastal cutthroat trout fry quickly migrate to channel margins and backwaters, where they remain throughout the summer. Upon leaving lateral habitats, juvenile coastal cutthroat trout use a variety of stream or riverine habitats. Juvenile coastal cutthroat trout may rear for two or more years in freshwater, seeking pools and other slow water habitats with root wads and large wood for cover (Trotter 1997). Often juvenile coho salmon are present in the same habitat, and the larger coho salmon will drive the cutthroat into riffles, where cutthroat will remain until fall and winter (Sabo 1995). Overwinter habitat includes pools near undercut banks or large woody debris (Bustard and Narver 1975). Juvenile coastal cutthroat trout are opportunistic feeders, taking advantage of whatever prey is available, with aquatic insects as the most available, and therefore most dominant, prey item consumed (Trotter 1997).

3.1.4 Migration

Seaward migration of coastal cutthroat trout ranges from March to July, and peaks in mid-May (Trotter 1997). Average fish length at this time was found to be 150 mm TL (Johnston 1979). Within river systems that empty into sheltered ocean environments, coastal cutthroat trout generally smolt at age 2 (Trotter 1989). Non-hatchery Columbia River coastal cutthroat trout populations commonly smolt at age 2 or 3, even though the river enters a non-sheltered ocean environment (Loch and Miller 1988), whereas those of hatchery origin generally smolted at age 1. Populations that migrate into unsheltered coastal areas generally smolt at older ages and larger sizes. However, smolting in anadromous forms may occur any time between 1 and 5 years (Trotter 1989).

The amount of time spent in salt water varies between populations, ranging from 2 to 9 months (Thorpe 1994). In most populations, coastal cutthroat trout remain within a few kilometers of the coast, migrate no more than 70 km from their home stream, and do not cross large bodies of open water (Trotter 1997). However, in a few situations where riverine influence occurs well into offshore ocean areas, notably the Columbia River plume, coastal cutthroat trout may migrate more than 50 km from the coast. While in the ocean, coastal cutthroat trout are opportunistic

feeders on a variety of fish and invertebrate prey items (Trotter 1997). Growth while in saltwater is often rapid, with growth rates of 25 mm per month reported from fish occupying the Columbia River plume (Pearcy et al. 1990).

The timing of return migration to fresh water varies by population. Populations with appreciable estuaries generally have relatively early returning fish (July to October), whereas streams draining directly into the ocean have late returning populations (mid-winter)(Trotter 1997). Nearly all anadromous coastal cutthroat trout overwinter in freshwater, after feeding in marine or brackish water (Trotter 1997). Trotter (1997) speculated that important overwinter habitat is comprised of deep pools with associated cover. Not all coastal cutthroat trout spawn upon returning to fresh water.

3.1.5 Spawning

The spawning period for anadromous cutthroat trout ranges from December to June, with peak activity in February (Trotter 1989). Coastal cutthroat trout spawn in small coastal streams, and tributaries within small and large watersheds (Trotter 1997); spawning streams generally have summer low flows averaging 0.1 m^3/sec, and do not exceed 0.3 m^3/sec. Use of small streams for spawning appears to be an adaptation to isolate their nursery/rearing ground from other, more competitive, species such as steelhead trout (Stolz and Schnell 1991). However, overlap with steelhead trout and coho salmon spawning areas may occur (Johnson et al. 1999). The preferred spawning substrate is pea to walnut sized gravel, in water depth of 15-45 cm, with pools nearby for escape cover. Actual spawning may extend over a period of 2 to 3 days (Trotter 1997).

Anadromous coastal cutthroat trout may be repeat (iteroparous) spawners. Some fish have been documented to spawn each year for at least five years, although some do not spawn every year and some do not return to seawater after spawning but instead remain in fresh water for at least a year. Anadromous coastal cutthroat trout may live to an age of 7 or 8 years, spawning three, four, or even as many as five times during their life (Trotter 1997).

3.2 Columbia River Bull Trout

3.2.1 Overview

The aquatics species BA, Appendix D, provides an overview of bull trout biology and ecology; these descriptions are incorporated herein by reference. The following is a brief overview of bull trout in the Columbia River DPS.

Bull trout are char native to the Pacific Northwest and western Canada. Bull trout are relatively dispersed throughout tributaries of the Columbia River Basin, including its headwaters in Montana and Canada. The Columbia River DPS includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin and currently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997). The Columbia River DPS comprises 141 bull trout subpopulations in four geographic areas of the Columbia River basin. The Project is located within the lower Columbia River geographic area, which includes all tributaries in Oregon and Washington downstream of the Snake River confluence near the town of Pasco, Washington.

The current distribution of bull trout in the lower Columbia River Basin is less than the historical range (Buchanan et al. 1997). Bull trout are thought to have been extirpated from several tributaries in five river systems in Oregon: the Middle Fork Willamette River, the North and South Forks of the Santiam River, the Clackamas River, the upper Deschutes River (upstream of Bend, Oregon), and the Crooked River (tributary to the Deschutes River) (Buchanan et al. 1997). Hydroelectric facilities and large expanses of unsuitable, fragmented habitat have isolated these subpopulations. Large dams, such as McNary, John Day, The Dalles, and Bonneville, separate four reaches of the lower Columbia River. Although bull trout may pass each facility in both upstream and downstream directions, the extent to which bull trout use the Columbia River is unknown. In addition, the nine major tributaries have numerous water storage facilities, many of which do not provide upstream passage.

4.0 ENVIRONMENTAL BASELINE

The aquatic species BA provides an extensive description of historic and current habitat conditions in the Columbia River and estuary (Chapter 2), a description of the complex processes and functions that occur in these riverine and estuarine habitats (Chapter 4), and discussions of coastal cutthroat trout and bull trout within these riverine and estuarine habitats (BA pages 4-10

to 4-12, and Appendix pages D1-7 to D1-10, D2-1 to D2-26, and D3-1 to D3-62); these descriptions are incorporated herein by reference.

The Environmental Baseline section, below, is presented in four sub-sections. The first sub-section (4.1 Lower Columbia River and Estuary Conditions) provides an overview of the current environmental conditions in the Colombia River and estuary. The second sub-section (4.2 Coastal Cutthroat Trout and Bull Trout in the Lower Columbia River and Estuary) reviews current information on coastal cutthroat trout and bull trout in the lower Columbia River and estuary, and discusses the importance of the Columbia River and its estuary's physical processes and resultant habitats to coastal cutthroat trout and bull trout. The third sub-section (4.3 Description of Lower Columbia River and Estuary Baseline Conditions Using a Conceptual Ecosystem Model) presents a framework for describing the complex river and estuary ecosystem processes and functions; how the Project may influence these important ecosystem processes and functions is the foundation for analysis of potential Project effects (presented in 5.0 Effects of Action section, below). The fourth sub-section (4.4 Updated Environmental Baseline Information for Columbian White-tailed Deer and Bald Eagle) updates the Service's terrestrial species opinion with new information on bald eagle and Columbian white-tailed deer in the Project area. Unless otherwise cited, the following information is extracted from the aquatic species BA.

4.1 Lower Columbia River and Estuary Conditions

The Columbia River is naturally a very dynamic system. It has been affected and shaped over eons by a variety of natural forces, including volcanic activity, storms, floods, natural events, and climatological changes. These forces had and continue to have a significant influence on biological factors (e.g., flow), habitat, inhabitants, and the whole riverine and estuarine environment of the Columbia River.

Over the past century, human activities have dampened the range of physical forces in the action area and resulted in extensive changes in the lower Columbia River and estuary. Effects that have been particularly large have occurred through changes to flow hydrographs, isolation of the floodplain, and diking and filling of wetland areas. The Columbia River estuary has lost approximately 43% of its historic tidal marsh (from 16,180 to 9,200 acres) and 77% of historic tidal swamp habitats (from 32,020 to 6,950 acres) between 1870 and 1970 (Thomas 1983). Within the lower Columbia River, diking, river training devices (pile dikes and rip rap), railroads, and highways have narrowed and confined the river to its present location. Between the Willamette River and the mouth of the Columbia River, diking, flow regulation, and other human activities have resulted in a confinement of 84,000 acres of flood plain that likely contained large amounts of tidal marsh and swamp. The lower Columbia River's remaining tidal marsh and

swamp habitats are located in a narrow band along the Columbia River and tributaries' banks and around undeveloped islands.

Since the late 1800s, the Corps has been responsible for maintaining navigation safety on the Columbia River. During that time, the Corps has taken many actions to improve and maintain the navigation channel. The channel has been dredged periodically to make it deeper and wider, as well as annually for maintenance. To improve navigation and reduce maintenance dredging, the navigation channel has also been realigned and hydraulic control structures, such as in-water fills, channel constrictions, and pile dikes, have been built. Most of the present-day dike system was built in the periods 1917-23 and 1933-39, with an additional 35 pile dikes constructed between 1957 and 1967. The existing navigation channel dike system consists of 256 dikes, totaling 240,000 linear feet. Ogden Beeman and Associates (1985) termed these Corps activities "river regulation", and noted that navigation channel maintenance activities, for a 100 year period prior to their 1985 report, required closing of river side channels, realigning river banks, removing rock sills, stabilizing river banks, and placement of river "training" features. Most of these baseline river training features and habitat alterations were constructed or occurred before any of the currently-listed aquatic species were placed on the Act's list of endangered and threatened species.

Another very significant change to the Lower Columbia River system has been the reduction of the peak seasonal discharges and changes in the velocity and timing of flows as a result of water storage by Columbia River basin reservoirs. For instance, flow regulation that began in the 1970s has reduced the 2-year flood peak discharge, as measured at The Dalles, Oregon, from 580,000 cfs to 360,000 cfs (Corps 1999).

These aforementioned physical changes also affect other factors in the riverine and estuarine environment. Tides raise and lower river levels at least 4 feet and up to 12 feet twice every day. The historical range for tides was probably similar, but seasonal ranges and extremes in tides have certainly changed because of river flow regulation. The salinity level in areas of the estuary can vary from zero to 34 parts per thousand (ppt) depending on tidal intrusion, river flows, and storms. Flow regulation has affected the upstream limit of salinity intrusion. The salinity wedge is believed to have ranged from the river mouth to as far upstream as RM 37.5 in the past. It is now generally believed that the salinity ranges between the mouth and RM 30. The river bed within the navigation channel is composed of a continuously moving series of sand waves that can migrate up to 20 feet per day at flows of 400,000 cfs or greater, and at slower rates at lesser flows. This rate of river discharge is not experienced as often as it was prior to flow regulation in the Columbia River.

4.2 Coastal Cutthroat Trout and Bull Trout in the Lower Columbia River and Estuary

4.2.1 Coastal Cutthroat Trout

Anadromous coastal cutthroat trout are believed to have been historically distributed in Washington tributaries to the Columbia River as far inland as the Klickitat River (Bryant 1949). Currently, distribution of all life forms of coastal cutthroat trout is believed to be limited to streams below Bonneville Dam (Leider 1997); a single above-Bonneville Dam population of coastal cutthroat trout was reported by Mongillo and Hallock (2001). According to Leider (1997), the status of anadromous coastal cutthroat trout populations in lower Columbia River tributaries is relatively depressed as compared to other populations in Washington. Interagency creel census from the lower Columbia River area indicates that anadromous coastal cutthroat trout harvest averaged 4,200 fish annually from the period of 1975 to 1985 and declined to less than 500 fish annually from 1986 to 1995 (Leider 1997). However, this period of declining coastal cutthroat trout harvest was also marked by changes in hatchery management and angling regulations, which may have made coastal cutthroat trout angling less attractive. Recent data from Mongillo and Hallock (2001) indicates that resident coastal cutthroat densities are relatively high throughout the southwestern Washington area. Washington has had an anadromous coastal cutthroat trout smolt stocking program since the 1940's, and currently stocks eight Columbia River tributaries (Leider 1997).

In Oregon, anadromous coastal cutthroat trout are believed to have been historically distributed from the mouth of the Columbia River inland to Fifteenmile Creek, east of the Hood River Basin (Hooton 1997). Historically 20-30 anadromous coastal cutthroat trout entered the hatchery on a tributary to the lower Sandy River, but none have been seen recently, or detected passing upstream of Marmot dam since 1977 (Hooton 1997). Coastal cutthroat trout inhabiting the Bull Run River have been cut-off from migrations due to several impassable dams, although resident and adfluvial coastal cutthroat trout remain abundant above the dams in reservoirs and tributary streams (Hooton 1997). Streams in the Columbia Gorge historically supporting small populations of coastal cutthroat trout include Latourell, Bridal Veil, Multnomah, Oneonta, Horsetail, McCord, Moffett, Tanner, Eagle, and Herman; current status is unknown for these streams (Hooton 1997). Although the Hood River and tributaries once supported both resident and anadromous coastal cutthroat trout, no anadromous cutthroat were collected at the Powerdale Dam fish trap in the early to mid-1990's (Hooton 1997). Previously, trap counts ranged from a high of 177 in 1969, to four in 1992, and two in 1993 (Hooton 1997). A total of 11 anadromous coastal cutthroat trout were collected at Powerdale Dam fish trap in 2001 (P. Connolly, pers. comm.). Within the Fifteenmile Creek basin, coastal cutthroat trout are known to be present in

Fivemile Creek, and suspected to be present in Eightmile Creek, although no information exists on their status and distribution (Hooton 1997). Anadromous coastal cutthroat trout are also present in tributaries to the Lower Willamette River below Willamette Falls. In general, anadromous populations are substantially reduced in abundance from historic levels in lower Willamette River tributaries (Hooton 1997). Anadromous coastal cutthroat trout have not been detected at the North Fork (Clackamas River) Dam since 1958 (Hooton 1997, citing D. Cramer, pers. comm.). Little is known about the status and production of anadromous coastal cutthroat trout in Oregon's lower Columbia River tributaries (Hooton 1997). Oregon has stocked coastal cutthroat trout in tributaries to the Columbia River since at least the 1940's, including most tributaries from Hood River downstream to Lewis and Clark River (Hooton 1997, Johnson et al. 1999). Oregon's anadromous coastal cutthroat trout stocking program in the Columbia River tributaries was terminated in 1994 (Hooton 1997).

Limited information is available about coastal cutthroat trout habitat use and preferences in the mainstem Columbia River or its estuary. Fisheries studies that have been conducted in the estuary and lower river do not clearly define habitat use or preferences of adult or juvenile coastal cutthroat trout. In most studies, coastal cutthroat trout were not the target species and the studies were not designed to sample all available habitats (e.g. Dawley et al. 1985, Bottom et al. 1984). An effort was made to systematically collect and review all available information on coastal cutthroat trout in the Columbia River and estuary. Appendix D of the aquatic species BA provides the summary of this data review effort, and is incorporated herein by reference. The following is a brief review of information on coastal cutthroat trout habitat use and preferences in the Columbia River and estuary, as extracted from Appendix D of the aquatic species BA.

Existing data indicate the lower Columbia River and estuary are used by coastal cutthroat trout for both limited and extensive durations. Available information seems to indicate that, depending upon age, source (wild or hatchery), migratory behavior, and sexual maturity, a variety of coastal cutthroat trout habitat use patterns occur. Based on sampling at Jones Beach from 1977 to 1983, Dawley et al. (1985) reported that coastal cutthroat were in the area March through November, with peak abundance occurring in April through June and in August through September; few fish were present in the winter. Studies of Columbia River tributaries in Washington show that juvenile coastal cutthroat trout migrate downstream from March to June, with peak movement typically occurring in May (Chilcote 1980; Chilcote et al. 1980; Blakely 2000). Additionally, the migration of spawned-out adults (kelts) peaked in May (Dawley et al. 1979 and 1980). However, available information does not clearly indicate whether any of these fish rear for any appreciable time in the upper riverine reach of the Columbia River prior to smolting, or if the riverine portion is used mainly as a migratory corridor. Some cutthroats clearly do not stay in

the river for long, as a large fraction of hatchery origin sea-run cutthroat captured in the Columbia River estuary and ocean plume had reached salt water at age-1 (Loch and Miller 1988; Pearcy et al. 1990). Wild fish captured in the plume had spent at least two winters in freshwater, so they may have reared for a time in the upper riverine reach. Loch (pers. comm.) believes that the upper riverine reach, from about Longview to Jones Beach, may be a transitional zone between river and estuary, where juvenile salmonids feed and complete their adaptation to salt water. Length of stay varies: some do not complete the transition and remain in the river, while others move into the estuary or migrate to sea (ibid.). Out-migrant coastal cutthroat trout often feed for an extended period in this transitional zone, and many hatchery coastal cutthroat trout residualize there (ibid.). This behavior has been well documented at Jones Beach where sampling was extensive (Loch 1982), but data for areas farther upstream are fragmentary and only suggestive. Loch (pers. comm., as cited in aquatic species BA) believes that portions of the upper riverine reach above Longview may be generally less hospitable to juvenile coastal cutthroat trout in terms of food and habitat, and may therefore serve more as a migratory corridor than as a long-term rearing area.

Sport fishery catch records show that adult and immature coastal cutthroat trout returning from the estuary and the ocean are captured in the upper and lower riverine reaches, mainly from Jones Beach to the Cowlitz River, mostly from July through September (Schuck 1980; Melcher and Watts 1995; Melcher and Watts 1996; Trotter 1997). The implication of declining catches after September is that the cutthroat trout have moved to other locations, probably into the tributaries to overwinter and, if mature, to spawn. It is possible that some coastal cutthroat trout may overwinter in the Columbia River or estuary. Lucas (1980) states that immature anadromous coastal cutthroat trout from lower Columbia River tributaries may overwinter in deep tributary pools or in the Columbia River estuary, but no substantiating data were presented. Dawley et al. (1985) collected few coastal cutthroat trout in the lower Columbia River and estuary during the winter, suggesting that few coastal cutthroat trout overwintered in those areas. This conclusion is open to question, however, because sampling was scant during this period and did not include all habitats that coastal cutthroat trout may have used. Smolt-size and larger coastal cutthroat trout overwinter in the lower Fraser River, Canada, within freshwater back-channels (Rempel 2001).

An analysis of NMFS data from the lower river and estuary studies in the late 1960's though the early 1980's suggests several spatial and temporal trends in abundance and size of coastal cutthroat trout in the Columbia River estuary. Coastal cutthroat trout were taken in the shallows (beach seining) of the upper freshwater estuary, and in the main channel (purse seining) throughout the estuary for at least April through September, whereas coastal cutthroat trout were seldom taken in the shallows of the lower two-thirds of the estuary (estuarine mixing and

marine zones) until May or later. Somewhat higher catch rates in the middle and upper estuary suggest that coastal cutthroat trout were more abundant there than in the lower estuary where catch rates tended to be lower. Frequent catches of more than one coastal cutthroat trout per set, when any were caught at all, indicated that occasional schooling occurred. Trends in size of coastal cutthroat trout by time of year and portion of the estuary were not clear.

Based on the above discussion, coastal cutthroat trout potentially utilize the lower Columbia River and estuary for longer periods than any of the other listed Columbia River salmonids. However, while at least limited numbers of coastal cutthroat trout may occur in the lower Columbia River and estuary throughout the year, and in greater numbers during their seaward and freshwater-return migrations, it is not clear which habitats are of the most importance to this species. Coastal cutthroat trout historically occurred in the Project area, and have adapted to the dynamic ocean, estuarine, and riverine conditions that make up the array of anadromous coastal cutthroat trout habitats. These habitats have been created by natural physical and biological processes. Given the limited information on this species, the Service assumes that properly functioning physical and biological processes and conditions, within the ocean, estuary, and river, are necessary to conserve coastal cutthroat trout and its habitats. The third sub-section (Description of Baseline Conditions Using a Conceptual Ecosystem Model) of the Environmental Baseline section introduces a conceptual model of the lower Columbia River and its estuary, and begins to describe the physical processes and habitat responses that characterize the Columbia River and estuary. These physical processes and habitat responses are the same with which coastal cutthroat trout have evolved, the same processes and responses that have been altered for the past 150 years, and are the same processes that will respond to the Proposed Projects construction, maintenance, and ecosystem restoration activities. It is the physical and biological response to any alteration of these natural processes and functions that are most important to analyzing Project-related effects to aquatic species, including coastal cutthroat trout. This analysis of Project-related effects to coastal cutthroat trout, based on analysis of Project impacts to natural physical and biological processes and functions, is presented in the Effects of Action section.

4.2.2 Bull Trout

Bull trout have been occasionally collected in the lower Columbia River near Puget Island (T. Coley, pers. comm., as cited in BA); no published records of bull trout occurrence in the Columbia River estuary have been located. No information is available indicating any holding, feeding, or other extended use of the lower Columbia River and estuary within the Project area by either juvenile or adult anadromous bull trout. Migratory bull trout populations are known to occur in lower Columbia River tributaries, including the Willamette and Lewis Rivers (63 FR 31647), and migratory bull trout are occasionally collected by fisheries workers and anglers below Bonneville Dam in other lower Columbia River tributaries. It is likely that low numbers of bull trout used the lower Columbia River as a migratory corridor between these tributaries.

Bull trout evolved within the dynamic Columbia River Basin, and rely on natural physical and biological processes and functions to complete its life cycle. As with coastal cutthroat trout, it is the physical and biological response to any alteration of these natural processes that are most important to analyzing Project-related effects to bull trout.

4.3 Description of Lower Columbia River and Estuary Baseline Conditions Using a Conceptual Ecosystem Model

4.3.1 Introduction

In discussions of the complex nature of the lower Columbia River (from Bonneville Dam downstream to the upper end of the estuary at RM 40), estuary (RM 40 to RM 3), and river mouth (RM 3 to the deep water disposal site), the SEI science panel identified the need for a consistent framework for understanding the lower Columbia River, estuary, and river mouth ecosystem. A conceptual ecosystem model was subsequently developed, with assistance of the BRT, of the lower Columbia River, estuary, and river mouth ecosystem relationships that are significant for listed and proposed salmonids. The conceptual ecosystem model is a way to show the interactions and relationships within the lower Columbia River, estuary, and river mouth that, when they are operating properly, help to characterize the lower Columbia River, estuary, and river mouth ecosystem as a whole. The aquatic species BA (Chapter 5) and Appendix E provide an extensive presentation and discussion of the conceptual ecosystem model, and describe the historic and current conditions of the lower Columbia River, estuary, and river mouth using the model. These descriptions are incorporated herein by reference.

The basic riverine and estuarine habitat-forming processes—physical forces of the ocean and river—create the conditions that define habitats . The habitat types, in turn, provide an

opportunity for the primary plant production that gives rise to complicated food webs. All of these pathways combine to influence the growth and survival of coastal cutthroat trout and bull trout in the lower Columbia River, estuary, and river mouth. The following is a summarization, based on the conceptual ecosystem model, of the lower Columbia River, estuary, and river mouth's ecosystem components, and how these factors collectively influence the growth and survival of the lower Columbia River, estuary, and river mouth's listed and proposed salmonid species, including coastal cutthroat trout and bull trout, rearing in and migrating through the lower Columbia River, estuary, and river mouth (Table 4.1). A brief narrative follows Table 4.1, to provide a summarization of the relationships between various ecosystem components and functions, and their influence on salmonid growth and survival. Specific information is provided, when available, regarding the influence of these ecosystem components on coastal cutthroat trout and bull trout.

Table 4.1. Conceptual Model Pathways and Indicators for Juvenile Salmonid Production in the Lower Columbia River, Estuary, and River Mouth.

Model Pathways	Pathway Description	Model Components (Indicators)	Indicator Description
Habitat-Forming Processes	Physical processes that define the living conditions and provide the requirements fish naturally need within the river system are included in the Habitat-Forming Processes Pathway	Suspended sediment	Sand, silt, and clay transported in the water column
		Bedload	Sand grains rolling along the surface of the riverbed
		Woody Debris	Downed trees, logs, root wads, limbs
		Turbidity	Quality of opacity in water, influenced by suspended solids and phytoplankton
		Salinity	Saltwater introduction into freshwater areas through the tidal ocean process
		Accretion/ erosion	Deposited/carved sediments
		Bathymetry	Topographic configuration of the riverbed

Habitat Types	This pathway describes definable areas that provide the living requirements for fish in the Lower Columbia River	Tidal Marsh and Swamp	Areas between mean lower low water (MLLW) and mean higher high water (MHHW) dominated by emergent vegetation (marsh) and low shrubs (swamp) in estuarine and riverine areas
		Shallow Water and Flats	Areas between 6-foot bathymetric line (depth) and MLLW
		Water Column	Areas in the river where depth is greater than 6 feet
Habitat Primary Productivity	This pathway describes the biological mass of plant materials that provides the fundamental nutritional base for animals in the river system	Light	Sunlight necessary for plant growth
		Nutrients	Inorganic source materials necessary for plant growth
		Imported Phyto-plankton Production	Material from single-celled plants produced upstream above the dams and carried into lower reaches of the river
		Resident Phyto-plankton Production	Material from single-celled plants produced in the lower reaches of the river
		Benthic Algae Production	Material from simple plant species that inhabit the river bottom
		Tidal Marsh and Swamp Production	Material from complex wetland plants present in tidal marshes and swamps
Food Web	The Food Web pathway shows the aquatic organisms and related links in a food web that supports growth and survival of salmonids	Deposit Feeders	Benthic organisms such as annelid worms that feed on sediments, specifically organic material and detritus
		Mobile Macro-invertebrates	Large epibenthic organisms such as sand shrimp, crayfish, and crabs that reside and feed on sediments at the bottom of the river
		Insects	Organisms such as aphids and flies that feed on vegetation in freshwater wetlands, tidal marshes, and swamps
		Suspension/ Deposit Feeders	Benthic and epibenthic organisms such as bivalves and some amphipods that feed on or at the interface between sediment and the water column
		Suspension Feeders	Organisms that feed from the water column itself, including zooplankton

		Tidal Marsh Macro-detritus	Dead and decaying remains of tidal marsh and tidal swamp areas that are an important food source for benthic communities
		Resident Microdetritus	Dead and decaying remains of resident phytoplankton and benthic algae, an important food source for zooplankton
		Imported Microdetritus	Dead remains of phytoplankton from upstream that serve as a food source for suspension and deposit feeders
Growth	The Growth Pathway highlights the factors involved in producing both the amount of food and access by fish to productive feeding areas	Habitat Complexity, Connectivity, and Conveyance	Configuration of habitat mosaics that allow for movement of salmonids between those habitats
		Velocity Field	Areas of similar flow velocity within the river
		Bathymetry and Turbidity	River bottom and water clarity conditions that influence the ability of salmonids to locate their prey
		Feeding Habitat Opportunity	Physical characteristics that affect access to locations that are important for fish feeding
		Refugia	Shallow water and other low energy habitat areas used for resting and cover
		Habitat-Specific Food Availability	Ability of complex habitats to provide feeding opportunities when fish are present
Survival	The Survival Pathway is a summary of key factors controlling or affecting growth and migration	Contaminants	Compounds that are environmentally persistent and bioaccumulative in fish and invertebrates
		Disease	Pathogens (viruses, bacteria, and parasites) that pose survival risks for salmon
		Suspended Solids	Sand, silt, clay, and organics transported within the water column
		Stranding	Trapping of young salmonids in areas with no connectivity to water column habitat
		Temperature and Salinity Extremes	Temperature or salinity conditions that are problematic to salmonid survival

		Turbidity	Water clarity as it pertains to potential for juvenile salmonids to be seen by predators
		Predation	Potential for piscivorous mammals, birds, and fish to prey on salmonids
		Entrainment	Trapping of fish or invertebrates into hopper or pipeline dredges

4.3.2 Habitat Forming Processes

Habitats are formed primarily by the interaction of hydrodynamic forces and sediment supply. In the lower Columbia River, estuary, and river mouth, both the river and the ocean influence the riverine and estuarine hydrodynamics. Ocean processes, including tidal action and waves, interact with river processes, including currents and sediment transport, in the lower Columbia River, estuary, and river mouth to produce complex hydrodynamics. The net result is deposition (accretion) of suspended sediments to form flats and carving (erosion) to form shallow and deep channels. These habitats may be colonized by marsh and swamp vegetation, as controlled by bathymetry (elevation of substrate) and, in the estuary, salinity (because plants and animals are adapted to certain salinity ranges, the salinity level, as well as seasonal and spatial patterns, strongly influences where species occur in the lower Columbia River and estuary). If the turbidity levels are low enough to allow sufficient light penetration for plant growth, certain areas may develop submerged vegetation such as eelgrass. Woody debris, deposited on the flats, along channel edges, and in marshes and swamps, creates a complex, vertical structure. Habitats in deeper riverine and estuarine areas are formed by bedload transport, which shapes portions of the river and estuary bed into a series of sand waves. In the Habitat-Forming Processes Pathway (below), all of these dynamics and interactions culminate in the expression of habitat types important to coastal cutthroat trout and bull trout in the lower Columbia River, estuary, and river mouth.

4.3.3 Habitat Types

The habitats most directly linked to salmonids in the lower Columbia River, estuary, and river mouth include the tidal marshes and swamps, shallow water and flats, and the water column. Habitat types are generally defined by specific elevation ranges.

Tidal marshes and swamps generally occur between Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW). Tidal marshes begin at lower tidal elevations, slightly above MLLW, and swamps occur at or above MHHW. Juvenile and adult coastal cutthroat trout use the edges of these marshes to feed, and the edges of shallow channels within the marshes as

refugia and feeding areas. Tidal marshes can be divided into saltwater marshes and freshwater marshes, each characterized by a distinctive vegetation type. Tidal marshes include tidally influenced areas all the way up to Bonneville Dam, as well as extensive tidal freshwater marshes in the lower Columbia River, particularly those in Cathlamet Bay.

Shallow water and flats occur throughout the intertidal zone and into the shallow subtidal zone in waters up to six feet deep. Benthic algae (largely benthic diatoms) develop on tidal flats and in the shallow subtidal zone within the system. Coastal cutthroat trout use shallow water and flats habitats for feeding and movement.

Water column habitat refers to waters that are greater than six feet deep. Freshwater plankton dominate the fresh and oligohaline portions of the water column upstream, and plankton tolerant of greater salinity dominate the estuary and the river mouth of water column habitats. Coastal cutthroat trout and bull trout utilize water column habitat for feeding and movement.

4.3.4 Habitat Primary Productivity Pathway

A major function of the habitats is to produce food used by organisms in the ecosystem. Habitat primary productivity refers to the amount of material (biomass) produced over time during plant growth that occurs within each habitat type. Primary productivity is driven by light and is supported by inorganic nutrients (e.g., nitrate, phosphate). Inorganic nutrients enter the system from the upstream watershed and the downstream ocean currents and through the breakdown and recycling of organic matter within the system. Live plant material and detritus are the primary sources of organic matter in the food web used by coastal cutthroat trout and bull trout in the lower Columbia River, estuary, and river mouth.

Primary productivity within water column habitat results from imported and resident phytoplankton. Imported phytoplankton are freshwater species produced in large quantities in the upstream watershed (particularly in the reservoirs behind the mainstem Columbia River and tributary dams), whereas resident phytoplankton are produced within the lower Columbia River and estuary.

Primary productivity within the shallow water and flats habitat results mostly from benthic algae. Shallow water habitats can also produce filamentous algae and flowering grasses such as eelgrass; however, the majority of primary productivity within the river's shallow water areas comes from benthic algae.

Primary productivity within tidal marsh and swamp habitat comes from the marsh and swamp vegetation, which includes emergent plants, shrubs, and trees.

4.3.5 Food Web Pathway

The base of any food web is the plant material produced over time or the primary productivity within each habitat type. The food web described in the conceptual model includes macrodetritus, the large, complex forms of dead plants, primarily from tidal marsh plants. Macrodetrital webs are supported by tidal channels and backwater sloughs, marshes and swamps, vegetated riparian habitats, and other shallow water and low velocity habitats. This food web also includes microdetritus, the material from simple-celled plant or organic particles. Microdetritus can be in the form of imported microdetritus if they are derived from imported phytoplankton, or resident microdetritus if they are derived from resident phytoplankton. Small animals that shred the larger plant matter and microbes, including bacteria, protozoa, and fungi, facilitate the breakdown of detritus. In addition to making the organic matter useful to the food

web, these breakdown processes recycle inorganic nutrients needed by the plants for primary production.

Salmonids, including coastal cutthroat trout and bull trout, eat invertebrate prey species that are supported by resident and imported microdetritus, and macrodetritus from tidal marsh and swamp plant material. The relative amount of food and food energy depends on the abundance of each habitat type (e.g., tidal marshes) and the input of nonresident material from upstream sources. Several types of invertebrate prey species make up the next level up the food chain from the primary producers and their detritus.

Mobile macroinvertebrates are large epibenthic organisms, such as sand shrimp, mysids, and Dungeness crab, that reside on the river bottom and feed on bottom sediments and byproducts of primary productivity. Mysids are the primary macroinvertebrates that are relevant to the coastal cutthroat trout and bull trout food web. Deposit feeders are benthic animals that feed by consuming organic matter in sediments. The term deposit feeders refers to both surface and subsurface deposit feeders, which include marine annelids (polychaetes), and freshwater annelids (oligochaetes), and benthic crustaceans. Suspension feeders are organisms that feed from the water column itself. For zooplankton and benthic/epibenthic organisms, this is accomplished primarily through "filter feeding". Suspension/deposit feeders are benthic and epibenthic organisms that feed on or at the interface between the sediment and the water column. Floating insects (larvae and adults) appear to be important in the diet of most of the salmonid species and age classes in the salmonid food web. Many of these insect types feed on live tidal marsh plants. All life stages of coastal cutthroat trout feed on both aquatic and terrestrial invertebrates, and older coastal cutthroat trout as well as bull trout feed on other fish that also use these invertebrate food items.

There has been a shift in the food web within the lower Columbia River. Tidal marsh and swamp vegetation and macrodetritus have declined. The benthic/epibenthic food web, which was a prominent feature of the historical lower Columbia River ecosystem, no longer produces as varied or rich a food web (Sherwood et al. 1990). The current ecosystem is now more dependent on a "microdetrital" food web supported by the estuary turbidity maximum (ETM) zone in the mainstem channels.

The ETM results from the combination of two processes, strong tidal forces and its interaction with the salt wedge in the lower Columbia River. This combination results in elevated levels of suspended particulate matter. The physical process occurs when strong tidal forces push salinity upriver beneath the outflowing river water. The turbulence caused by this tidal forcing results in resuspension of sediment and other particulate material present on the river bed.

Concurrently, dissolved material in the river water flocculates when it comes into contact with the salt wedge pushing its way up river. The interaction of these forces results in the ETM.

The ETM supports the detrital food chain and salmon production, and in the current estuary the ETM sustains the highest secondary productivity (Simenstad et al. 1990). Fish and invertebrate community surveys in the Columbia River estuary provide strong evidence that physical processes that promote concentration of organic matter and the maintenance of zooplankton populations within the estuary control the feeding environment for estuarine fishes (Bottom and Jones 1990). With the degradation of the macrodetrital food chain, the ETM has assumed an important role in providing food for salmon that enables them to mature properly and enhances their ability to survive.

4.3.6 Growth Pathway

Salmonids, including coastal cutthroat trout and bull trout, are adapted for using a complex mosaic of many habitat areas as they migrate downstream, and during their residence in the lower Columbia River, estuary, and river mouth. This mosaic of habitats used by salmonids is referred to as habitat complexity. An absence or reduction in the natural complexity of habitats available may affect the salmonids' ability to reach food resources needed for growth. Habitat conveyance is the opportunity for salmonids to move over flats and into tidal marsh systems as the water level rises and falls with the tide and with river flow. Connectivity refers to links and spatial arrangements among habitats in the mosaic of changing habitat areas. Feeding habitat opportunity reflects the variable access among feeding, rearing, and refuge habitats along the migratory corridor. Habitat-specific food availability needs to exist for salmonids to feed within the set of habitats. Lastly, low current velocity, shallow water areas provide productive feeding areas for salmonids. However, because salmonids are visual predators, turbidity and uneven bathymetry may influence their ability to successfully capture prey items.

4.3.7 Survival Pathway

Besides growth, a variety of factors interact to affect the ultimate survival of salmonids, including coastal cutthroat trout and bull trout, in the lower Columbia River, estuary, and river mouth. Factors that can negatively affect survival include contaminants, predation, suspended solids, temperature and salinity extremes, stranding, entrainment, and competition.

Contaminants may affect the health (physiological integrity) of salmonids and may result in disease as well as a reduced ability to physiologically adapt to saltwater, avoid predators, forage effectively, and seek and find shelter. Contaminants can be taken up directly through the water

column or through contaminated prey. Predation is a major factor affecting salmonid survival in the lower Columbia River, estuary, and river mouth. Birds, including Western grebes, cormorants, gulls, terns, and great blue herons, are known to prey on salmonids. Piscine and pinniped predators also may prey salmonids. Suspended solids, which can be a major contributor to turbidity, may affect survival by reducing the ability of salmonids to see prey, and indirectly cause mortality via starvation. Temperature and salinity extremes typically stress fish, which may lead directly or indirectly to mortality. Stranding can occur when fish are washed up onto higher ground by waves or ship wakes, or if they are caught for extended periods of time in a shallow pool during an extended low tide. Fisheries biologists have observed stranding of salmonids in the lower Columbia River system. Entrainment refers to the uptake of fish during dredging. Finally, competition between and among members of the outmigrating salmonid populations may play a role in survival; however, little is understood or documented regarding the effects of competition in the lower Columbia River, estuary, and river mouth.

4.4 Updated Environmental Baseline Information for Columbian White-tailed Deer and Bald Eagle

4.4.1 Columbian White-tailed Deer

As noted in the terrestrial species opinion, Columbian white-tailed deer occur on islands and mainland habitats in the middle portions of the Project area. Columbian white-tailed deer numbers on Tenasillahe Island and mainland areas decreased as a result of the 1996 Columbia River floods. Since 1996, the four major sub-populations have remained stable or increased in numbers (A. Clark, pers. comm.). The estimated 2001 numbers of Columbian white-tailed deer, and the doe:buck:fawn ratio, is provided in Table 4.2.

Table 4.2. Estimated 2001 numbers and sex/age ratios of Columbian white-tailed deer, by geographic area/sub-population.

Area	Estimated Deer Numbers	Sex and Age Ratios
Julia Butler Hansen mainland	120-140	31:100:49
Tenasillahe Island	130-150	50:100:18
Puget Island	150	68:100:49
Westport Flats/Wallace Island	170-180	47:100:40
Crims Island	42-65	unknown
Brownsmead Flats	5-15	unknown

Several ecosystem restoration activities are proposed in locations that support Columbian white-tailed deer sub-populations. Short-term and long-term habitat restoration activities are proposed at the Tenasillahe Island sub-population area, and noxious weed control is proposed on Wallace Island.

Long-term habitat restoration at Tenasillahe Island is proposed, if and when Columbian white-tailed deer are delisted and Tenasillahe Island habitat restoration plans are found by the Service to be compatible with Julia Bulter Hansen National Wildlife Refuge's purposes and goals. This

long-term Project action would potentially reduce the Columbian white-tailed deer carrying capacity on Tenasillahe Island. Proposed Project purchase of Cottonwood/Howard Island, and subsequent introduction of Columbian white-tailed deer to this island complex, may allow for a new, secure sub-population of Columbian white-tailed deer to be established. The Columbian white-tailed deer recovery plan requires, for delisting of the Columbia population, a minimum of 400 Columbian white-tailed deer to be maintained within at least three viable sub-populations in suitable, secure habitat.

4.4.2 Bald Eagle

Bald eagle nests occur at or near several of the ecosystem restoration activity locations. In addition, bald eagles perch on pilings, trees, stumps, mud flats, and other locations throughout the Columbia River and estuary (A. Clark, pers. comm.); these perch locations may be adjacent to the ecosystem restoration projects. Three bald eagle pairs nest either on or in close proximity to Lois Island embayment restoration project (Tongue Point/Mill Creek; Lois Island/John Day Point; Cathlamet Bay), one pair nests on Miller Sands Island near the Miller/Pillar habitat restoration project; two pairs nest on Tenasillahe Island (Tenasillahe/North Hunting Island; Clifton Channel/Tenasillahe West) near the Tenasillahe Island interim and long-term restoration actions; and approximately 30 bald eagle pairs nest within or adjacent to the Columbia River estuary, where the purple loosestrife control activities will occur. Bald eagles do not currently nest on Cottonwood/Howard Islands. Two bald eagle nesting territories occur near the Bachelor Slough restoration project (Bachelor Island; Mallard Slough).

5.0 EFFECTS OF ACTION

5.1 Introduction

The proposed Project has several distinct components, including Project construction and maintenance activities, monitoring and adaptive management, and ecosystem restoration and research actions. The Effects of Action section includes sub-sections that address each Project component separately. Section 7.0 (Conclusion) will aggregate effects from each Project component, and, combined with effects from interrelated and interdependent actions, cumulative effects, environmental baseline, and the proposed action, will determine whether the Project, as a whole, jeopardizes the continued existence of proposed coastal cutthroat trout or threatened bull trout.

Additional analysis of effects to bald eagle and Columbian white-tailed deer from ecosystem restoration actions is provided (5.7 Updated Analysis of Effects for Columbian White-tailed Deer and Bald Eagle). The terrestrial species opinion previously analyzed the effects of Project navigation features on bald eagle and Columbian white-tailed deer and those analyses are incorporated herein by reference (terrestrial species opinion pages 11-18). Since 1999, the navigation features' construction and maintenance actions have not changed in a way that creates different effects, and no additional information on navigation feature construction and maintenance effects is available. Therefore, construction of ecosystem restoration features is the only new Project action and effect that will be analyzed in this opinion for these two species.

As noted in Section 2.0 of these Service opinions (Description of the Proposed Action), several steps were involved in development of the current Proposed action. Those steps included a re-evaluation of potential project effects; an analysis of these potential effects within the framework of an ecosystem-based conceptual model; the development of compliance measures and monitoring conditions to minimize and/or avoid Project impacts; and the development of an adaptive management process to review information from the compliance and monitoring activities and make necessary Project modifications to minimize and/or avoid impacts. The Corps will be responsible to determine how to address the adaptive management team's decisions. By using this "frontloading" approach, the Service and the Corps defined a proposed action that minimized or avoided Project-related effects. Therefore, some potential Project effects will not be discussed herein, as the Corps' proposed action successfully avoids these potential effects.

Several tools were used for the Service's analysis of potential Project effects. To interpret potential Project effects to Lower Columbia River, estuary, and river mouth processes and functions, the conceptual model, numerical models, and BRT deliberations were employed. The pathways and indicators defined in the conceptual model (see Chapter 5 of the aquatic species BA) will be used herein as a framework to discuss potential Project effects.

To investigate specific physical habitat changes (salinity, velocity, depth) that might occur after Project implementation, two numerical models, the Corps of Engineers – Waterways Experiment Station (WES) RMA-10 model and the Oregon Health Sciences University/Oregon Graduate Institute (OHSU/OGI) Eulerian – Lagrangian CIRCulation (ELCIRC) model, were used. The Service's analysis was additionally assisted by the SEI panel process, which reviewed multiple aspects of the proposed Project (historical and existing status of the lower Columbia River ecosystem; numerical modeling of hydraulic parameters; salmonid estuarine ecology; sediments and sediment quality; and monitoring and adaptive management). The aquatic species BA and its appendices (see Section 6.1.5.1 and Appendices F and G) provide a complete overview of these

analysis techniques and results of quantitative analyses and modeling outputs, and are incorporated herein by reference.

The following discussion is an analysis of the potential direct and indirect effects to coastal cutthroat trout and bull trout and their habitats from Project construction and maintenance activities, using the conceptual model indicators, and focusing on Project-related effects to key habitat types. Uncertainty regarding Project-related effects and associated risk to ecosystem indicators is discussed. Interrelated and interdependent actions, and their associated effects, are considered. Monitoring and adaptive management measures, proposed by the Corps to reduce Project-related risk and uncertainty, are discussed. A subsequent sub-section addresses potential effects resulting from proposed monitoring, ecosystem restoration, and research proposals. Finally, Service conclusions on overall Project-related effects are presented.

5.2 Uncertainty Regarding Project-related Effects and Associated Risk to Ecosystem Indicators as Related to Monitoring Actions

The SEI panel suggested that scientific and management decisions involve a level of uncertainty related to environmental effects and associated risk to the ecosystem from those environmental effects. The term "uncertainty" pertains to the amount of information available to predict a Project-related change to an indicator. For instance, if ample information for an indicator was available, the uncertainty associated with that indicator, in regards to potential Project effects, would be low.

For the purposes of these conference and consultations, the term "risk" pertains to the level of threat to the health or survival coastal cutthroat trout and bull trout from Project-related changes to indicators. For instance, if coastal cutthroat trout and bull trout are extremely sensitive to small changes in an indicator, then the risk associated with any Project-related changes to that indicator would be high. For purposes of the consultation and conference process, including BRT analysis and deliberations, each conceptual model indicator was evaluated to determine both uncertainties and risk from implementing the proposed Project activities. That information is included in the aquatic species BA (Table 7-1), and is incorporated herein by reference.

As noted below in Section 5.3 of these Service opinions, the Service believes that Project-related indirect effects to ecosystem indicators will be limited. Key physical processes that likely will have limited changes during the navigation channel construction and maintenance actions include suspended sediment, accretion/erosion, turbidity, salinity, bathymetry, and bedload. The short-term nature of those impacts were discussed during the SEI panel process and verified using the numerical modeling conducted by WES and OHSU/OGI. It should be noted that the levels of Project risk to ecosystem indicators were not high enough to require Project modification, but, due to long-term uncertainties, were still of a level to warrant verification through monitoring.

Based on uncertainties from long-term Project effects, and associated risk to salmonids, the Corps proposed a Monitoring Program (see Table 2.5, and Section 2.2.6 of these Service opinions) and the Service provided review and comment on it as part of the BRT process. The Monitoring Program addresses the long-term ecosystem uncertainties and risk to the main ecosystem indicators and key habitat features (Table 5.1) addressed in Section 5.3. Monitoring results will be reviewed, and future changes to management will occur if adverse findings were determined.

Table 5.1. Pathways and Indicators to be Addressed by the Monitoring Program

Monitoring Action	Pathway	Indicators
MA-1: Maintain three hydraulic monitoring stations to investigate pre- and post-Project relationships among flow, tide, salinity, water surface, and water temperature	Habitat-forming processes	Bedload; Salinity
	Growth	Habitat complexity, connectivity, and conveyance; Velocity Field; Feeding Habitat Opportunity
MA-2: Compare actual to predicted sediment dredge volume	Habitat-forming processes	Bedload
MA-3: Complete bathymetric surveys to track habitat alterations	Habitat-forming processes	Accretion/Erosion; Bathymetry
	Key Habitat Types	Shallow water/flats habitat
MA-4: Aerial and ground mapping to track habitat alterations	Key Habitat Types	Tidal marsh and swamp habitat
	Food Web	Suspension/deposit feeders; Insects; Tidal marsh macrodetritus
	Growth	Refugia; Habitat-specific food availability
MA-5: Contaminants monitoring team to undertake annual contaminants review activities	Survival	Contaminants
MA-6: Investigate pre- and post-Project salmonid stranding events	Survival	Stranding

5.3 Effects from Construction and Maintenance Activities

Project construction, maintenance, and effect minimization activities may have immediate (direct) effects to coastal cutthroat trout and bull trout, as well as short-term and long-term (indirect) effects to ecosystem processes and functions of importance to these species. Additional activities, interrelated to the proposed action, may also have indirect effects to coastal cutthroat trout and bull trout. The pathways and indicators from the conceptual ecosystem model are used as an analytical framework for discussing indirect effects from construction and maintenance activities. The Service believes that, if a pathway or indicator is negatively influenced by the Project, then a negative, indirect, short- or long-term impact to coastal cutthroat trout and bull trout and their habitats also may be occurring.

5.3.1 Immediate (Direct) Effects

Direct mortality to coastal cutthroat trout or bull trout from construction and maintenance activities could occur from entrainment into the dredge draghead or during in-water blasting activities.

The Service believes that any coastal cutthroat trout or bull trout entrained by the dredging activities will suffer injury or perish. Entrainment of organisms by hopper dredging has been evaluated at the mouth and in the Columbia River (Larson and Moehl 1990; R2 Resources Consultants 1999). Larson and Moehl (1990) reported that no juvenile or adult salmonids were collected during the four years of the study, even though other pelagic fish species were collected. This study concluded that, because dredging occurred below the depth where salmonids migrate, no salmonids were entrained. Documented entrainment of salmonids occurred during a research study in which the dredge draghead was purposely operated while elevated in the water column instead of within the substrate to determine presence/absence of fish. (R2 Resource Consultants 1999). This entrainment incidence level involved two salmonids. No juvenile salmonids have been entrained during monitored, normal dredging operations in the Columbia River (Larson and Moehl 1990).

The Project dredging procedures propose that the draghead and/or cutterhead will be buried, to the extent possible, in the sediment of the river bed during dredging operations. No suction will occurring through the draghead and/or cutterhead if it is raised more than three feet off the river bottom. Both these proposed “impact minimization” measures reduce the potential for coastal cutthroat trout and bull trout entrainment. Further, the Service believes that coastal cutthroat trout and bull trout are not found near deep-water dredging activities. It is believed that adult coastal cutthroat trout and bull trout have sufficient swimming capacity to avoid entrainment, and are further protected by the dredging “impact minimization” actions noted above. The Service believes that compliance monitoring, to ensure the proposed entrainment minimization

measures are implemented, will be important in minimizing any injury or death of salmonids during dredging activities.

Observations of sub-yearling and juvenile salmonid distribution and relative vulnerability to dredging entrainment impacts were conducted in the lower Columbia River (Carlson et al. 2001). Research indicated that the majority of salmonids were not utilizing the bottom of the navigation channel, where entrainment might occur during dredging activities. Analysis of hydroaccoustic sampling data revealed that, during the highest salmonid annual abundance in the lower Columbia River, only 0.0017% of those fish were adjacent to the dredging zone (within 3 ft of the navigation channel bottom) during the daylight hours, 0.0249% were adjacent to the dredging zone in the evening hours, and 0.0107% were adjacent to the dredging zone at night (Carlson et al. 2001). The combination of very limited occupancy by salmonids of deep water locations, and BMPs that restrict dredge draghead or cutterheads to be operated, to the extent possible, under the sediment surface, will ensure that entrainment of salmonids is minimized.

One location (Warrior Rock, RM 87.3) may require one-time in-water blasting. The Service anticipates blasting could injure or kill any coastal cutthroat trout or bull trout within the blasting area. However, the proposed action minimizes potential direct effects by requiring a blasting plan, using an in-water work window of November 1 to February 28 when listed trout and salmon abundances are lowest, and reducing the associated pressure wave by creating an implosion. The Service believes reducing implosion-induced over-pressure to less than 10 psi will greatly minimize blast-related impacts to coastal cutthroat trout or bull trout. However, blasting during the in-water work window minimizes, but does not avoid, direct impacts to bull trout or coastal cutthroat trout, which may use the Warrior Rock area year-round. The Service believes that development of a Service-approved monitoring plan, to ensure the proposed blasting measures are implemented, will be important in minimizing any injury or death of coastal cutthroat trout or bull trout during blasting activities.

5.3.2 Short- and Long-term (Indirect) Effects to Ecosystem Processes and Functions of Importance to Coastal Cutthroat Trout and Bull Trout

The aquatic species BA determined that, of the 38 conceptual ecosystem model indicators that might be influenced by the Project's construction, maintenance, and effects minimization activities, a total of 20 indicators of ecosystem process and function may influenced in the short- and long-term. After review of the conceptual ecosystem model (see Chapter 5 of the aquatic species BA) and the effects analysis (see Chapter 6 of the aquatic species BA), the Service analyzed five habitat forming process indicators (suspended sediment, bedload, turbidity, salinity, bathymetry) and three key habitat types (tidal marsh and swamp, shallow water and

flats, and water column) associated with physical and biological indicators that could be potentially be affected by the Project. The seven key indicators (insects, macrodetritus, microdetritus, benthic algae, deposit feeders/suspension-deposit feeders/suspension feeders, mobile macroinvertebrates, and phytoplankton) that related the prey base to coastal cutthroat trout and bull trout are integrated into the discussion of key habitat types in which they are primarily found. The habitat complexity, connectivity, and conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability indicators are analyzed as a group because they can influence more than one habitat type. Thus, grouping them may better reflect an ecosystem approach to impact assessment. One additional indicator, stranding, may be caused by post-construction, deep-draft vessel traffic that is interdependent to the Project, and is discussed under 5.4 Effects from Interrelated and Interdependent Activities, below.

5.3.2.1 Ecosystem Indicator - Suspended Sediment (including an analysis of accretion and erosion)

Project dredging and disposal actions and future, interrelated activities may influence suspended sediment concentrations in the lower Columbia River, estuary, and river mouth. In areas adjacent to dredges and shoreline disposal operations, increases in suspended sediment concentrations may temporarily increase local water column turbidity (see Ecosystem Indicator - Turbidity, section 5.3.2.3 below).

Dredging operations are likely to cause downstream suspended sediment increases of zero to 2 mg/L, depending on the number and type of dredges operating. Most of the dredging and disposal-induced suspended sediment should rapidly settle onto adjacent substrates. Ocean disposal will result in longer periods of sediment suspension before the sediment settles onto the deepwater substrate. Based on data indicating that less than 1 percent of the dredged material is fine enough to remain in suspension following disposal, the Corps estimates that disposal of construction-related dredging will contribute up to 180,000 cubic yards of suspended sediments over the 2-year construction period.

Background suspended sediment loads for the same 2-year period have been estimated at four mcy. This is a maximum increase of 4.5 percent in the suspended sediment load and generally equates to less than 1 mg/L increase in suspended sediment concentrations. These volumes will have a limited influence on accretion and erosion in important salmonid habitat areas.

Contaminants associated with dredged and disposed sediments may be resuspended in the ecosystem. Contaminants are discussed below. However, much of the material to be dredged from the navigation channel will originate from existing sand waves, a dynamic natural feature of the river bottom, that are constantly moving due to river current action. These sand waves contain a small percentage of fine sediments and organic material, thus have the potential to carry a limited amount of contaminants into natural resuspension from current action or dredging and disposal.

Materials resuspended by dredging and disposal activities may accumulate within the ETM, and be redistributed into lateral habitats of importance to salmon. The effects of the deposition of additional fine sediments into lateral habitats may be beneficial to those habitats, or detrimental due to the presence of contamination. Resuspension of contaminants related to the Project are further described below. Interrelated and/or interdependent activities, such as deepening of adjacent ports and berths, can also have similar influence on suspended sediments. Ship wakes, interrelated to the Project, will cause limited increases in suspended sediment, however, the

deepened channel may result in less ship traffic and overall less ship wake-induced suspended sediment.

The Service believes that Project-related changes to suspended sediment could affect the habitat-forming process of sediment accretion and erosion. Because the Project-related slight increase in suspended sediment may increase accretion of sediment in lateral habitat areas, this Project effect will have neutral or slightly beneficial effects to habitats used by coastal cutthroat trout and bull trout. As noted above, increases in turbidity from Project activities is discussed under Ecosystem Indicator - Turbidity, section 5.3.2.3 below.

5.3.2.2 Ecosystem Indicator - Bedload (including an analysis of accretion and erosion)

Riverbed side-slope adjustments and some shoreline erosion are predicted to alter the accretion and erosion patterns within shallow water and flats habitat in the lower Columbia River at five locations – RM 99, 86, 75, 72, and 46 through 42. A single location in the estuary, RM 22.5, is projected to experience riverbed side-slope adjustments. These six locations are all historic dredge material disposal sites, and provide limited coastal cutthroat trout and bull trout habitat.

The side-slope adjustment process will take five to ten years to occur after construction. Over that time, shallow water and flats habitat at six shoreline disposal sites will tend to erode toward the shoreline and become deeper. The Corps determined that side-slope adjustments will not occur in natural shoreline areas because these riverbanks are stable, indicating that it is unlikely that tidal marsh and swamp habitat would be affected by side-slope adjustments. The Corps proposes to monitor for any impacts from side-slope adjustments to riparian habitats, including tidal marsh and swamp habitat. This information will enable the Corps and Service to track and react to potential changes in side-slope adjustment.

Sand from upstream areas is one of the sources of material for habitat-forming processes (accretion) in the estuary. This sand is important to the formation of tidal marsh and swamps and shallow water and flats habitat. The removal of sand from the river via dredging and upland disposal will not alter the ongoing, natural sediment transport process towards the estuary. The volume and rate of the bedload movement is not expected to change with Project activities. The volume of sand to be dredged over the life of the Project represents a small fraction of the total volume of sand in the riverbed. In addition, transport potential, rather than sand supply, is the limiting factor in sediment supply to the estuary. Therefore, it is likely that the impact to bedload processing of sand removal associated with the Project will be of a limited nature.

The Service believes that Project-related effects to bedload may alter potential habitat for coastal cutthroat trout and bull trout habitat at five riverine and one estuarine sites. Predicted side-slope adjustments will harm these species' aquatic habitat by alteration of shallow water, shoreline habitat. Shoreline habitats provide important feeding and rearing areas for these species, therefore any effects to these habitats, above those effects or locations predicted in the aquatic species BA, are important to monitor and address. However, these six shoreline sites are highly erosive and unstable, and do not provide high quality habitat for coastal cutthroat trout and bull trout Additional effects discussion regarding side-slope adjustment is provided below.

5.3.2.3 Ecosystem Indicator -Turbidity

Turbidity affects the ability of light to penetrate into water, and, in turn, affects the amount of plant growth that can occur. This is important for habitat development, particularly in the shallow water areas, because the plant growth adds stability and reduces the chance for erosion. Some temporary and localized changes to river and estuary turbidity levels are anticipated to occur from the Project. Localized turbidity levels from Project construction and maintenance activities, five to 26 NTUs above background levels, are not likely to produce detectable effects on plant growth in the lower river or estuary. Increased turbidity will be localized to deep water areas where dredging and in-water disposal will occur; these slight increases to natural lower Columbia River and estuary turbidity levels will occur in deeper water areas where the majority of coastal cutthroat trout and bull trout migration and feeding activities are not occurring. Local turbidity increases in shallow water areas will occur during shoreline disposal. Turbidity plumes resulting from lower Columbia River and estuary dredging and disposal occurs in a "near-field" area (Carlson et al. 2001). Increased turbidity from these Project activities are below the known turbidity levels that stimulate avoidance response by juvenile salmonids, as identified by Servizi and Martens (1992). Ocean disposal will result in localized and short-lived periods of increased turbidity. While high levels of turbidity are known to affect salmonid physiology and feeding success, the combined background and project-related turbidity concentrations are well below known salmonid impact levels (see 2001 BA sections 4 and 6.1.4).

5.3.2.4 Ecosystem Indicator - Salinity

The concentration of salinity in important habitat and rearing areas of the estuary and the longitudinal gradient of salinity between the freshwater and ocean environments that bound the estuary are important to coastal cutthroat trout growth and survival. Bull trout have not been collected in the Columbia River estuary, therefore changes to salinity are not addressed for this species. The Project will change the estuary's cross-sectional profile and have associated effects on estuary salinity gradients. Based on the WES RMA-10 and OHSU/OGI modeling, the largest Project-related impacts on salinity profiles occur at the lowest river flow analyzed (70,000 cfs).

In shallow areas of Cathlamet Bay and Grays Bay, where important coastal cutthroat trout habitat and food resources exist, the WES RMA-10 model predicted a post-Project salinity increase of 0.1 to 0.15 ppt. The OHSU/OGI model confirmed these predictions. Within the deeper navigation channel, where limited juvenile salmonid habitat and food resources exist, the WES RMA-10 model predicted post-Project salinity increases in the range of 1.0 to 1.5 ppt. The OHSU/OGI model confirmed these findings, but predicted slightly larger increases in salinity

than those predicted by WES RMA-10 modeling for Youngs Bay and along the Oregon side of the navigation channel up to Tongue Point.

Modeling runs for higher river flows indicated even smaller post-Project salinity increases in important salmonid habitats. The OHSU/OGI model also was used to determine if, post-Project, there would be a significant change in habitat opportunity, as defined by Bottom et al. (2001) and the SEI workshop process. Using the OHSU/OGI model an example of the potential changes to habitat opportunity was developed by modeling Cathlamet Bay for five one-week model simulations (see Table 6-1 of the aquatic species BA). The model predicted, for important, shallow water Cathlamet Bay salmonid habitats, there was virtually no difference in the habitat opportunity, pre- and post-Project, for salinity between 0-5 ppt.

Changes to the ETM can effect phytoplankton, nutrient cycling, and availability of coastal cutthroat trout prey primarily within the estuary. Changes in salinity as a result of the Project could result in a permanent shift in the boundaries of the ETM, of up to one mile upstream. This upstream movement will affect the location where imported phytoplankton die, and with other accumulated organic matter, are cycled through the estuary system. A change in the location and range of the ETM may affect the distribution of nutrients and thereby the location and abundance of salmonid food in shallow water habitats.

While it is believed salmonids, including coastal cutthroat trout, do not feed in the ETM, nutrient cycling from the ETM may transfer to shallow water habitats and to the food items which coastal cutthroat trout prey on. No change in type or quantity of imported phytoplankton is anticipated in the short-term, and short-term effects to coastal cutthroat trout from predicted shifts in ETM, and subsequent modification in nutrient cycling, is anticipated to be limited, and will not harm coastal cutthroat trout. However, long-term impacts of the predicted shift in the ETM, based on potential changes to phytoplankton and nutrients (see Table 7-1 of the aquatic species BA) over the Project's life are uncertain. The Service believes the Corps' proposed Columbia River ETM workshop should enhance the understanding of the ETM and its influence on estuary ecosystem function. Workshop findings will be discussed within the Adaptive Management Process for the Project. Project modifications may then be implemented, as necessary, to minimize Project-related effects to the ETM.

5.3.2.5 Ecosystem Indicator - Bathymetry (including an analysis of velocity field)

Bathymetric changes will occur in and adjacent to the navigation channel. Dredging will lower the riverbed by three feet, in and adjacent to the navigation channel. Long-term riverbed adjustments will occur on adjacent side slopes (see Section 5.3.2.2, above). Within the riverine areas, 60

percent of the navigation channel will require deepening, whereas only 45 percent of the navigation channel in the estuary reach will require dredging. In-water and shoreline disposal of dredged materials will cause bathymetric changes by raising river and ocean bed elevations at disposal sites.

The deepened navigation channel will result in a small effect (decrease of up to 0.18 feet) on Columbia River water surface elevations in the upper Project area, essentially immeasurable decrease (0.02 feet) in water surface elevation in the estuary, and no water surface elevation change in the river mouth reach. These water surface elevations should not impact existing habitats or reduce the ability of coastal cutthroat trout or bull trout to access those habitats. Also, within the upper river portion of the Project, lower water levels may allow marsh progradation (i.e., building out) waterward of the marsh.

The OHSU/OGI model evaluated pre-and post-Project water depth differences in terms of hours of habitat opportunity. The model outputs for important, shallow water Cathlamet Bay salmonid habitats are nearly identical for pre- and post-Project water depths, indicating effects of the proposed action on the water depths will have a limited impact on habitat opportunity.

Changes in bathymetry from dredging and disposal may change river velocity, and thereby affect habitat opportunity. The WES RMA-10 modeling results indicated that average pre- and post-Project velocity differences are small, ranging from approximately -0.2 foot per second to 0.2 foot per second. The largest velocity differences were noted in the navigation channel, and are within the normal velocity range commonly encountered by coastal cutthroat trout and bull trout.

Pre- and post-Project velocity differences in shallow salmonid habitat areas outside the navigation channel ranged from approximately -0.05 to 0.05 foot per second. OHSU/OGI modeling supports these results. The post-Project velocities are well within the range of favorable velocities identified for juvenile salmonids, as defined by NMFS (Bottom et al. 2001). The Service believes these post-Project values are favorable velocities for all life stages of coastal cutthroat trout using these shallow water habitats. The OHSU/OGI model evaluated pre- and post-Project velocity magnitude differences in terms of hours of habitat opportunity. Modeling results were done for vertically averaged water column velocities and for minimum and maximum water column velocities. Both the spatial distributions and the area-weighted averages for water column velocity were similar for pre- and post-Project. Maximum differences in average hours of approximately ten to 15 percent (increase and decrease) between base and plan were predicted for model runs at both low and high flow. In these cases, the model runs for the post-Project scenario estimated higher habitat opportunity hours than the environmental baseline.

Based on the impacts to water depth-associated habitat opportunity, the Service concludes that there will be a limited, short-term effect on feeding habitat opportunity or refugia for coastal cutthroat trout and bull trout. In particular, the changes in water surface elevations projected within the estuarine and riverine reaches are not likely to alter the amount or location of refugia. In addition, changes to river current velocity from the proposed dredging are anticipated to be small (particularly in the side channels and shallow water areas that provide the refugia) and will not affect the function of the available refugia.

While short-term impacts appear to be unlikely, the long-term impacts to habitat opportunity and refugia for coastal cutthroat trout and bull trout over the Project's life from these limited bathymetric and hydraulic changes cannot be quantified and are therefore uncertain. Any long-term, negative changes in bathymetric or hydraulic conditions may harm these species' aquatic habitat, thereby negatively effecting refugia and habitat opportunity for these species. Therefore any effects to these habitat conditions, above those effects or locations predicted in the aquatic species BA, are important to monitor and address via the Adaptive Management Process.

5.3.2.6 Effects from Construction and Maintenance Activities on Key Salmonid Habitats

During the course of this consultation and conference, much discussion centered around the potential effect of construction and maintenance activities on tidal marsh and swamp, shallow water and flats, and water column habitats. The conceptual model identified these habitat types as being important, in particular, to coastal cutthroat trout residing in the estuary. The Service provides a detailed examination of these three key habitat types, and summarizes the Project-related effects to the key habitat type at the end of each sub-section.

5.3.2.7 Tidal Marsh and Swamp

Tidal marsh and swamp habitat occurs sporadically along the margins of shallow water areas of the Columbia River and estuary, with these habitats' most concentrated occurrence in the estuary and downstream portions of the riverine reach. The Service believes these shallow, complex, productive habitats are important to all life stages of coastal cutthroat trout. Bull trout, if present in the lower Columbia River, are not believed to use these shallow water habitats. No dredging or disposal within the tidal marsh and swamp habitat is planned, therefore no direct loss of tidal marsh and swamp habitat from the Project is anticipated. The Service, in analyzing potential Project effects to tidal marsh and swamp, focused on Project-related effects to the habitat-forming processes of salinity and bathymetry, and also reviewed Project effects to ecosystem indicators that would respond to changes in habitat .

Based on the WES RMA-10 and OHSU/OGI model outputs, the post-Project salinity distribution is unlikely to change within shallow water estuary areas, where much of the tidal marsh and swamp habitat is located. In addition, even if larger post-Project salinity changes occur in the estuary than were predicted by the models, the dominant marsh plants found in these habitats exhibit wide salinity tolerances. In upriver areas, tidal marsh and swamp habitats will not be influenced by any post-Project changes to salinity distribution, as these habitat features are upstream of salt water influence.

The other major habitat-forming process that may influence tidal marsh and swamp habitat is bathymetry. Predicted post-Project water surface elevation changes range from zero to -0.18 foot, with the smallest elevation changes predicted in the estuary and lower river areas. In fact, tidal marsh and swamp habitat may increase slightly in upriver Project areas as a result of the channel deepening. The predicted decrease in water surface elevation in upriver areas may provide more shallow water habitat that is at the appropriate depth for tidal marsh to develop. This would allow tidal marshes to establish or expand, and may lead to a long-term, small increase in tidal marsh habitats.

The Corps determined that side-slope adjustments will not occur in natural shoreline areas because these areas are stable, indicating that it is unlikely that tidal marsh and swamp habitat would be affected by post-Project side-slope adjustments. The Corps proposes to monitor for any impacts from side-slope adjustments to riparian habitats, including tidal marsh and swamp habitat. This information will enable the Corps and the Service to track and react to potential changes in side-slope adjustment.

The following are the two specific environmental indicators that could be affected by changes to tidal marsh and swamp habitats:

5.3.2.7.1 Insects

Terrestrial insects form part of the prey base for coastal cutthroat trout. Insect larvae and some adults insects are often found in the stomachs of coastal cutthroat trout that feed in shallow flats and marsh channels. Salinity intrusion, associated primarily with the main channel, is not expected to change the abundance of insects that are located primarily along the water margins in shallow wetlands and marsh channels.

Short-term impacts to insect abundance and diversity are likely to be limited. Based on Table 7-1 of the aquatic species BA, the uncertainty and risk of impact to insect production and salmonid food availability, although potentially limited, is uncertain in the long term. Long-term

monitoring, as recommended above for areas of side-slope adjustment, will provide information on Project-related effects to insect production.

5.3.2.7.2 Macrodetritus and Microdetritus

The production of prey resources important to coastal cutthroat trout is partially supported by marsh detritus. Resident microdetritus, which is derived from benthic and planktonic algal production, is important to suspension feeders and suspension/deposit feeders. Imported microdetritus is mostly derived from algal production upriver, including that produced above dams. As a primary producer, it is an important food source for suspension feeders and suspension/deposit feeders that form part of the prey base for coastal cutthroat trout.

The proposed dredging action is not likely to have an effect on the amount or productivity of tidal marsh macrodetritus or microdetritus. This is because no dredging or disposal within the tidal marsh and swamp habitat is planned.

Due to the predicted lowering of water elevation in the upper portion of the Project area, the amount and characteristics of tidal marsh and swamp habitat could result in limited expansion along the shallow water margins of the upper Project area. Increased macrodetritus and microdetritus production may occur from limited marsh expansion upstream of RM 80. Due to the predicted upstream shift of the ETM, there may also be a limited shift in the extent of resident and imported microdetritus food web input. The Project may also result in a small shift in the location of where resident microdetritus dies. Thus, short-term impacts to macrodetritus and microdetritus are likely to be limited. Based on Table 7-1 of the aquatic species BA, the risk and uncertainty to this indicator suggests the limited nature of this expansion will have an uncertain benefit to coastal cutthroat trout in the long-term.

5.3.2.7.3 Tidal Marsh and Swamp Summary

The Service anticipates negative short-term Project-related effects to tidal marsh and swamp habitats will be limited. Long-term Project effects to tidal marsh and swamp habitats are of moderate uncertainty, but low risk to adverse habitat modification (see aquatic species BA, Table 7-1). Any long-term, negative changes in tidal marsh or swamp habitat may harm coastal cutthroat trout feeding and refugia needs. Therefore any effects to these habitat conditions, above those effects or locations predicted in the aquatic species BA, are important to monitor and address.

5.3.2.8 Shallow Water and Flats

Shallow water and flats habitats provide important feeding and rearing areas for various life stages of coastal cutthroat trout and migratory bull trout. The Service, in analyzing potential Project effects to shallow water and flats habitats, focused on Project-related effects from side slope adjustments after channel dredging and after shoreline disposal, and also reviewed Project effects to ecosystem indicators that would respond to changes in shallow water and flats habitat.

The entire post-Project navigation channel may experience side-slope erosion and subsequent adjustment of side-slope angle. The erosion and adjustment will, over five to ten years, lower the adjacent river bed angle until a new, more stable side-slope is established. While side-slope adjustments will occur throughout the Project area in deeper water, where minimal salmonid habitat use is known to occur, some side-slope adjustment will occur in shallow water and flats habitats.

The Corps predicts shoreward erosion from side-slope adjustment to occur in a total of six sandy beach areas: five in the lower Columbia River (RM 99-86, 75, 72, and 46-42) and one in the estuary (Miller Sands Spit). These areas have shallow water habitats that could be used by coastal cutthroat trout and bull trout, however, the Corps indicates these are highly erosive areas that have little productivity.

The Service believes that, even though each of the six sandy beach sites may experience 10 to 50 foot lateral erosion into the sandy shoreline, minimal impact to coastal cutthroat trout and bull trout or their shallow water habitat will occur. As noted in 5.3.2.2, Ecosystem Indicator - Bedload, above, predicted side-slope adjustments will harm habitat for coastal cutthroat trout and bull trout by alteration of these six areas with shallow water, shoreline habitat. Shallow water habitats provide important feeding and rearing areas for coastal cutthroat trout and bull trout, therefore any effects to these habitats, above those effects or locations predicted in the aquatic species BA, are important to monitor and address. However, these six shoreline habitats are highly erosive and unstable, and do not provide high quality habitat for these species.

Shoreline disposal could potentially disturb and shift the location of shallow water habitat at three proposed shoreline disposal sites. No coastal cutthroat trout and bull trout will be injured during shoreline disposal activities, as dredged materials are discharged above the water line. Therefore, the Service's analysis focused on the potential for disturbing coastal cutthroat trout and bull trout that use existing shallow water habitat within these areas. The three shoreline disposal locations have steep side slopes (around ten percent) that provide about seven acres per mile of shallow water areas. Shoreline disposal will affect a total of about 4.5 miles or 30 acres of shallow water. While 30 acres of shallow water habitats will be periodically impacted during the project life, the three disposal sites are all highly erosive and do not contain many of the

important habitat features that shallow water habitats typically include, such as low velocity, vegetation, and food sources. These sites had previously been approved by NMFS for shoreline disposal because of their low productivity.

The following is the one specific environmental indicator that could be affected by changes to shallow water and flats habitats:

5.3.2.8.1 Benthic Algae

Benthic algae consist primarily of benthic diatoms that occur on sediment grains and larger inorganic material and on macrophytes as epiphytes.

There will be no dredging in the shallow flats and channels where benthic algae primarily occur. Flowlane disposal is not expected to affect benthic algae because it is done below the depth range where benthic algae occur, about 1 meter below MLLW. No dredging or disposal activities are proposed for areas with significant benthic production. The closest potential effect would be from the shoreline disposal at Sand Island (O-86.2). However, the existing currents and erosion rates at the beach nourishment site create a coarse-grained and erosive environment that severely limits the potential for significant benthic production. Accordingly, no effects to benthic production are anticipated in the riverine reach.

Modeling by OHSU/OGI and WES predicts an upstream shift of salinity of less than a mile. Accordingly, there may be an upstream shift in the location of benthic algae production. Any salinity change would occur primarily in the navigation channel, not in productive side channels or lateral habitats. Thus, short-term impacts to benthic algae are likely to be limited. However, long-term Project-related indirect impacts are uncertain (see Table 7-1 of the aquatic species BA). The Service believes long-term risk to food web production for coastal cutthroat trout and bull trout, based on changes to benthic algae production, is limited.

5.3.2.8.2 Shallow Water and Flats Summary

The Service anticipates negative short-term Project-related effects to shallow water and flats habitats will be limited to areas of side slope adjustment and shoreline disposal. Long-term Project effects to shallow water and flats habitats are of moderate uncertainty, with low to moderate risk to adverse habitat modification (see aquatic species BA, Table 7-1). Any long-term, negative changes in shallow water and flats habitat may harm benthic production, feeding, migration, and refugia needs for coastal cutthroat trout and bull trout. Therefore any effects to these habitat conditions, above those effects or locations predicted in the aquatic species BA, are important to monitor and address via the Adaptive Management Process.

5.3.2.9 Water Column

Coastal cutthroat trout have been mainly collected at shallower depths in the naturally-turbid lower Columbia River, estuary, and river mouth. This species is known to use a variety of habitats, including shallow and deep water habitats in other rivers (Giger 1972). The Service believes this species occupies the mid- to upper portion of the lower Columbia River, estuary, and river mouth's water column habitat for movement, migration, and feeding, but also may use deeper water areas. Migratory bull trout, a sight-feeder, also may use the upper water column in the lower Columbia River, where better visibility occurs. Deeper water column habitat in the lower Columbia River, estuary, and river mouth is less used by salmonids, with water deeper than 20 feet believed to be rarely used. Water column habitat adjacent to the navigation channel, turning basins, and berths will be increased to no more than 48 feet deep. The Project may affect water column habitat by a short-term blasting activity, by temporary water clarity reduction during dredging and flowlane disposal activities, and by long-term changes in estuary salinity distribution and ETM range.

Blasting will be done once during Project construction, and will occur only during the in-water work window, following a blasting plan that minimizes impacts to aquatic species. Blasting may have direct effects to coastal cutthroat trout and bull trout, and was discussed in Section 5.3.1 of these Service opinions, Direct Effects. Blasting during the in-water work window minimizes, but does not avoid, direct impacts to coastal cutthroat trout and bull trout, which may use the Warrior Rock area year-round. As noted in Section 5.3.1 above, Direct Effects, the Service believes that development of a Service-approved monitoring plan, that ensures that the proposed blasting measures are implemented, will be important to minimize any injury or death to coastal cutthroat trout and bull trout during blasting activities.

Temporary water clarity reductions will occur from dredging and disposal activities. A proposed impact minimizing action will require all in-water disposal activities, except shoreline and two ecosystem restoration features, to occur below 20 feet in depth, where less coastal cutthroat trout and bull trout use occurs. Ecosystem restoration features at Miller-Pillar and Lois Island embayment are the ecosystem restoration exceptions to the minimization proposal. Effects from ecosystem restoration activities are addressed in Effects Resulting from Proposed Monitoring, Ecosystem Restoration, and Research Proposals section, below. As noted in the Turbidity discussion above, these temporary turbidity increases will not decrease plant growth and subsequent habitat forming processes. However, Project-related turbidity levels may harass coastal cutthroat trout and bull trout by limited impacts to these fishes' physiology and feeding. Although Project construction and maintenance activities may occur outside of the normal November 1 to February 28 in-water work period, and therefore increase turbidity during periods of highest coastal cutthroat trout and bull trout abundance in the Project area, coastal cutthroat trout and bull trout use occurs primarily at depths shallower than 20 feet, and so would not be expected to be impacted by turbidity from dredging and disposal operations. The Service believes these slight increases to natural Columbia River and estuary turbidity levels will occur in deeper water areas where the majority of coastal cutthroat trout and bull trout migration and feeding activities are not occurring, therefore these species should experience only limited harm from increased water column turbidity.

As noted in the ETM and salinity discussions above, the WES RMA-10 and OHSU/OGI models predicted that there was virtually no difference in the habitat opportunity (i.e., salinity "accumulation") between pre- and post-Project modeling runs for important shallow water Cathlamet Bay salmonid habitats, including those used by coastal cutthroat trout. However, a shift in the location of the ETM would occur and may affect the estuarine distribution of nutrients and thereby the location and abundance of coastal cutthroat trout food in shallow water habitats. The risk and uncertainty to the ETM, based on changes in salinity (Table 7-1 of the aquatic species BA), is low in the short-term, but more uncertain in the long-term because of extrapolating modeling results over the life span of the Project.

The following are the three specific environmental indicators that could be affected by changes to water column habitats:

5.3.2.9.1 Deposit Feeders/Suspension-Deposit Feeders/Suspension Feeders

Limited removal of organisms via dredging and burying of deposit feeders, suspension/deposit feeders, and suspension feeders will occur in portions of the navigation channel deep water areas and the three shoreline disposal sites. Flowlane disposal will bury some animals and, if

deposition of sediments is heavy, will result in the partial loss of some communities. Removal and burial effects are expected to be relatively short-lived, with dredge and disposal areas being recolonized by deposit feeders. Deposit feeders occur in low densities in the navigation channel because the sand waves create constantly shifting habitat conditions. In these and other areas of the river, densities fluctuate as a result of constantly changing environmental conditions. No changes to deposit feeders are anticipated in shallow water areas, side channels, or embayments, which are the important locations for salmonid feeding opportunities. Other than the low risk identified to deposit feeders in the bottom of the navigation channel, Table 7-1 of the aquatic species BA suggests that the long-term changes from dredging and disposal to deposit feeders, suspension/deposit feeders, and suspension feeders is uncertain. Because deposit feeders, suspension/deposit feeders, and suspension feeders are prey items for coastal cutthroat trout and bull trout, any removal of these organisms via dredging or disposal may cause short-term harm to these fish species. However, because the loss of food items is limited, will not occur in the most important habitat types, and these invertebrates recolonize dredge and disposal locations rapidly, the Service believes this harm is minimized.

5.3.2.9.2 Mobile Macroinvertebrates

Dredging will result in removal of mobile macroinvertebrates in the channel. Entrainment by dredges is likely lethal to macroinvertebrates. In addition, flowlane disposal may temporarily bury some animals and, if deposition of sediments is heavy, will result in the loss of some members of the group. Removal and burial effects are expected to be relatively short-lived, with dredged areas being recolonized within six to 12 months (Flemmer et al. 1997). Mobile macroinvertebrates located in shallow water, flats, and tidal marsh channels are not likely be affected. Coastal cutthroat trout and bull trout may feed on certain mobile macroinvertebrates, and therefore any loss of these prey items via dredging or disposal may harm these species. However, the Service anticipates this harm from dredging or disposal to be localized to areas of low importance to these species.

Mobile macroinvertebrates in the estuary appear to be adapted to respond rapidly to disturbances and can recolonize areas following these disturbances. Due to this group's wide salinity tolerance, Project-related changes in estuary salinity are not expected to have an effect on the distribution of mobile macroinvertebrates. In addition, since Project-related temperature and suspended sediment changes are not anticipated or will be limited in nature, mobile macroinvertebrates should not be influenced by limited Project-related changes to these indicators.

5.3.2.9.3 Phytoplankton

Because salinity may intrude farther into the estuary as a result of the deeper channel depth, the point where imported phytoplankton contact dilute seawater will be farther upstream from current conditions. Predicted changes in salinity intrusion may affect the location of resident phytoplankton productivity. Based on Table 1 of the aquatic species BA, the short-term impacts to imported and resident phytoplankton productivity changes are likely to be limited, and will not harm coastal cutthroat trout and bull trout. However, long-term impacts over the Project's life, based on the BRT's risk and uncertainty analysis, are uncertain.

5.3.2.9.4 Water Column Summary

The Service anticipates negative, short-term Project-related effects to water column habitats will be limited to blasting areas and areas where in-water disposal is occurring, and to ecosystem indicators associated with inwater disposal. The Service believes that development of a Service-approved monitoring plan that ensures that the proposed blasting measures are implemented, will be important to minimize any injury or death of coastal cutthroat trout and bull trout during blasting activities. The Service believes that only limited harassment from increased water column turbidity will occur to coastal cutthroat trout and bull trout. Removal of deposit feeders, suspension/deposit feeders, suspension feeders, and mobile macroinvertebrates via dredging or disposal activities may cause short-term harm to coastal cutthroat trout and bull trout. Long-term Project effects to water column habitats are of moderate uncertainty, with low risk to adverse habitat modification (see aquatic species BA, Table 7-1). Any long-term, negative changes in water column habitat may harm feeding, migration, and refugia needs of coastal cutthroat trout and bull trout. Therefore any effects to these habitat conditions, above those effects or locations predicted in the aquatic species BA, are important to monitor and address via the Adaptive Management Process.

5.3.2.10 Indicators that Occur in More Than One Key Habitat Type

During informal consultation, consideration was given to whether the proposed Project has the potential, based on post-Project changes in water surface elevation, velocity, and salinity intrusion, to change habitat complexity, connectivity, or conveyance; feeding habitat opportunity; refugia; and habitat-specific food availability associated with tidal marsh and swamps and shallow water and flats habitat areas. These are indicators that may respond to Project-related changes in any of the key habitat types, and therefore reflect an ecosystem approach to impact assessment.

The Corps undertook modeling to examine the potential Project effects on habitat opportunity and key habitat types from changes in water surface elevation, velocity, and salinity intrusion.

The OHSU/OGI and WES RMA-10 modeling results indicate slight changes to water surface elevation, velocity, and salinity intrusion. Within Cathlamet and Grays Bays' tidal marsh and swamps and shallow water and flats habitat habitats, modeling predicted post-Project salinity increases of 0.1 to 0.15 ppt, velocity decreases of 0.05 feet per second, and depth changes of less than 0.02 feet. Habitat opportunity, based on a combined analysis of these indicators, shows no significant difference between pre- and post-Project conditions in tidal marsh and swamps and shallow water and flats habitats. The OHSU/OGI modeling also related these physical parameters to the concept of habitat opportunity (see Bottom et al. 2001). In the modeling example provided by OHSU/OGI, navigation channel improvements are predicted to result in a limited change in habitat opportunity hours for Cathlamet and Grays Bays, based on the depth and velocity criterion and salinity "accumulation."

The two indicators most related to habitat opportunity are feeding habitat opportunity and refugia (see Chapter 5 of the aquatic species BA). Additional indicators related to habitat opportunity are habitat complexity, connectivity, and conveyance; and habitat-specific food availability. Based on the limited impacts indicated by the OHSU/OGI habitat opportunity modeling results, the Service believes the Project will have limited short-term effects on tidal marsh and swamps and shallow water and flats habitat habitats. Limited effects to these key habitats should result in limited effects to associated habitat complexity, connectivity, and conveyance; feeding habitat opportunity; habitat-specific food availability; and refugia for coastal cutthroat trout and bull trout. The Service anticipates limited harm to coastal cutthroat trout or bull trout from changes to habitat opportunity and associated indicators.

Model-generated estimates of habitat opportunity provide an indication of limited change to depth, velocity, and salinity within key habitat types (tidal marsh and swamps and shallow water and flats habitat habitats), but does not predict response by key habitat or other related indicators' to Project-related changes in depth, velocity, and salinity over the long-term. This fact, combined with the risk and uncertainty indications provided in Table 7-1 of the aquatic species BA for habitat opportunity-related indicators, suggest that the long-term impact to these indicators is uncertain. The Service believes any effects to these habitat conditions, above those effects predicted by modeling or presented in the aquatic species BA, are therefore important to monitor over longer time scales and address via adaptive management.

5.3.2.11 Contaminants

Dredging and in-water disposal activities in the navigation channel, turning basins, and berths, and in-water disposal activities in the ocean, along with other natural and anthropogenic processes, could expose salmonids to some contaminants. Of particular concern is resuspension of

persistent organochlorine contaminants including total polychlorinated biphenyls (PCBs) and the pesticide DDT and its metabolites DDE and DDD ($\sum$DDTs), which have bioaccumulated in resident fish and wildlife within the estuary (see terrestrial species Opinion for further description of these concerns). In addition, petroleum compounds, characterized as total polyaromatic hydrocarbons (PAHs), have been identified in lower Columbia River sediments. The organochlorine and PAH contaminants have the ability to impact growth, survival, and reproduction of juvenile salmon and trout, and can cause sublethal effects such as immune dysfunction (Arkoosh et al. 1991; also see aquatic species BA, Appendix B for further discussion of lethal and sublethal impacts of these chemicals on salmonids). Data collected by NMFS indicate that juvenile salmonids within the Columbia River estuary have contaminant body burdens that may already be within the range where sublethal effects may occur, although the sources of exposure are not clear (NWFSC Environmental Conservation Division 2001).

Data are sparse regarding the exact pathways for uptake and bioaccumulation of contaminants by juvenile salmonids in the lower Columbia River, or the relationships between sediment and tissue contamination (see aquatic species BA Appendix B for identification of specific pathways for salmonids). Recent studies suggest that sediments are a major source of hydrophobic contaminants to aquatic biota (Zaranko et al. 1997, Maruya and Lee 1998). In sediments, contaminants are adsorbed to the organic carbon in silt, which is part of the fine particulate fraction. The microbial biofilm that accumulates on the surface of organic particles constitutes the food of certain types of epibenthic invertebrates; together, they make up the pathway by which these contaminants enter food chains involving juvenile salmonids. Thus, juvenile salmonids bioaccumulate organochlorine contaminants and PAHs principally from their food (i.e., epibenthic prey species) as opposed to water. NMFS has documented some contaminants in the epibenthic prey species of juvenile salmonids in the lower Columbia River (NWFSC Environmental Conservation Division 2001).

In order to adequately address the potential contaminant-related impacts from Project activities, it is important to assess the amount of fine-grained (and thereby potentially-contaminated) material retained in the estuary following dredging and disposal activities. According to the aquatic species BA, the Columbia River navigation channel is dominated by course-grained materials (primarily sand) with very low organic carbon, although pockets of fine materials are occasionally encountered, such as within the turning basin at Astoria, Oregon. The navigation channel is characterized by sand waves along the riverbed that move downstream. As the downstream sand movement occurs, bedload transport erodes sand from the upstream face, deposits in the downstream trough, and then buries it with more sand eroded from the upstream face. This transport occurs in a layer only a few sand grains thick. The sand that forms the cutline shoals or sand waves is repeatedly re-exposed to the water column. Consequently, fine

material mixed in with the sand is likely to be swept away as the layers are exposed to the river currents, resulting in the limited potential for release of fines during the dredging activity. The Corps employed a risk-based analysis (see Appendix B of the aquatic species BA) to address the potential resuspension of contaminants (total PCBs, $\sum$DDTs, and total PAHs) produced by Project construction and maintenance activities. The results of the Corps' assessment concluded that contaminant concentrations in the navigation channel sediments posed only negligible risk to juvenile salmonids, whereas some nearshore sediments closest to point sources of contamination posed risks.

It is important to ensure that sufficient sediment samples are available to adequately characterize the nearshore and channel sediment. During their Sediment Quality Evaluation for the Project, the Corps reported 3 of 23 samples chemically analyzed within or near the navigation channel contained fine-grained sediments with detectable levels of DDT, DDE, DDD, and total PCBs. However, none of these samples exceeded DMEF contaminants thresholds. These data and other sediment data were evaluated in the risk assessment for salmonids (see Appendix B of the aquatic species BA), which concluded that sediments from the navigation channel pose negligible risks to salmonids. However, this Appendix B conclusion was based on relatively few sediment samples collected within the navigation channel, especially below RM 40. The Corps has subsequently submitted additional analysis of all available sediment and contaminants data from the Columbia River navigation channel (Corps' April 22, 2002 addendum). The Corps has determined there are no navigation channel sediment and contaminants data which exceed current DMEF contaminants thresholds. These additional data also do not exceed NMFS' thresholds for PCB's (for 75 ng/g dry weight for 1% total organic carbon TOC) and PAH's (1,000 ng/g dry weight sediment) (J. Buck, pers. comm.).

Due to the highly erosive and dynamic nature of the navigation channel, described above, new data contained in the Corps April 22, 2002 addendum, and the Corps' risk analysis results and information provided in Appendix B of the aquatic species BA, the Service believes it unlikely that any contaminants within the navigation channel would be present in high enough concentrations to expose and impact coastal cutthroat trout and bull trout. However, it is unknown how much fine material will be resuspended during Project dredging and disposal activities, or whether or not any of the fine material released would be contaminated. The general lack of organic material and very low organic carbon concentrations in the navigation channel sediments would likely result in rapid transfer of any available carbon and contaminants into salmonid tissues. Even low concentrations of bioaccumulative contaminates would be readily available to salmonids in this situation, and predators higher in the food chain, such as bald eagle, could be more at risk than salmonids. The Service's heightened concern for bald eagle, which has an elevated risk of effect from bioaccumulation of contaminants, is reflected in the Service's

terrestrial species Opinion. Therefore, the Service believes additional navigation channel samples should be periodically collected, and all other new sediment quality data evaluated, on a regular basis, during Project activities to better determine the distribution of fine materials, carbon, or contaminants within the navigation channel.

In summary, the Service believes that dredging and inwater disposal activities associated with the Project could release a small amount of fine-grained sediments. It is uncertain as to whether most of these fine-grained sediments would be uncontaminated (due to the erosional forces within the main channel of the river), or if some of the fine-grained material would be associated with contaminants. In the high-energy environment of the navigation channel, any contaminated material would move rapidly through the system and be deposited outside the flow lane in depositional areas within the estuary, or be transported down the flow lane and into the ocean. Any contaminants that did reach riverine and estuarine depositional areas, combined with contaminants transported and deposited due to natural and other non-Project anthropogenic sources, would eventually be redistributed, resuspended, and transferred along the estuary and river food chain.

The contribution of Project activities to contaminant burdens in salmonids is not well defined and, as such, some uncertainty exists as to Project effects to coastal cutthroat trout and bull trout. The Service therefore supports implementation of the Corps' contaminants research activities ERA-4 and ERA-5, proposed in the aquatic species BA (see Table 8-1) and monitoring action MA-5, proposed in the aquatic species BA (see Table 7-3). However, the Service believes estimated risk of exposure of coastal cutthroat trout and bull trout from contaminated sediments from Project activities appears limited (see Appendix B of the aquatic species BA).

5.4 Effects from Interrelated and Interdependent Activities

5.4.1 Willamette River Navigation Channel Deepening

More than 11 miles of the Willamette River are included in the Project authorized by Congress but are not analyzed in the aquatic species BA or these Service opinions. Concerns over Willamette River sediment contamination and uncertainty regarding the scope and timing of remedial investigations and actions caused the Corps to remove this portion from the proposed action. Potential effects from any future, Willamette River Navigation Channel deepening activity cannot be determined, due to the unknown implications of Superfund cleanup and other remedial actions. If the Corps is to proceed with a Willamette River navigation channel deepening project in the future, the Corps will be required to review the additional effects of future federal action through a separate Act consultation process.

5.4.2 Deepening and Maintenance of Project Berths

Construction and maintenance dredging at a total of seven lower Columbia River berths, associated with three grain facilities, one gypsum plant, and one container terminal, represent actions that are interrelated and/or interdependent to the Project. However, these Service opinions do not provide incidental take coverage for berth dredging, as these activities will undergo future Act consultation. The future Act consultation will initiate upon the Service's receipt of applications for Federal permits, prior to berth dredging activities.

Future berth deepening and maintenance activities are likely to have both direct and indirect impacts on coastal cutthroat trout and bull trout. Direct effects include death or injury due to entrainment during dredging activities. Indirect effects include harm and harassment to coastal cutthroat trout and bull trout via increased turbidity, loss of food resources, and resuspension of contaminants in sediments.

Effects from future berth deepening activities will be minimized due to application of dredging and disposal BMPs and other compliance measures (see Table 2.1 of these Service opinions). Sediment testing, based on DMEF protocols, will ensure dredged materials from berths are disposed in the least impactful method. Additional sediment testing may be required by NMFS and the Service (see discussion of MA-5 in section 3.2.6 of these Service opinions). Dredging activities will occur within the November 1 to February 28 inwater timing window, when coastal cutthroat trout and bull trout abundance is lowest. Dredge activities will occur in deep water, where food resources are limited and most salmonids are not present. Finally, higher quality habitat, associated with key habitat types in the ecosystem conceptual model, are not believed to occur at these existing berth features, and therefore impacts to these habitats will be avoided.

The Service believes berth deepening and maintenance will have limited future adverse effects on coastal cutthroat trout and bull trout. While some of these adverse effects can be successfully minimized by application of BMP's and compliance measures, a limited amount of harm and harassment of coastal cutthroat trout and bull trout is likely to occur from berth deepening and maintenance activities. These berth deepening and maintenance activities will undergo future Act analysis and consultation prior to berth dredging activities to address this incidental take of coastal cutthroat trout and bull trout.

5.4.3 Development of Port Activities and Deep Draft Vessels

Based on the Corps' 1999 FEIS analysis, future development of other lower Columbia River port facilities is not analyzed here as an interrelated or interdependent activity because such

development will be caused by regional market factors such as commodity demand, not by channel improvements. The Corps' April 15, 2002, addendum further supports the Corps' FEIS conclusion that, aside from berth deepening, potential future port development is not interrelated or interdependent with the Project.

Impacts from interdependent ship wakes would occur only if the Project resulted in more frequent or larger, higher-energy ship wakes. Current impacts from shallow- and deep-draft ship traffic utilizing the 40 foot navigation channel are considered part of the environmental baseline and are not considered interrelated or interdependent to the Project; only future, Project-dependent ship traffic is considered in this analysis.

The Corps analysis of post-Project ship wake effects indicated that larger, fully-loaded ships would have a 1-5 percent increase in "blockage ratio" (indicative of slightly higher ship wake generation), whereas smaller vessels would have a 1-5 percent decrease in "blockage ratio" (indicative of slightly lower ship wake generation). The Service concludes that these limited increases and decreases in post-Project ship wake are not likely to increase suspended sediment, shoreline erosion, or increase current rates of ship wake-induced salmonid stranding.

In summary, the Corps concluded in their 1999 FEIS that channel deepening will not induce additional ship traffic, or contribute to development of additional port infrastructure or new ports. This conclusion is consistent with historical vessel traffic trends on the Columbia River and with the market forces that drive port facility development.

5.4.4 Non-indigenous Species Introductions

Several non-indigenous aquatic species are believed to have been introduced into the Columbia River via ballast discharge (e.g., asian clam). These non-indigenous species introductions may continue to occur from ongoing vessel traffic, regardless of the Project's deepened channel. Future deep-draft cargo vessel traffic, interrelated and/or interdependent to the deepened navigation channel, also may introduce additional non-indigenous species. Federal authority for management and regulation of exotic species via ship ballast resides with the U.S. Coast Guard. While the Service believes additional non-indigenous species introductions could have detrimental impacts on Columbia River and estuary ecosystem resources, the Service does not believe that new boat traffic, interrelated and/or interdependent to the deepened navigation channel, will increase the risk of introduced species above current baseline levels.

5.4.5 Summary

If new information is identified which changes the assumptions and/or conclusions of the 1999 FEIS or aquatic species BA regarding the potential for future interrelated and interdependent Project actions, the Corps will need to reinitiate Project consultation to address those activities. Additionally, no other non-Project activities within the lower Columbia River, estuary, or river mouth have been reviewed in this effects analysis. Therefore, any additional actions to deepen or otherwise improve adjacent port facilities not addressed in this Project consultation and conference, would be subject to separate environmental analysis and regulatory review.

5.5 Effects Resulting from Proposed Monitoring, Ecosystem Restoration, and Research Activities

The BRT has identified the monitoring, research and ecosystem restoration components of the proposed action to verify assumptions, reduce scientific uncertainties and provide for long-term beneficial effects to coastal cutthroat trout and bull trout and their important habitats. Substantial scientific information suggests that certain habitat types play a major role in the long-term viability of salmonid populations, including tidal marsh and swamp habitats; shallow water and flats habitats; and water column habitats. The Corps therefore has identified a number of restoration actions that have a high probability of enhancing the availability and productivity of these habitats for salmonids within the Project area. Nevertheless, the implementation of these restoration actions and the implementation of the monitoring and research actions will likely have short term detrimental impacts of limited scope and duration to salmonids .

This section reviews the effects of these components of the proposed action on coastal cutthroat trout and bull trout. The Service notes the difficultly of quantifying effects to coastal cutthroat trout and bull trout from monitoring, research, and restoration action, based upon available information, and further notes that much of the scientific emphasis during this conference and consultation focused upon the effects of the navigation project upon habitat indicators and habitat forming processes that may be of significance to coastal cutthroat trout and bull trout. The modeling efforts did not seek to directly quantify the long-term effects of these restoration or research activities on habitats of importance to coastal cutthroat trout and bull trout. Hence, the effects analyses associated with these monitoring, restoration, and research activities are necessarily of a different and more qualitative nature than those associated with the navigation improvements.

5.5.1 Monitoring Program

Section 2.2.6 of these Service opinions describes the elements of the comprehensive monitoring program that is part of the proposed action, and Table 2.5 enumerates objectives of each element

of the monitoring and their relation to the assumptions or predictions associated with this consultation. In Table 5.2, below, the Service describes the anticipated effects of these monitoring activities. The Service concludes that any adverse effects of implementing a monitoring program are likely to be limited, and will not cause take of coastal cutthroat trout or bull trout.

Table 5.2 Proposed Project Monitoring Activities and Effects of Monitoring Program Implementation

Monitoring Activity	Anticipated Effects of Monitoring Program to Salmonids
Maintain three hydraulic monitoring stations: One downstream of Astoria, one in Grays Bay, and one in Cathlamet Bay. Parameters measured would include salinity, water surface elevation, and water temperature.	Over-water access to maintain monitoring stations should have minimal impacts to salmonids and their habitats.
Monitor annual dredging volumes from both construction and O&M activities.	None
Conduct main channel bathymetric surveys throughout Project area.	Over-water access to conduct bathymetric surveys should have minimal impacts to salmonids and their habitats.
Repeat estuary habitat surveys being conducted by NMFS.	Over-water and aerial access to conduct habitat surveys should have minimal impacts to salmonids and their habitats.
Review the SEDQUAL database and other available data to determine if there are areas that would require additional sampling. Review existing contaminants database using NMFS guidelines or trigger values that are more protective of salmonids and trout. Provide notification during construction dredging to monitor for presence of fine-grained material – i.e., oily sheens.	Over-water access to conduct additional sediment surveys, and substrate-disturbing activities associated with additional surveys should have minimal impacts to salmonids and their habitats.
Monitor the incidence of stranding of juvenile salmon on beaches in action area. Field surveys will be made monthly at selected beaches (upper, mid, and lower river) during the April-August out-migration to measure the number of fish being stranded along beaches.	Over-water access to conduct salmonid stranding surveys should have minimal impacts to salmonids and their habitats. Handling of stranded salmonids is anticipated. Procedures for salvaging ESA-listed salmonids are provided in this Opinion's Incidental Take Statement.

5.5.2 Ecosystem Restoration Activities

The Corps proposed several ecosystem restoration activities to create or improve salmonid habitat, specifically tidal marsh/swamp and shallow water/flats habitat. Six of the seven new restoration features proposed by the Corps (Lois Island Embayment Habitat Restoration, Purple Loosestrife Control, Miller/Pillar Habitat Restoration, Tenasillahe Island Interim and Long-term Restoration, and Bachelor Slough Restoration) occur in-water and have the potential, during implementation, to affect coastal cutthroat trout and, for the above-estuary restoration projects, bull trout. The translocation of Columbian white-tailed deer to Cottonwood/Howard Island will have no effect on coastal cutthroat trout and bull trout as the action is upland in nature. Two of

the three original restoration actions identified in the FEIS (Columbia River Tidegate Retrofits and Walker-Lord and Hump-Fisher Islands Channel Connectivity Enhancements) occur in-water, so they also have the potential to affect coastal cutthroat trout and bull trout. Other original FEIS restoration actions (e.g. Shillapoo Lake) are disconnected from coastal cutthroat trout and bull trout habitats and will not have either beneficial or detrimental effects to coastal cutthroat trout and bull trout. Section 8.0 of the aquatic species BA and Chapter 4 of the Corps 1999 FEIS describe the proposed restoration activities and their effects on salmonids, including coastal cutthroat trout and bull trout. Both descriptions are incorporated here by reference.

5.5.2.1 Lois Island Embayment

Construction actions for the Lois Bay embayment restoration feature may result in temporary impacts to coastal cutthroat trout. Materials to be placed in the embayment are primarily clean, medium-grained sands that meet the guidelines for in-water placement in accordance with the DMEF. Consequently, transfer of contaminated sediments is avoided, and the turbidity plume associated with discharge into the restoration site is expected to be limited.

However, since several dredge and fill events at the temporary sump and Lois Island restoration sites will occur, there are opportunities for benthic organisms, other salmonid prey items, and coastal cutthroat trout to be affected during dredging and disposal. These actions may cause direct taking of a limited number of coastal cutthroat trout via death and injury from material disposal in shallow water Lois Island embayment habitats and deeper water temporary sump habitat, harm to coastal cutthroat trout via loss of prey items, and harassment of coastal cutthroat trout via the turbidity plume. The Service believes these effects should be limited to the sediment storage site and restoration site and will be very short in duration. In addition, placement of sediments into the Lois Island embayment will be restricted to the November 1 to February 28 in-water work window, to minimize impacts to coastal cutthroat trout. Recolonization of the restored embayment by plants will take five to ten years or more, depending on the species and their means of colonization. The tidal marsh fringing the embayment and the large expanses of tidal marsh in Cathlamet Bay represent a large source of plant propagules for the restoration site. Similarly, benthic organisms are abundant in Cathlamet Bay and represent an excellent source population for rapid recolonization of the embayment. Benthic productivity and related use by salmonids may be less for an undetermined interim period as populations reestablish and densities increase. The proposed restoration feature will be beneficial to coastal cutthroat trout in the long-term because, as tidal marsh habitats recolonize, primary (plant) and benthic productivity should approach historical levels. The proposed restoration feature would benefit coastal cutthroat trout by improving habitat complexity,

connectivity, or conveyance, feeding habitat opportunity, refugia and habitat-specific food availability.

5.5.2.2 Purple Loosestrife Control

The restoration feature for purple loosestrife control would include an integrated pest management approach using biological agents, herbicides, and mechanical control measures. These actions would typically occur in the upper elevations of tidal marsh habitat and have little likelihood of adversely affecting coastal cutthroat trout, directly or indirectly. RODEO, an EPA-registered chemical approved for over-water application, would be used in conjunction with the other control measures.

RODEO application may result in the short-term, very limited loss of some native vegetation, and will create openings in marsh habitat where non-native plants previously existed. The herbicide will be wicked and spot-sprayed on to purple loosestrife by hand, thereby limiting chemical contact with water. Wicking also lessens the potential for impacts to native vegetation. Mechanical control (pulling) would only affect a small area at any given time, typically during lower tidal stages.

By helping to eradicate purple loosestrife in the Columbia River estuary and thereby reestablish the diverse native vegetation of tidal marsh habitats, this restoration feature is likely to benefit coastal cutthroat trout. These changes should benefit habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability.

5.5.2.3 Miller/Pillar Habitat Creation

Construction actions for the Miller/Pillar habitat creation may result in temporary impacts to coastal cutthroat trout. Construction of this restoration action may result in the temporary displacement of coastal cutthroat trout from the immediate area of the discharge pipe and the pile dike construction location, and temporary loss of benthic prey items.

Materials to be used for habitat creation are primarily clean, medium-grained sands that meet the guidelines for in-water placement in accordance with the DMEF. Consequently, transfer of contaminated sediments is avoided, and the turbidity plume associated with discharge into the restoration site is expected to be limited. These actions may cause direct taking of a limited number of coastal cutthroat trout via death and injury from material disposal in shallow water habitats, harm to coastal cutthroat trout via loss of prey items, and harassment of coastal

cutthroat trout via the turbidity plume. The Service believes these effects should be limited to the restoration site and will be very short in duration.

Once construction is completed, future potential disturbance actions would be limited to maintenance of the new pile dikes, an intermittent effort over many years. Pilings and spreaders would be fitted with bird excluders to minimize or eliminate use by double-crested cormorants. A previous study has established that driving of wood piles with an impact hammer does not produce sounds that are in the hearing range of salmonids (Carlson et al. 2001).

The construction and maintenance of this restoration action, for the short-term, are likely to adversely affect coastal cutthroat trout shallow water and water column habitat, and temporarily remove some food resources, but will benefit coastal cutthroat trout by providing more productive habitats for benthic invertebrates and thus coastal cutthroat trout as well. This habitat restoration feature should result in improvements to habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia and habitat-specific food availability.

5.5.2.4 Tenasillahe Island Tidegate and Inlet Modifications

This ecosystem restoration feature will improve both habitat connectivity and water quality of interior channels. Coastal cutthroat trout should be able to access additional acres of productive tidal marsh and swamp habitat for rearing and foraging. Construction impacts from tidegate installation and inlet modification are anticipated to be of short duration (a few days to two weeks). However, since inwater work would be required, some limited duration harassment of coastal cutthroat trout from the turbidity plume may occur. Through appropriate timing, impacts to coastal cutthroat trout in the immediate construction area can be further minimized. The Service anticipates that this action will benefit coastal cutthroat trout by opening up access to productive rearing and refuge areas that are not now accessible to coastal cutthroat trout. This action will result in improvements to water quality, habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia and habitat-specific food availability.

5.5.2.5 Tenasillahe Island Historical Habitat Restoration

Long-term Tenasillahe Island restoration activities will only occur if Columbian white-tailed deer were delisted and the eventual long-term Tenasillahe Island restoration plan was consistent with the Julia Butler Hansen National Wildlife Refuge's purpose and goals. This future restoration action will be developed in the future, and therefore will undergo site-specific Section 7 consultation when fully designed. Conceptually, the Service believes that, should this project be undertaken, numerous ecosystem indicators would be benefitted, including tidal marsh and

swamp habitat, and all pathways associated with habitat primary productivity, food web, salmonid growth, and salmonid survival.

5.7.2.6 Bachelor Slough

This project is designed to increase river flows traveling through the slough, with associated improvements in water quality and connectivity. Coastal cutthroat trout and bull trout would be more likely to be attracted to Bachelor Slough under these changed conditions during their migrations. Cooler temperatures would be beneficial to fish in Bachelor Slough. Additionally, six acres of riparian habitat would be restored along the Bachelor Slough shoreline, plus additional riparian forest habitat would be developed on the disposal areas associated with this activity.

Dredging would occur between July 1 and September 15, to avoid periods when salmonids are most abundant. All disposal materials would be placed on existing disposal sites or upland areas. Disposal of material dredged from Bachelor Slough provides an opportunity to develop riparian forest. Riparian forest restoration would provide for detrital and insect export to the Columbia River. Permanent riparian forest habitat would provide for export of large woody debris to the Columbia River and its estuary over the long term.

Bachelor Slough sediment quality would be evaluated prior to implementation of the restoration feature to ensure dredge-released contaminants would not occur. The project would be modified if contaminants were determined to be outside established regulatory parameters for upland disposal. Timing restrictions for pipeline dredging will minimize impacts to coastal cutthroat trout and bull trout from dredging operations. Due to the project timing and the current, low quality salmonid habitat in Bachelor Slough, the Service does not believe this project will have adverse effects on coastal cutthroat trout and bull trout.

5.5.2.7 Columbia River Tidegate Retrofits

The Corps has proposed to retrofit the tidegates on five tributaries to the Columbia River, and to conduct additional tidegate retrofit activities on other tributaries in the future. The Oregon tributaries include Tide Creek, Grizzley Slough, and Fertile Valley Creek, and the two Washington tributaries include Burris Creek and Deep River. Further information on these proposals is located in Chapter 8.4 of the aquatic species BA and Chapter 4 of the Corps 1999 FEIS. That information is incorporated here by reference. Construction actions are of short duration (e.g., less than one week per structure) and soil disturbance, thus turbidity, would typically be limited in nature. If the entire tide gate and associated culvert require replacement, temporary coffer dams would be placed on each end of the culvert to preclude sediment impacts

to the stream. However, since inwater work would be required, some limited duration harassment from the turbidity plume may occur to coastal cutthroat trout and bull trout.

The tidegate retrofit restoration feature is estimated to provide or improve fish access to 38 miles of tributary streams. These tributaries contain spawning, stream rearing, and (near their confluence with either the Columbia River or a more major tributary) backwater channel and freshwater marsh habit for rearing and/or overwinter refuge from floods. Additionally, the Corps would replace additional tidegates with these same methodologies, if additional tidegate retrofit projects were identified. This action should result in short- and long-term improvements to habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability by reconnecting the Columbia River to these tributary streams.

5.5.2.8 Walker/Lord and Hump/Fisher Islands Channel Connectivity Enhancements

The purpose of this restoration action is to improve water flow and circulation through this island complex, thereby lowering embayment temperatures and creating a network of channels. This feature should increase habitat connectivity and improve foraging conditions for coastal cutthroat trout and bull trout. Construction activities are primarily upland in nature and involve construction of a channel in a historical dredged material deposition area. A brief period of in-water construction would occur when the channels at the embayment and river are opened. Given the short duration of the construction action and the fact that material to be excavated is primarily medium-grained sand, turbidity in adjacent waters should be of short duration and extent. Construction timing would typically be late summer to take advantage of lower water levels, dry soil conditions, and the general absence of fish. As a result, the potential for short-term adverse impacts to coastal cutthroat trout and bull trout would be minimized. Due to timing and location of the inwater action, the Service does not believe the restoration action will take coastal cutthroat trout and bull trout. This restoration will provide some short- and long-term improvements to habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability.

5.5.2.9 Martin Island Embayment Modification

The project objective of this wildlife mitigation action is to create tidal marsh habitat, which would increase detrital export to the Columbia River. The Proposed action may have some adverse effect on an aquatic environment, including smothering of plants, algae, invertebrates, and potentially coastal cutthroat trout and bull trout. These actions may cause limited taking of coastal cutthroat trout and bull trout via death and injury from material disposal in shallow water

habitats, harm to coastal cutthroat trout and bull trout via loss of prey items, and harassment of coastal cutthroat trout and bull trout via the turbidity plume. The Service believes these effects should be limited to the restoration site and will be very short in duration. Construction placement of dredged material and topsoil will temporarily increase turbidity, although a barrier placed at the inlet will minimize turbidity export to the adjacent side channel. However, the principal material to be placed into the embayment is primarily clean, medium-grained sand from the navigation channel, which would minimize impacts from turbidity and avoid bioaccumulation of contaminants. In the long term, the project would benefit benthic invertebrates, including those species that are used as forage resources by coastal cutthroat trout and bull trout, and improve habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia and habitat-specific food availability. In addition, development of tidal marsh habitat would not preclude use of the embayment by coastal cutthroat trout and bull trout except during low tide periods.

5.5.3 Ecosystem Research Actions

Ecosystem research actions are measures proposed by the Corps to assist the efforts of the Corps, NMFS, the Service, and others in understanding the broader issues of the lower Columbia River, estuary, and river mouth ecosystem. These research actions address indicators of the salmonid conceptual model, and are intended to provide useful information for the conservation and recovery of coastal cutthroat trout and bull trout. The annual and cumulative results will be presented to the adaptive management team. The Service strongly supports implementation of these ecosystem research activities.

Effects to coastal cutthroat trout and bull trout and two listed terrestrial species, bald eagles and brown pelicans, are expected to occur from implementation of ecosystem research activities. Because any impact to coastal cutthroat trout and bull trout from research activities is directed and intentional, instead of incidental to the purpose of the action, the future implementation of these research activities may require the issuance of research permits authorizing direct take of listed species by either NMFS or the Service under Section 10(a)(1)(A) of the Act.

5.6 Summary of Effects of the Proposed Action on the Biological Requirements of Coastal Cutthroat Trout and Bull Trout

The analysis in 5.3.1 of these Service opinions indicate that direct effects to coastal cutthroat trout and bull trout would be limited. The Service agrees with the aquatic species BA's general assessment of potential Project indirect effects during the two year construction period of navigation improvements. Based on the conceptual model, impacts to key physical processes

have the potential for affecting habitat forming processes, i.e., the "building blocks"of salmonid habitat in the lower Columbia River, estuary, and river mouth. Those key physical processes include suspended sediment, accretion/erosion, turbidity, salinity, bathymetry, and bedload. The impacts to those key physical processes will be of a limited nature during the Project construction period, were discussed during the SEI panel process, and validated using the numerical modeling conducted by WES and OHSU/OGI. These results indicate that the indirect effects of the Project on coastal cutthroat trout and bull trout in the short-term is limited.

Based on these limited, short-term direct and indirect Project effects, the Service believes population numbers of coastal cutthroat trout and bull trout will not be appreciably reduced. The Service also believes that the Project will not appreciably reduce, other than during short-duration and limited locations of salmonid avoidance of dredging and disposal operations, the distribution of coastal cutthroat trout and bull trout. Because no coastal cutthroat trout or bull trout spawning habitat occurs in or adjacent to the Project, the Project will not cause loss of spawning habitat. Overall, the Service believes the short-term direct and indirect effects of the Project will not appreciably reduce any of the coastal cutthroat trout and bull trout population numbers, distribution within each DPS, or reproductive success.

The aquatic species BA has characterized many of these changes to key habitats and indicators over the short-term as not being significant. The Corps believe that because these predicted changes are within the natural variation of river conditions (e.g., changes to the ETM, accretion/erosion rates) or will not change river conditions at all (e.g., bedload changes, volume and rate of suspended sediment transport, water level changes to the estuary, structure, distribution, net productivity, and detritus production of marshes and swamps, the location of mobile macroinvertebrates, velocity changes in shallow water habitats and available refugia, salinity changes as they impact habitat types, bathymetry, and the impact on habitat opportunity as it relates to water depth in the estuary), that the Project will have limited effects.

During the conference and consultation process, the Service identified certain issues regarding potential long-term effects of the Project. These have centered on limited effects that may be caused by Project actions that are not detectable in the short term, but may affect salmonid habitats over the life span of the Project. This could include ecosystem effects that are not identifiable based on the Service's review of best available science and our current understanding of the ecosystem. Topics of concern identified during this reinitiation include those related to the ETM, formation and preservation of tidal marsh and swamp habitats, habitat opportunity changes in isolated geographic areas, and elimination of connectivity between habitats relied on by salmonids.

The changes to physical processes resulting from the Project will likely result in a limited, incremental, but permanent change in the physical conditions in the lower Columbia River, estuary, and river mouth. Any changes in a static system should be predictable, using modeling and other tools, over the life span of the Project. However, the ecosystem of the lower Columbia River, estuary, and river mouth is not a static system. Numerical modeling cannot account for this non-static state. As acknowledged in the aquatic species BA, these changes will result in a new dynamic equilibrium in the lower Columbia River, estuary, and river mouth ecosystem.

Not withstanding the Corps' assessments, the Service believes that the predicted changes to the lower Columbia River, estuary, and river mouth physical system should not be extrapolated over the life span of the Project without additional monitoring and verification. In the example developed as part of the OHSU/OGI modeling for the reinitiation of consultation, the potential changes to habitat opportunity in Cathlamet Bay for five one-week model simulations (Table 6-1 of the aquatic species BA) is a model simulation run over a short time duration. The aquatic species BA indicates that the proposed actions "will not have an impact on habitat opportunity as it relates to water depth." Based on the information provided in the aquatic species BA, extrapolating these results over the life span of the Project instead of limiting those results to the period modeled does not fully acknowledge potential model limitations or long-term variability in the ecosystem.

A key conclusion identified during the SEI panel process and BRT discussions was that risk and uncertainty existed regarding whether the predicted physical changes will have negative, positive, or neutral effects to listed salmonids or their habitats. That level of risk and uncertainty also surrounded the biological response of coastal cutthroat trout and bull trout to those potential physical changes over the life span of the Project. Therefore, the BRT conducted a qualitative risk and uncertainly analysis (see Table 7-1 of the aquatic species BA). That analysis documented the need for a precautionary approach to the protection of ecosystem elements (i.e., key indicators within each pathway of importance to salmonids). Therefore, the Corps proposes, and the Service agrees, that the development of a robust Monitoring Program and Adaptive Management Process is appropriate to address the Project-related risk and uncertainties raised surrounding the key coastal cutthroat trout and bull trout habitat pathways and indicators identified in these Service opinions.

5.7 Updated Analysis of Effects for Columbian White-tailed Deer and Bald Eagle

5.7.1 Columbian White-tailed Deer Effects

The aquatic species BA (8.4.1.2) provides an overview of ecosystem restoration effects to Columbian white-tailed deer. Only the Cottonwood/Howard Island Columbian white-tailed deer reintroduction and the Tenasillahe Island interim restoration activities could have an adverse influence on Columbian white-tailed deer.

Because Columbian white-tailed deer reintroduction activities, including capture from source sub-population, translocation, and subsequent release on Cottonwood/Howard islands, will potentially cause take of Columbian white-tailed deer, the Service will acquire a section 10(a)(1)(A) recovery permit for these activities. The Corps' action of supporting, via cost-share agreement, the Service's translocation activities will not have an adverse effect on the Columbian white-tailed deer. The Service believes a long-term habitat management plan should be developed between the Service and the Cottonwood/Howard islands landowners to ensure management actions provide for long-term, secure Columbian white-tailed deer habitat.

Tenasillahe Island interim restoration activities will occur adjacent to Columbian white-tailed deer habitat, and may, both during interim project construction and future tidegate operations, influence Columbian white-tailed deer. Two tidegates will be replaced and two control inlets will be constructed on Tenasillahe Island, requiring short-duration construction activity. The Service believes this construction activity, on previously-modified flood-control levees, will cause limited harassment of Columbian white-tailed deer. Tidegates will be designed to ensure that Columbian white-tailed deer habitat will not be flooded during daily tidal or high water events. The Service believes the Corps actions, through careful hydraulic engineering analysis, tidegate design, and proper instruction to Service staff regarding tidegate operation, will minimize potential longer-term impacts to Columbian white-tailed deer or their habitats at Tenasillahe Island from this interim restoration activity.

The long-term Tenasillahe Island restoration action will not occur until the Columbia population of Columbian white-tailed deer are delisted, and the Julia Butler Hansen National Wildlife Refuge has completed a thorough compatibility evaluation of long-term Tenasillahe Island restoration action's influence on the Julia Butler Hansen National Wildlife Refuge's purpose and needs. Additionally, as indicated by the aquatic species BA, no Columbian white-tailed deer incidental take coverage for the long-term restoration activities will be necessary if the population has been

delisted. Therefore, the Service does not provide any analysis of effects to Columbian white-tailed deer from this in-the-future restoration activity.

Restoration projects are anticipated to have a long-term benefit on Columbian white-tailed deer, as these projects restore habitat functions at the restoration sites, and potentially allow expansion of existing Columbian white-tailed deer into new, suitable habitats in the lower Columbia River and estuary.

5.7.2 Bald Eagle Effects

The aquatic species BA (8.4.1.3) provides an overview of ecosystem restoration effects to bald eagle. The Corps determined that effects to bald eagles would be limited to short-term harassment of bald eagles during restoration projects' construction. Restoration projects are anticipated to have a long-term benefit on bald eagles, as these projects restore habitat functions.

Three pairs of bald eagles nest near the Lois Island embayment restoration project; one pair (John Day Point/Lois Island pair) may be within ½ mile of the restoration activities, and within line-of-sight, thereby increasing the likelihood of short-term harassment. One bald eagle pair nests on Miller Sands Island near the Miller/Pillar habitat restoration project. Two bald eagle pairs nest on Tenasillahe Island near the Tenasillahe Island interim and long-term restoration actions, and two bald eagle nesting territories occur near the Bachelor Slough restoration project. Approximately 30 additional nesting pairs occur throughout the estuary and lower Columbia River, estuary, and river mouth.

Bald eagles may exhibit nesting behavior from January 1 to August 31, therefore any restoration activities within this period may influence bald eagle nesting success. The Corps has determined that the Bachelor Slough project, which is located next to the Bachelor Slough bald eagle pair, is the only ecosystem restoration action that occurs immediately adjacent to a bald eagle nest. Therefore, to avoid bald eagle harassment while nesting, the Bachelor Slough restoration action will be implemented later in the nesting period, preferably between August to October. Due to the varying proximity of restoration projects to the Bachelor Slough and Miller Sands Island pairs, and the three nesting bald eagle pairs near Lois Island embayment, bald eagle foraging behavior may be variably influenced by restoration activities. The Service generally recommends, to avoid impacts to bald eagle behavior, that human activities occur at least ½ mile line-of-sight from bald eagle activity areas. However, since these restoration projects are more than 1,500 feet from adjacent bald eagle nests, and construction is of short duration, any bald eagle harassment is limited. Restoration projects also are generally limited in size, thereby providing ample alternative foraging areas for bald eagles. The Service believes, since these bald eagles currently

experience a variety of human activities near their nesting and foraging areas, that these short-term ecosystem restoration construction activities will not create impacts that are new or unusual for bald eagles. Finally, to protect the approximately 30 nesting pairs dispersed throughout the Project area, the Corps proposes to operate the Purple Loosestrife Control project boats at least 1,500 feet from known nest sites.

The Service believes the Corps has adequately attempted to minimize and avoid adverse restoration project construction effects on bald eagle. However, there will be a limited amount of harassment of bald eagle during restoration project activities. The Service believes, in the long term, restoration projects will benefit bald eagle populations in the Columbia Recovery Zone.

6.0 CUMULATIVE EFFECTS

6.1 Introduction

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in these Service opinions. The action area of the proposed action under consideration encompasses the lower Columbia River (from Bonneville Dam downstream to the upper end of the estuary at RM 40), estuary (RM 40 to RM 3), and river mouth (RM 3 to the deep water disposal site). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Project area is currently a disturbed estuarine and riverine ecosystem altered by previous dredging to establish the navigation channel, disposal of dredged material, diking and filling, sewage and industrial discharges, water withdrawal, and flow regulation, to highlight a few of the anthropogenic activities that have occurred over the last 100 years. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or will be) reviewed through separate Section 7 consultation processes and are not considered cumulative effects.

State, Tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives. Government and private actions may include changes in land and water use patterns, including ownership and intensity, any of which could affect listed species. Even actions that are already authorized are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area, which encompasses numerous government entities exercising various authorities and many private land holdings, make any analysis of cumulative effects difficult. This section identifies representative

actions and ongoing state and Tribal fish and habitat restoration plans that, based on currently available information, are reasonably certain to occur. It also identifies, to the extent currently possible, existing goals, objectives, and proposed plans by state and Tribal governments. However, the Service is unable to determine at this point in time whether such proposed plans will in fact result in specific actions which will subsequently lead to cumulative effects.

6.2 State Actions

Each state in the Columbia River basin administers the allocation of water resources within its borders. Water resource development has slowed in recent years. Most arable lands have already been developed, the increasingly diversified regional economy has decreased demand, and there are increased environmental protections. If, however, substantial new water developments occur, cumulative adverse effects to listed species are likely. The Service cooperates with the state water resource management agencies in assessing water resource needs in the Columbia River basin. Through restrictions in new water developments, vigorous water markets may develop to allow existing developed supplies to be applied to the highest and best use. Interested parties have applied substantial pressure, including ongoing litigation, on the state water resource management agencies to reduce or eliminate restrictions on water development. It is, therefore, impossible to predict the outcomes of these efforts with any reasonable certainty.

In the past, each Columbia River Basin state's economy depended on natural resources, with intense resource extraction. Changes in the states' economies have occurred in the last decade and are likely to continue, with less large-scale resource extraction, more targeted extraction, and significant growth in other economic sectors. Growth in new businesses, primarily in the technology sector, is creating urbanization pressures and increased demands for buildable land, electricity, water supplies, waste-disposal sites, and other infrastructure.

Economic diversification has contributed to population growth and movement in all four states, a trend likely to continue for the next few decades. Such population trends will result in greater overall and localized demands for electricity, water, and buildable land in and near the action area; will affect water quality directly and indirectly; and will increase the need for transportation, communication, and other infrastructure. The impacts associated with these economic and population demands will probably affect habitat features such as water quality and quantity, which are important to the survival and recovery of the listed species. The overall effect will be negative, unless carefully planned for and mitigated.

Some of the state programs described above are designed to address impacts to habitat features. Oregon also has a statewide, land-use planning program that sets goals for growth management

and natural resource protection. Washington State enacted a Growth Management Act to help communities plan for growth and address the effects of growth on the natural environment. If the programs continue, they may help lessen the potential for the adverse effects discussed above.

In July 2000, the governors of Idaho, Montana, Oregon, and Washington released their "Recommendation for the Protection and Restoration of Fish in the Columbia River Basin," with the stated goal of "protection and restoration of salmonids and other aquatic species to sustainable and harvest able levels meeting the requirements of the Endangered Species Act, the Clean Water Act, the Northwest Power Act and tribal rights under treaties and executive orders while taking into account the need to preserve a sound economy in the Pacific Northwest." The recommendations include the following general actions related to the Lower Columbia River:

Habitat Reforms

- Designate priority watersheds for salmon and steelhead.
- Provide local watershed planning assistance and develop the priority plans by October 1, 2002, and for all Columbia River basin watersheds by 2005.

- Integrate Federal, state, and regional planning processes with the Northwest Power Planning Council's amended Fish and Wildlife Program.
- Cooperate with Federal, Tribal, and local governments to implement the National Estuary Program for the Lower Columbia River estuary, including creation of salmon sanctuaries.

Funding and Accountability

- Seek funding assistance for existing activities designed to improve ecosystem health and fish and wildlife health and protection.
- Work regionally to create a standardized and accessible information system to document regional recovery progress.

If these recommendations are implemented by the states individually and collectively, they should have beneficial effects on listed species and their habitats.

6.2.1 Oregon

Most future actions by the state of Oregon are described in the Oregon Plan for Salmon and Watershed measures, which includes the following programs designed to benefit salmon and watershed health in the lower Columbia River:

- Oregon Department of Agriculture water quality management plans.
- Oregon Department of Environmental Quality development of Total Maximum Daily Loads (TMDLs) in targeted basins; implementation of water quality standards.
- Oregon Watershed Enhancement Board funding programs for watershed enhancement programs, and land and water acquisitions.
- Oregon Department of Fish and Wildlife (ODFW) and Oregon Water Resources Department (OWRD) programs to enhance flow restoration.
- OWRD programs to diminish over-appropriation of water sources.
- ODFW and Oregon Department of Transportation programs to improve fish passage; culvert improvements/replacements.
- Oregon Division of State Lands and Oregon Parks Department programs to improve habitat health on state-owned lands.
- State agencies funding local and private habitat initiatives; technical assistance for establishing riparian corridors; and TMDLs.

If the foregoing programs are implemented, they may improve habitat features considered important for the listed species. The Oregon Plan also identifies private and public cooperative programs for improving the environment for listed species. The success and effects of such programs will depend on the continued interest and cooperation of the parties.

6.2.2 Washington

The state of Washington has various strategies and programs designed to improve the habitat of listed species and assist in recovery planning. Washington's 1998 Salmon Recovery Planning Act provided the framework for developing watershed restoration projects and established a funding mechanism for local habitat restoration projects. It also created the Governor's Salmon Recovery Office to coordinate and assist in the development of salmon recovery plans. Washington's "Statewide Strategy to Recover Salmon," for example, is designed to improve watersheds.

The Watershed Planning Act, also passed in 1998, encourages voluntary planning by local governments, citizens, and Tribes for water supply and use, water quality, and habitat at the Water Resource Inventory Area or multi-Water Resource Inventory Area level. Grants are made available to conduct assessments of water resources and to develop goals and objectives for future water resources management. The Salmon Recovery Funding Act established a board to localize salmon funding. The board will deliver funds for salmon recovery projects and activities based on a science-driven, competitive process. These efforts, if developed into actual programs, should help improve habitat for listed species.

Washington's Department of Fish and Wildlife and tribal comanagers have been implementing the Wild Stock Recovery Initiative since 1992. The comanagers are completing comprehensive species management plans that examine limiting factors and identify needed habitat activities. The plans also concentrate on actions in the harvest and hatchery areas, including comprehensive hatchery planning. The Department and some western Washington treaty Tribes have also adopted a wild salmonid policy to provide general policy guidance to managers on fish harvest, hatchery operations, and habitat protection and restoration measures to better protect wild salmon runs.

Washington State's Forest and Fish Plan were promulgated as administrative rules. The rules are designed to establish criteria for non-Federal and private forest activities that will improve environmental conditions for listed species. The Washington legislature may amend the Shoreline Management Act, giving options to local governments for complying with endangered species requirements in marine areas.

The state of Washington also established the Lower Columbia Fish Recovery Board to begin drafting recovery plans for the lower Columbia region. The future impacts of the board's efforts will depend on legislative and fiscal support. The Washington Department of Transportation is

considering changing its construction and maintenance programs to diminish effects on stream areas and to improve fish passage.

Water quality improvements will be proposed through development of TMDLs. The state of Washington is under a court order to develop TMDL management plans on each of its 303(d) water-quality-listed streams. It has developed a schedule that is updated yearly; the schedule outlines the priority and timing of TMDL plan development.

Washington State closed the mainstem Columbia River to new water rights appropriations in 1995. All applications for new water withdrawals are being denied based on the need to address endangered species issues. The state established and funds a program to lease or buy water rights for instream flow purposes. This program was started in 2000 and is in the preliminary stages of public information and identification of potential acquisitions. These water programs, if carried out over the long term, should improve water quantity and quality in the state.

As with Oregon's state initiatives, Washington's programs are likely to benefit listed species if they are implemented and sustained.

6.3 Local Actions

Local governments will be faced with similar and more direct pressures from population growth and movement. There will be demands for development in rural areas, as well as increased demands for water, municipal infrastructure, and other resources. The reaction of local governments to growth and population pressure is difficult to assess without certainty in policy and funding. However, future development in Oregon will be governed for the foreseeable future by Oregon's statewide land use planning program, and Washington's will be governed by its Growth Management Act, both of which address issues of natural resource protections.

Increased industrialization associated with regional economic trends and growth patterns may also have the potential to result in additional dredging around dock facilities, alteration and loss of riparian areas, increased pollution, alteration and loss of shallow water habitat, and potential additional dredging for deeper access channels to enable ports to compete with other west coast port facilities. Because there is little consistency among local governments regarding current ways of dealing with land use and environmental issues, both positive and negative effects on listed species and their habitats from other development caused by regional and national growth trends will probably be scattered throughout the action area.

In Oregon and Washington, most local governments are considering ordinances to address effects on aquatic and fish habitat from different land uses. The programs are part of state planning structures; however, local governments in Oregon are likely to be cautious about implementing new programs, because of the passage of the constitutional amendment (Measure 7) pertaining to compensation to private landowners. Local governments may also participate in regional watershed health programs, although political will and funding will determine participation and, therefore, the effect of such actions on listed species.

As identified in the FCRPS Hydropower Opinion, the Lower Columbia River Estuary Partnership (LCREP) works with private environmental groups, Federal, state, and local governments on ecosystem protection of the lower Columbia River. Through continued implementation of their Comprehensive Conservation and Management Plan (CCMP), LCREP encompasses a watershed wide perspective, cross cutting political boundaries to address land use, water quality, and species protection. LCREP coordinates and implements a program for conservation of the lower Columbia River. LCREP is also actively working with the Services on recovery planning for salmonids. Thus, there is potential for a comprehensive, cohesive, and sustained program for species recovery in the lower Columbia River.

6.4 Tribal Actions

Tribal governments will participate in cooperative efforts involving watershed and basin planning designed to improve aquatic and fish habitat. The earlier discussion of the effects of economic diversification and growth applies also to Tribal government actions. Tribal governments have to apply and sustain comprehensive and beneficial natural resource programs such as the ones described below, to areas under their jurisdiction to have measurable positive effects on listed species and their habitats.

One Tribal program illustrates future Tribal actions that should have such positive effects. The *Wy-Kan-Ush-Mi Wa-Kish-Wit*, or "Spirit of the Salmon" plan is a joint restoration plan for anadromous fish in the Columbia River basin prepared by the Nez Perce, Umatilla, Warm Springs and Yakama Tribes. It provides a framework for restoring anadromous fish stocks, specifically salmon, Pacific lamprey (eels), and white sturgeon in upriver areas above Bonneville Dam. The plan's objectives related to the estuary are as follows:

- Protect the remaining wetlands and intertidal areas in the estuary upon which anadromous fish are particularly dependent.
- Undertake an immediate assessment of remaining and potential estuary habitat.
- Protect existing estuary habitat complexity.

- Evaluate and condition additional proposals for hydroelectric and water withdrawal developments, navigation projects, and shoreline developments on the basis of their impact on estuarine ecology.
- Identify and implement opportunities to reclaim former wetland areas by breaching existing dikes and levees.
- Reestablish sustained peaking flows that drive critical river and estuarine processes.

The plan emphasizes strategies and principles that rely on natural production and healthy river systems. The plan's technical recommendations cover hydroelectric operations on the mainstem Columbia and Snake rivers; habitat protection and rehabilitation in the basin above Bonneville Dam, in the Columbia estuary, and in the Pacific ocean; fish production and hatchery reforms; and in river and ocean harvests. Overall, future implementation of the Spirit of the Salmon plan should have positive cumulative effects on listed species and their habitats.

The Nez Perce, Warm Spring, Umatilla, and Yakama Tribal governments are now seeking to implement this plan and salmon restoration in conjunction with the states, other Tribes, and the Federal government, as well as in cooperation with their neighbors throughout the basin's local watersheds and with other citizens of the Northwest.

6.5 Private Actions

The effects of private actions are the most uncertain. Private landowners may convert their lands from current uses, or they may intensify or diminish those uses. Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or they may result from growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects are even more so.

There are a number of private environmental groups working in the lower Columbia River on conserving and restoring ecosystem functions that benefit salmonids. Those groups include the North American Joint Waterfowl Plan, Ducks Unlimited, Sea Resources, the Columbia Land Trust, and the Columbia River Estuary Study Task force. As independent organizations, each environmental group has its own charter and therefore function independently. However, these groups are coordinating their work through LCREP's science workgroup. Overall, their actions should have positive cumulative effects on listed species and their habitats.

6.6 Summary

Non-Federal actions are likely to continue to affect listed species. The cumulative effects of non-federal actions in the action area that are reasonably certain to occur are difficult to analyze, considering the broad geographic landscape covered by these Service opinions, the geographic and political variation in the action area, the uncertainties associated with state, Tribal, and local government and private actions, and ongoing changes to the region's economy. Many negative effects, such as impacts to fish habitat from continued urbanization, water extraction, and water quality alterations, are reasonably certain to occur. However, state, Tribal, and local governments have developed plans and initiatives to benefit listed species. LCREP's CCMP is another important tool currently being used to coordinate organizations as they conduct habitat conservation, restoration, and recovery actions that benefit anadromous fish. Although State, Tribal, and local governments have developed plans and initiatives to benefit listed species, they must be applied and sustained in a comprehensive manner before the Service can consider them "reasonably certain to occur in its analysis of cumulative effects. However, the data and information generated from the above identified listed species plan actions can also be incorporated into the Project's Adaptive Management Process to help guide future management of the Project.

7.0 CONCLUSION

The analysis in the proceeding sections of these Service opinions form the basis for conclusions as to whether the proposed action, the Columbia River Channel Improvements Project, satisfies the standards of section 7(a)(2) of the Act. To do so, the Corps must ensure that their proposed action is not likely to jeopardize the continued existence of any listed species. Service species addressed in these Service opinions do not have designated critical habitat. Section 2 of this Opinion describes the constituent components of the proposed action. Section 3 describes the rangewide status of coastal cutthroat trout and bull trout, and Section 4 discusses the lower Columbia River, estuary, and river mouth environmental baseline, including the Service's knowledge of coastal cutthroat trout and bull trout habitat needs and use in the Project area. Additional information on bald eagle and Columbian white-tailed deer is provided in Section 4. Section 5 details the likely effects of the proposed action, including interrelated and/or interdependent Project actions, both on individuals of the listed and proposed species in the action area, as well as their habitats. Section 6 considers the cumulative effects of relevant non-federal actions reasonably certain to occur in the action area. On the basis of this information and analysis, the Service draws its conclusions about the effects of the Project on the survival and recovery of the listed and proposed Service species.

7.1 Coastal Cutthroat Trout and Bull Trout

7.1.1 Effects Analysis

Based on the effects analyses (section 5.0) of these Service Opinions, we believe that the most predictable impacts from the proposed action to coastal cutthroat trout and bull trout and their habitats in the lower Columbia River, estuary, and river mouth are short-term, physical changes during the construction and subsequent maintenance periods of the Project. Impacts to key physical processes have the potential for affecting habitat-forming processes. However, the impacts to those key physical processes will be of limited and short-term nature during the Project construction and maintenance periods. This conclusion was verified during the SEI panel process, as well as during BRT discussions of the numerical modeling conducted by WES and OHSU/OGI. Therefore, Project construction and maintenance impacts to key habitat types (i.e., tidal marsh and swamp, shallow water and flats, and water column) should be limited as well.

Section 5.3.1 (Direct Effects) indicated Project construction and maintenance would have limited potential to take coastal cutthroat trout and bull trout via dredging entrainment and blasting activities. Our indirect effects analysis also found that short-term, physical changes to any of the habitat-forming process indicators (Section 5.3.2) during the Project's construction and

maintenance periods were unlikely to have more than a limited adverse effect on any of the conceptual ecosystem model's indicators. Based on minor predicted changes to key physical habitat-forming processes discussed above, short-term Project effects to habitat complexity, connectivity, and conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability are likely to be limited.

Contaminants (Section 5.3.2.11) is another indicator that can affect more than one habitat type. The contaminants analysis indicates that juvenile salmonids are being exposed to toxicants in their food supply in the lower Columbia River, estuary, and river mouth. However, while the source of those toxicants is not clear, based on our effects analysis, the potential of the Project to exacerbate this situation is minimal, given the characteristics of the material being dredged and disposed of during the construction period. To be as protective as possible, Monitoring Action 5, identified in Table 7-3 of aquatic species BA (pages 7-9), addresses the potential for release of contaminants and will help to identify and minimize the potential to resuspend contaminants during Project activities.

Based on the limited short-term direct and indirect Project effects on the important indicators of the ecosystem conceptual model, the Service believes population numbers of coastal cutthroat trout and bull trout will not be appreciably reduced. The Service also believes that the Project, other than during short-duration and limited locations of salmonid avoidance of dredging and disposal operations, will not appreciably reduce the distribution of coastal cutthroat trout and bull trout. As no coastal cutthroat trout or bull trout spawning habitat occurs in or adjacent to the Project, the Project will not cause loss of spawning habitat. Overall, the Service believes the short-term direct and indirect effects of the Project will not appreciably reduce any of the coastal cutthroat trout and bull trout DPS' population numbers, distribution within each DPS, or reproductive success. Therefore, the Service believes that the Project will not appreciably reduce the likelihood of survival and recovery of coastal cutthroat trout or bull trout.

7.1.2 Monitoring Program and Adaptive Management Process

Because of the low level of uncertainty surrounding the long-term biological response of listed salmonids to predicted physical changes, the best available scientific information does not allow the Service to predict with certainty how the limited physical changes would affect coastal cutthroat trout and bull trout and their habitats over the life span of the Project. Section 5.6 of these Service opinions discusses long-term uncertainty and risk, and reviews the need for reducing long-term uncertainty and risk via a precautionary approach to the protection of ecosystem elements (i.e., key indicators within each pathway of importance to salmonids). In order to address those risks and uncertainties associated with the potential for adverse effects to

coastal cutthroat trout and bull trout over the life span of the Project, and to ensure that Project effects are not significant, the Service agrees with the Corps' proposed Monitoring Program and Adaptive Management Process. The need for a Monitoring Program and Adaptive Management Process was a major finding identified in the Sustainable Ecosystems Institute Channel Improvement Questionnaire. The Service therefore believes that the implementation of the monitoring and adaptive management programs will ensure that long-term Project effects are addressed, and that these long-term effects will not appreciably reduce the likelihood of coastal cutthroat trout and bull trout survival and recovery.

The Monitoring Program and Adaptive Management Process will be used to evaluate potential effects of the proposed action during the construction and maintenance phases of the Project. Monitoring and adaptive management will assist the Service with verification that the Project's long term adverse effects to coastal cutthroat trout and bull trout and their habitats are limited. Based on the results of the Monitoring Plan and review of the Adaptive Management Process, adjustments may be made to the construction and maintenance activities of the Project. As an additional result of annual monitoring program review, the adaptive management team may decide that mitigation or restoration actions will be necessary to address adverse impacts.

The monitoring program elements and the framework for the adaptive management process, as currently proposed in the aquatic species BA, address the main concerns identified in section 5 (Effects of Action), and will ensure the Project-related environmental impacts to the lower Columbia River, estuary, and river mouth are minimized. The Service also believes that the Monitoring Program and the Adaptive Management Process provides the Corps with the opportunity to integrate elements of the Project into a broader set of research objectives and restoration activities in the Columbia River Basin (i.e., estuary action items in the All-H paper and NMFS' FCRPS Hydropower Opinion).

7.1.3 Ecosystem Research Actions

The Corps has proposed a number of Ecosystem Research Actions (Table 8-1 of the aquatic species BA) under Section 7(a)(1) of the Act. The proposed ecosystem research actions support currently on-going research actions in the lower Columbia River. They also begin to address longer term environmental issues of the river's ecosystem, such as contaminants, and will provide a venue, via the proposed ETM workshop, to better understand and propose meaningful management actions to conserve the ETM. The data and information resulting from the ecosystem research actions can also be brought forward into the Adaptive Management Process to inform and guide future management decisions associated with the Project. For these reasons,

the Service believes that the proposed ecosystem research actions are a beneficial aspect of the Project.

7.1.4 Ecosystem Restoration Features

The Corps has proposed a number of ecosystem restoration features (see Table 8-2 of the aquatic species BA) in furtherance of Section 7(a)(1) of the Act. During BRT discussions, and discussions among the Corps, the Ports, the Service, and NMFS management, participants identified the need to address any proposed restoration features in the context of habitat type, function, and value, and linking those values to listed species.

The ecosystem restoration features will provide benefits to the habitat types identified in the Conceptual Model (see Chapter 5 of the aquatic species BA). When implemented in coordination with the Service and other organizations conducting habitat conservation/restoration activities, these features should complement those activities currently occurring in the lower Columbia River and estuary. For these reasons, the Service believes that the proposed ecosystem restoration features should benefit coastal cutthroat trout and bull trout and their habitats. As with the Monitoring Plan, the Adaptive Management Process, and the ecosystem research actions, the ecosystem restoration features also provide the Corps the opportunity to integrate elements of the Project into a broader set of research objectives and restoration activities in the Columbia River Basin (i.e., estuary action items in the All-H paper and NMFS' FCRPS Hydropower Opinion).

7.1.5 Coastal Cutthroat Trout and Bull Trout Conclusion

The Project's blasting and entrainment effects may directly kill or injure a limited number of coastal cutthroat trout and bull trout, and the Project's indirect effects to lower Columbia River, estuary, and river mouth ecosystem indicators may cause limited harm and harassment to coastal cutthroat trout and bull trout. Over the long-term, these effects will be monitored and addressed via a monitoring and adaptive management process. Therefore, after reviewing the current status of coastal cutthroat trout and bull trout, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is the Service's biological and conference opinions that the proposed Columbia River Channel Improvements Project will not jeopardize the continued existence of threatened Columbia River DPS of bull trout or the proposed Southwestern Washington/Columbia River DPS of coastal cutthroat trout. No critical habitat has been designated for these species, therefore, none will be affected.

7.2 Bald Eagle and Columbian White-tailed Deer Conclusion

The terrestrial species Opinion determined that the Project would not jeopardize the continued existence of bald eagles or Columbian white-tailed deer (analysis is presented on page 20 of the terrestrial species Opinion). Additional ecosystem restoration actions, reviewed within these Service opinions, were determined to cause limited, short term harm to nesting and foraging bald eagles that exist near restoration project locations. After reviewing the current status of bald eagles and Columbian white-tailed deer, the environmental baseline for the action area, the effects of the proposed action (presented in both the terrestrial species Opinion and in these Service opinions), and cumulative effects, it is the Service's biological opinion that the proposed Columbia River Channel Improvements Project will not jeopardize the continued existence of threatened bald eagle or endangered Columbian white-tailed deer. No critical habitat has been designated for these species, therefore, none will be affected.

8.0 INCIDENTAL TAKE STATEMENT

8.1 Introduction

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary; they must be implemented by the action agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in Section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered in this incidental take statement. If the Corps (1) fails to adhere to the terms and conditions of the incidental take statement, and/or (2) fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)].

An Incidental Take Statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

The terrestrial species Opinion provides an Incidental Take Statement for Project-related take to Columbian white-tailed deer and bald eagle. Additional terms and conditions, for Project-related take resultant from newly-proposed ecosystem restoration projects, is addressed herein. The terrestrial species Opinion's Incidental Take Statement also is provided herein (below) to allow

the Corps to refer to one Incidental Take Statement when reviewing its Project-related non-discretionary requirements for Columbian white-tailed deer and bald eagle.

This Incidental Take Statement starts at the point of signature of the Biological Opinion, and continues to apply through construction and into the maintenance period of the Project. Since the proposed action will continue until un-authorized by Congress, this Incidental Take Statement will be reviewed every year during the annual meeting of the Adaptive Management Team.

8.2 Amount or Extent of the Take

8.2.1 Coastal Cutthroat Trout and Bull Trout

The Service anticipates that the proposed action covered by these Service opinions will result in short-term and long-term incidental take of coastal cutthroat trout and bull trout. These types and amount of take are described below.

Based on BRT discussions of the conceptual model, other BRT deliberations including the SEI workshops, and use of the conceptual ecosystem model and numerical models in the effects analysis (see Section 5.0 of these Service opinions), short-term incidental take of coastal cutthroat trout and bull trout is likely to occur.

Short-term incidental take of coastal cutthroat trout and bull trout, in the form of killing and injury from blasting and entrainment, is likely to occur during channel construction and maintenance actions. Short-term take, in the form of harm, is likely to occur from loss of coastal cutthroat trout and bull trout prey items from entrainment and burial during disposal, and loss of a limited amount of low quality, shallow water and shoreline coastal cutthroat trout and bull trout habitat from side-slope adjustment and erosion. Additional short-term take is likely to occur from dredge and disposal-induced turbidity, which will harass coastal cutthroat trout and bull trout via temporary behavior modification.

Based on the effects analysis in Chapter 6.0 of the aquatic species BA, the Corps concluded that few, if any, coastal cutthroat trout and bull trout are likely to be directly taken as a result of blasting actions. Therefore, the Service limits the amount of allowable incidental take from the single blasting event to no more than one bull trout and 10 coastal cutthroat trout. Incidental take occurring beyond these limits is not authorized by this consultation.

Based on the effects analysis in Chapter 6.0 of the aquatic species BA, the Corps concluded that few, if any, coastal cutthroat trout and bull trout are likely to be directly taken as a result of entrainment during dredging. However, due to the Corps' inability to monitor entrainment events during all dredging activities, it is difficult for the Service to quantify an estimate of entrainment-induced incidental take. The aquatic species BA indicates, based on sampling for hopper dredge entrainment events, no salmonids were entrained during hopper dredging using hopper dredging methodologies proposed in the aquatic species BA. The Corps has indicated that pipeline dredge entrainment is impossible to evaluate. Based on existing entrainment information, and the requirement that dredge's draghead and cutterhead, to the extent possible, remain below the sediment surface during suction, the Service believes an unquantifiable, but limited amount, of incidental take of coastal cutthroat trout and bull trout is likely to occur as a result of entrainment.

Implementation of certain ecosystem restoration features may result in a limited amount of unquantifiable incidental take from inwater fill or other construction activities. This incidental take may include direct take through smothering during disposal into ecosystem restoration features, temporary disruption of benthic prey item production, temporary increases in turbidity, and temporary exclusion of coastal cutthroat trout and bull trout from these restoration features.

During the long-term, habitat modifications to the lower Columbia River, estuary, and river mouth may alter important coastal cutthroat trout and bull trout habitats, and therefore cause harm to these species. These habitat modifications may occur throughout the Project area. The indicators analyzed in Section 5.3.2 of these Service opinions, Short- and Long-term (Indirect) Effects to Ecosystem Processes and Functions of Importance to Coastal Cutthroat Trout and Bull Trout, could potentially be affected in the long-term by the proposed action. Based on the risk and uncertainty analysis conducted by the BRT (see Table 7-1 of the aquatic species BA), how these impacts would affect coastal cutthroat trout and bull trout and their habitats is uncertain over the life span of the Project. However, the potential long-term effects to ecosystem indicators are not of high risk to coastal cutthroat trout and bull trout (see Table 7-1 of the aquatic species BA). Therefore, the Service believes that long-term impacts will be adequately addressed via the proposed compliance measures, monitoring program, and adaptive management program.

Even though the Service expects some low level of long-term incidental take to occur due to the proposed action covered by these Service opinions, the best scientific and commercial data available are not sufficient to enable the Service to estimate a specific amount of long-term incidental take to the species themselves over the life span of the Project. Therefore, based on

the information in the aquatic species BA, and these Service opinions' effects analysis, the Service anticipates that an unquantifiable, but low, amount of incidental take over the life span of the Project is likely to occur as a result of the proposed action covered by these Service opinions.

8.2.2 Bald Eagle

8.2.2.1 Terrestrial species Opinion's Incidental Take Statement

The terrestrial species Opinion's Incidental Take Statement indicated:

The Service anticipates that two bald eagle pairs will be harassed through disturbance as a result of the placement of dredged material on lands adjacent to the nest sites and foraging areas used by the Martin Island and Buckmire bald eagle pairs. Additionally, it is predicted that all bald eagles pairs that occur on the Columbia River below the Portland-Vancouver area (29 pairs) will be harmed as a result of biomagnification of contaminants mobilized during the dredging of fine sediments in or around the Columbia River channel. Harm to bald eagles will be made evident by a decrease in annual productivity in eagles below river mile 60, an increase in contaminant concentrations in eggs of these eagles, and presence of contaminants in depositional areas within eagle foraging habitat.

These amounts and extent of Project-related bald eagle take are still valid.

8.2.2.2 Ecosystem Restoration Actions

The ecosystem restoration actions will result in harassment to nesting and foraging bald eagles that are adjacent to restoration projects in the lower Columbia River and estuary. The Service anticipates that ecosystem restoration activities will cause short-duration, limited harassment to one bald eagle pair at Lois Island, one bald eagle pair at Miller Sands Island, two bald eagle pairs on Tenasillahe Island, one bald eagle pair at Bachelor Slough, and approximately 30 bald eagle pairs that nest throughout the estuary and lower Columbia River adjacent to purple loosestrife restoration activities.

8.2.2.3 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act

The Fish and Wildlife Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the bald eagle terms and conditions specified herein.

8.2.3 Columbian White-tailed Deer

8.2.3.1 Terrestrial species Opinion's Incidental Take Statement

The terrestrial species Opinion's Incidental Take Statement indicated:

The Service anticipates that approximately 100 acres of foraging habitat for Columbia white-tailed deer will be eliminated as a result of the proposed project, and thus all the deer associated with these acres will be harassed by the placement of dredged material in these areas.

These amounts and extent of Project-related Columbian white-tailed deer take are still valid.

8.2.3.2 Ecosystem Restoration Actions

A single ecosystem restoration action will likely result in harassment of Columbian white-tailed deer. All Columbian white-tailed deer using the Tenasillahe Island interim restoration construction areas will likely be harassed during the short-duration construction events.

8.3 Effect of the Take

In the accompanying Opinions, the Service determined that this level of anticipated and unquantifiable take is not likely to result in jeopardy to coastal cutthroat trout, bull trout, bald eagle, or Columbian white-tailed deer.

8.4 Reasonable and Prudent Measures

The Service believes that the following Reasonable and Prudent Measures are necessary and appropriate to minimize take of coastal cutthroat trout, bull trout, bald eagle, and Columbian white-tailed deer from activities associated with navigation channel improvements:

8.4.1 Coastal Cutthroat Trout and Bull Trout Reasonable and Prudent Measures

The prohibitions against taking coastal cutthroat trout, found in section 9 of the Act, do not apply until coastal cutthroat trout is listed. However, the Service advises the Corps to consider implementing the following reasonable and prudent measures for coastal cutthroat trout. If this conference opinion is adopted as a biological opinion following a listing, these reasonable and prudent measures, with their implementing terms and conditions, will be nondiscretionary.

The Service believes that the following Reasonable and Prudent Measures are necessary to minimize take of coastal cutthroat trout and bull trout during implementation of the Project in the lower Columbia River, estuary, and river mouth:

1. Minimize the likelihood of incidental take associated with short-term (direct and indirect) impacts to coastal cutthroat trout and bull trout during Project construction and maintenance activities.

2. Minimize the likelihood of incidental take to coastal cutthroat trout and bull trout that is associated with long-term uncertainty and associated risk from Project effects by implementing a Monitoring Program.

3. Minimize the likelihood of incidental take to coastal cutthroat trout and bull trout associated with Project impacts by implementing an Adaptive Management Process to review results of monitoring program and other applicable new information, and determine actions necessary to minimize any adverse effects.

4. Minimize the likelihood of incidental take during implementation of Ecosystem Restoration Actions in the Lower Columbia River and estuary.

5. Provide the Service with annual reports from Project compliance, monitoring, restoration, and research activities, thereby expediting future take minimization decisions by the Adaptive Management Team.

8.4.2 Bald Eagle Reasonable and Prudent Measures

The terrestrial species Opinion's Incidental Take Statement indicated:

1. Avoid disturbance of nesting bald eagles;

2. Avoid disturbance of foraging eagles;

3. Ensure effectiveness of measures proposed for bald eagle conservation; and

4. Prevent or minimize transport of contaminated sediment into depositional areas in the lower estuary outside the navigation channel.

No additional bald eagle reasonable and prudent measures are provided for ecosystem restoration activities.

8.4.3 Columbian White-tailed Deer Reasonable and Prudent Measures

The terrestrial species Opinion's Incidental Take Statement indicated:

1. Minimize loss of forage and cover habitat for Columbia white-tailed deer.

No additional Columbian white-tailed deer reasonable and prudent measures are provided for ecosystem restoration activities.

8.5 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

8.5.1 Coastal Cutthroat Trout and Bull Trout Terms and Conditions

1. In order to minimize the likelihood of incidental take to coastal cutthroat trout and bull trout associated with short-term (direct and indirect) impacts during Project construction and maintenance activities, the Corps shall do the following:

    a. Minimize effects from entrainment through the following actions:

        a.1 Implement the dredging Impact Minimization Measures and Best Management Practices as identified in Chapter 3 of the aquatic species BA.

        a.2 Monitor operation of the dredge draghead and/or cutterhead to minimize the time they are removed from the substrate.

b. Minimize effects from blasting through the following actions:

b.1 The blasting plan, outlined on page 6-20 of the FEIS for the Project, will be developed in conjunction with federal and state agencies and submitted to the Service for approval 30 days prior to blasting. The blasting plan will include specific monitoring actions to determine if any listed fish were killed or injured, and include a clause that, if the blasting results in a take of coastal cutthroat trout or bull trout, the Corps will discontinue blasting until such time as that take can be assessed and measures enacted to minimize impacts.

b.2 The results of the blasting plan monitoring shall be presented at the adaptive management team meeting during the year in which the blasting occurs.

c. Prior to navigation channel construction and maintenance implementation, provide "contractor compliance plan" to the Service for review and approval. The plan must describe specific compliance monitoring actions, designed to minimize impacts to coastal cutthroat trout and bull trout, that will occur during dredging and disposal actions, as described in the aquatic species BA table 7-4, 7-5, and 7-6. In addition, the contractor shall be required to report to the Corps any unanticipated or unusual events or visual observations (e.g., water surface oil slicks, injured/dead fish, and/or unusual colored or smelling sediments) that are not required in the contractor compliance plan. If take of coastal cutthroat trout and bull trout is observed during compliance monitoring, the Service shall be contacted immediately to determine the need for Project modification, compensation, or cessation of the project.

2. In order to minimize the likelihood of incidental take to coastal cutthroat trout and bull trout that is associated with uncertainty and risk from long-term Project effects, the Corps shall implement a monitoring program:

a. Finalize and implement the Monitoring Program (Table 7-3 of the aquatic species BA). All activities related to scope identification, i.e., goals, milestones for completion, and check-in points, Triggers for Management Change (management decision points that include specific metrics), and sampling/testing protocols to be developed, will be coordinated with the Service. The final monitoring program

shall also ensure that adequate pre-, during, and post- construction monitoring actions occur to allow for comparable pre- and post-Project data analysis.

Two proposed monitoring actions, MA-1 and MA-3, shall be implemented over a longer time-scale (Term and Condition 4.a.1 of this Incidental Take Statement discusses Adaptive Management timeframes that link to long-term monitoring actions) than proposed in the aquatic species BA. These monitoring activities are vital to understanding long-term Project-related changes to the lower Columbia River, estuary, and river mouth, and to allow for future adaptive management team decisions. Therefore, the Corps will continue, for the entire duration that the adaptive management program is operating, to collect and analyze data associated with MA-1 and MA-3 activities.

Monitoring action MA-4 shall ascertain Project related changes in habitat. Additionally, the Corps shall compare results of this monitoring action to any similar research efforts by the Northwest Fisheries Science Center's (i.e., their Columbia River estuary study) or other organizations in the estuary for a more complete assessment of habitat changes. At the end of the proposed monitoring period, monitoring results from MA-4 and associated research/monitoring shall be reviewed by the adaptive management team. The adaptive management team will determine whether additional MA-4 or a sub-component of MA-4 will go forward into the future.

a.1 Submit the Final Monitoring Program design to the Service by December 15, 2002, for approval.

a.2 Implement the Final Monitoring Program, as per the implementation dates.

b. Continue to work with the Service on the revision of the DMEF manual to develop a set of contaminant testing protocols appropriate for marine and fresh water environments. Upon final completion of the revised DMEF manual, the Project's MA-5 Monitoring Program action will be updated to reflect any new protocols or effects thresholds. Any changes to MA-5 that are deemed necessary, due to DMEF revisions, will be submitted to the Service for review and approval prior to their Project-related implementation. The Corps shall continue to support the work of the Regional Sediment Evaluation Team that is updating the DMEF manual.

c. The best available information indicates that the Columbia River navigation channel sediments do not exceed current DMEF or NMFS contaminants thresholds. The interagency contaminants review team, identified in MA-5, shall ensure that the Project continues to proceed with the best available sediment and contaminant information. The interagency contaminants review team shall meet annually to review sampling distribution and frequency, sediment quality, and contaminants concerns of all lower Columbia River and estuary sediment sample locations. The interagency contaminants review team shall provide the Adaptive Management Team with annual, or more regular, updates on current sediment and contaminants information in the Project area. Additionally, the interagency contaminants review team shall recommend to the Adaptive Management Team, beginning at the first Adaptive Management Team meeting in January, 2003, any additional sampling or contaminants testing necessary for purposes of minimizing contaminants resuspension from Project dredging and/or disposal activities. The Corps shall complete additional sediment and contaminant samples determined necessary by the Adaptive Management Team. Any samples that the Adaptive Management Team determines are necessary as a result of the January, 2003 meeting shall be completed prior to Project construction.

d. The Corps will host an ETM workshop to better understand and propose meaningful management actions to conserve the ETM. The ETM workshop will be conducted by December 15, 2005. The Corps will coordinate the following actions with the Service in the development of this workshop, including:

- Developing the scope of the meeting, agenda, and list of meeting attendees.
- Any information obtained through monitoring and research should be made available for the workshop
- Prepare a final report of the ETM workshop to be submitted to the Service one month after completion of the workshop for Service approval.
- Results from the final ETM report will include, as appropriate, management actions that will be presented to the adaptive management team for consideration in the Adaptive Management Process.

e. Minimize effects from stranding through the following actions:

e.1 Develop and implement a stranding study to be developed in conjunction with NMFS, Service, the Ports, and appropriate state agencies. The stranding study will evaluate parameters that influence stranding.

Potential factors include: cross-sectional area, velocity, water level, bank configuration, location along river, slope of bank, ship traffic past site, and type, size, draft, and speed of vessel. The stranding study design shall be submitted to the Service by December 15, 2002, for approval. The standing study shall be implemented by April 2003.

e.2 The stranding plan shall include an identified scope including goals, milestones for completion, check-in points, triggers for management change (i.e, management decision points that include specific metrics), and sampling/testing protocols to be developed in coordination with the Service.

e.3 The results of the standing plan shall be used to develop a plan to minimize and/or eliminate fish stranding. The stranding minimization plan, as it applies to ship traffic, will be provided to the U.S. Coast Guard, for use in their regulation of river traffic, and to the adaptive management team for consideration during the Adaptive Management Process.

e.4 The stranding study will be repeated two years following construction of the deeper channel.

4. The Corps shall implement an Adaptive Management Process to review results of the monitoring program and other applicable new information, and determine actions necessary to minimize any adverse effects to coastal cutthroat trout and bull trout:

a. Establish the adaptive management team that implements the Adaptive Management Process. The adaptive management team will review scientific information collected through monitoring, research, or best management practices while implementing this action. The adaptive management team shall meet annually, or more frequently if new circumstances arise.

a.1 The adaptive management team shall determine Project effects, and evaluate the effectiveness of the compliance measures, the monitoring program, research, and ecosystem restoration features. In doing so, the adaptive management team will ensure that Project construction, operation and maintenance, and ecosystem restoration activities have no greater impacts than predicted in the aquatic species BA or in these Service opinions and Incidental Take Statement.

a.2 If an adverse effect is determined by the adaptive management team, the Corps shall, within 30 days, submit an impact minimization plan to the Service for approval. The Corps plan could range from proposing mitigation actions, to modifying or stopping the Project if warranted.

b. The Corps, NMFS, and the Service will develop goals, stated purposes, operating principles, and composition of the adaptive management team. The Corps should review 65 FR 35242 for a Service overview of using adaptive management for certain listed species decision-making and permitting activities. Portions of this Service policy document may be pertinent to the Corps' final design of the Adaptive Management Process for this Project. The framework for actions taken by the adaptive management team shall be based on the following:

b.1 Short-term (Years 0-5: Pre-construction, construction, and post-construction) - Focus shall be on potential short-term project impacts and modifications to minimize impacts. The effectiveness of the compliance measures, the monitoring program, research, and ecosystem restoration features will be evaluated. Additional mitigation features may be recommended for implementation and/or modifying or stopping the project if warranted.

b.2 Mid-term (Years 5-10) - Conduct trend analyses with monitoring data and research actions to detect ecosystem changes over the longer term and apply to actions identified above; and

b.3 Long-term (Years 10 and beyond) - Translate trend analysis information into long-term trends in ecosystem impacts and restoration of the ecosystem.

c. Information gathered through monitoring and research actions will be used to annually assess Project effects to the following indicators[1]:

- Shift in the location of the ETM,

[1]These are minimum effects to be examined based on the state of knowledge at the time these Service opinions were issued. As additional effects are identified, or the existing list of effects is modified, this list will be changed to fit the contemporary needs to the Monitoring Program and Adaptive Management Process.

- ETM functions,
- Accretion/erosion rates,
- Habitat types,
- Food resources for salmonids,
- Changes to sideslope adjustments adjacent to the entire navigation channel and associated loss of shallow water/flats or tidal marsh/swamp habitats in riverine and estuarine areas.
- Physical features of habitat types, habitat opportunity, bathymetry, bedload changes, rate of suspended sediment transport, and water level changes to the estuary.
- Structure, distribution, net productivity, and detritus production of marshes and swamps,
- Velocity changes in shallow water habitats and available refugia, and
- Salinity changes as they impact habitat types

d. Submit the proposed design of the Adaptive Management Process to the Service by December 15, 2002 for approval.

e. Conduct the first Adaptive Management Team meeting in January, 2003.

f. The adaptive management team will function for the duration of the Monitoring Program and prescribed ecosystem research actions.

g. The Corps will provide facilitation support at all meetings of the Adaptive Management Team.

5. In order to minimize the likelihood of incidental take through implementation of Ecosystem Restoration Actions (see Table 8-2 of the aquatic species BA), the Corps shall:

a. Conduct all shallow water ecosystem restoration in-water construction activities, including excavation and dredge material placement, during the in-water construction window. The in-water construction window is the time period when fewest coastal cutthroat trout and bull trout occur in the Project area, thereby minimizing potential for incidental take. The pipeline dredge in-water construction window for Miller/Pillar and Lois Island embayment projects is November 1 to February 28. Hopper dredge disposal in deep water, temporary storage sump locations does not have an in-water construction window. The in-

water construction window for Columbia River tidegate retrofit projects is July 1 to September 15.

b. The Corps will submit a plan that describes how dredge material will be staged in temporary sumps during Lois Island embayment and Millar/Pillar restoration actions, and how resuspension of contaminants from temporary storage sump will be minimized.

c. To the extent possible, the Corps shall maintain dredge draghead and/or cutterhead at or below the substrate surface during ecosystem restoration construction activities that require dredging activities.

d. The Corps shall enter into an agreement with the Project sponsors that will require the sponsors to ensure future maintenance of retrofitted tidegates. In addition, the Corps will require guarantees from the Project sponsors that volitional fish passage, via timely operation of the tide gate passage features, will occur during key salmonid migration periods. The Corps will coordinate fish design for tidegate retrofits with Service fish passage engineers.

e. The Corps shall coordinate with the Service on the Integrated Pest Management Plan for the Purple Loosestrife Control Program, including Service review and approval for all over-water use of RODEO.

f. The Corps shall coordinate with the Service on the development and implementation of pre- and post- construction monitoring protocols for the Ecosystem Restoration Actions to gauge their effectiveness in restoring the type, function, and value habitats identified in the aquatic species BA. The Corps' restoration features monitoring plans shall be submitted to the Service for review and approval by December 15, 2002.

6. The Corps shall provide the Service with annual reports from Project compliance, monitoring, restoration, and research activities, and summarize annual compliance with this Incidental Take Statement's reasonable and prudent measures and their implementing terms and conditions:

a. Compliance:

a.1 The Corps will submit a series of reports based on the dredging Impact Minimization Measures and Best Management Practices for compliance (i.e., construction and maintenance) actions to the Service in six month intervals during the navigation channel construction process. These reports will consist of the following minimum elements: how the Corps implemented and responded to the Impact Minimization Measures and BMPs, how much material was dredged and disposed of, how many fish were take due to blasting and entrainment, were any unusual sediments encountered and how were these events addressed, how effective were the BMPs in minimizing impacts from Project construction, and how did the Corps addressed any adverse compliance monitoring finding.

a.2 The Corps must record daily operations while dredging to ensure all BMPs are followed. In order to complete this task, the Corps will develop a standard tracking table for workers of the dredging vessels. The results of the tracking information will be included in summary form and as an appendix to the construction and maintenance annual reports (see Integrated Annual Report requirement, below).

b. Monitoring Activities:

b.1 An annual monitoring report will be completed for each monitoring action (MA-1 to MA-6). The following shall be included in the monitoring report for each monitoring action: 1) Overview of monitoring action; 2) monitoring data and results; 3) Any adverse impacts to coastal cutthroat trout or bull trout and/or their habitats that were determined to be related to Project activities; 4) Recommendations to be reviewed by the Adaptive Management Team.

c. Ecosystem Restoration Actions:

c.1 Upon completion of each restoration action, the Corps will submit an monitoring report to the Service. The report will include:

- Detailed discussion of monitoring results.

- Photographic documentation of environmental conditions at the project site before, during, and after project completion.
- Photographs will include general project location views and close-ups showing details of the project area and project, including pre and post construction.
- Each photograph will be labeled with the date, time, photo point, project name, the name of the photographer, and a comment describing the photograph's subject.
- Recommendations on methods to improve site-specific restoration activities.

d. Ecosystem Research Actions:

d.1 An annual research progress report, and a final report, shall be completed for each research action. Each final report shall clearly define research objectives, and report on research findings. Recommendations for additional research, or discussion of management implications, also shall be provided.

e. Integrated Annual Report:

e.1 The Corps shall provide an annual progress report toward implementing all reasonable and prudent measures, and their implementing terms and conditions. As appropriate, based on the Integrated Annual Report, the Service will determine whether reinitiation of consultation is indicated.

8.5.2 Bald Eagle Terms and Conditions

The terrestrial species Opinion's Incidental Take Statement indicated:

1. Avoid dredging areas where fine-grained materials (silts and clays) are present. If avoidance is not feasible, determine grain size and conduct chemical analysis in accordance with the Corps' Tier I, IA, and IIB sampling process (DMEF 1998). A suitable *in vitro* assay for dioxin-like compounds can be used in lieu of a full dioxin and fran analytical scan, but detection limits shall approach 1 pg/g. Fine materials containing the organochlorine compounds DDT or its metabolites, PCBs, dioxins, or furans above Tier II screening limits outlined in the DMEF (1998), will either not be dredged or will be placed in approved upland sites or in the ocean.

2. Continue monitoring annual productivity for all lower Columbia River bald eagles for five-years following initiation of the project. Reduction of annual productivity below 0.50 young per occupied nest site with a known outcome for bald eagle pairs below river mile 60 should be reported immediately to the Service. Project operations should then be re-evaluated to determine the extent to which dredging is influencing bald eagle productivity.

3. Develop a Service-approved plan to monitor concentrations of organochlorine contaminants (DDE, PCBs, and dioxin-like compounds) in lower Columbia River bald eagle eggs within three-years of channel deepening initiation. DDE and PCBs have declined in this population over the last 10 years, and concentrations in eggs should not significantly increase during the dredging operation from the last egg sampling period in 1994 and 1995.

4. The Corps shall develop and implement a Service-approved monitoring plan to determine if contaminants are released or made available during the dredging operation and inwater disposal. The Corps may involve the Regional Management Team, the Oregon Department of Environmental Quality, and the U.S. Geological Survey, and other interested parties, in the development of this plan. If contaminant availability is found to be enhanced by dredging and/or disposal, then the Corps shall implement a Service-approved, phased-approach contaminant sampling plan in the lower estuary to determine: 1) if fine-grained materials are deposited or increase in the lower estuary (near the turbidity maximum) as a result of dredging operations for channel deepening; 2) if organochlorine contaminants are associated with any increases in fine-grained materials in the area as a result of dredging operations; 3) if contaminants associated with the fine-grained materials are available or are transferred to benthic or epibenthic organisms in the area; and, 4) if contaminants associated with the dredging operation are transferred to higher trophic levels. A suitable weight-of-evidence approach shall be used determine the association between deposition of fine-grained materials and the channel deepening. Negative results in an earlier phase of the monitoring plan would likely negate implementation of the later phases.

The following is an additional bald eagle term and condition:

5. Submit annual monitoring reports, required in bald eagle terms and conditions 2, 3, and 4, above, to the Adaptive Management Team for annual review and adaptive management decisions.

8.5.3 Columbian White-tailed Deer Terms and Conditions

The terrestrial species Opinion's Incidental Take Statement indicated:

1. Place dredged materials on the site incrementally, as described in the biological assessment.

2. Monitor designated Columbian white-tailed deer site, as described in the biological assessment, to determine habitat suitability on an annual basis for 10 years. A report will be provided to the Service by December 31 of the year following initiation of the proposed placement of dredged material at W44.0, containing:

    a. the habitat types observed;
    b. the amount and proportion of habitat available and fully suitable for Columbian white-tailed deer foraging and cover;
    c. numbers of Columbian white-tailed deer observed and estimated to use the mitigation sites; and
    d. proposed remediation if habitat is not fully suitable for foraging and cover.

3. Reports will be provided annually for three years, then every five years, starting with the fifth year after initiation, throughout the duration of the proposed project.

The following are additional Columbian white-tailed deer terms and conditions:

4. The Corps will design the Tenasillahe Island tidegates to ensure that Columbian white-tailed deer habitat will not be flooded during daily tidal or high water events. The Corps shall use careful hydraulic engineering analysis and subsequent tidegate design, and provide proper instruction to Service staff regarding tidegate operation.

5. Submit annual monitoring reports, required in Columbian white-tailed deer terms and conditions 2 and 3, above, to the Adaptive Management Team for annual review and adaptive management decisions.

8.5.4 Salvage Requirements

Upon location of a dead, injured, or sick endangered or threatened species specimen, initial notification must be made to the Service Law Enforcement Office in Wilsonville, OR at (503) 682-6131. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best

possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

8.5.5 Conclusion

The Service believes that no more than one bull trout and 10 coastal cutthroat trout will be killed or injured during Project blasting, an unquantifiable but limited number of bull trout and coastal cutthroat trout will be killed or injured due to Project-related entrainment, and an unquantifiable, but limited amount of harm and harassment to bull trout, coastal cutthroat trout, bald eagle, and Columbian white-tailed deer will occur as a result of all other aspects of the Project's proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Corps must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

9.0 CONSERVATION RECOMMENDATIONS

9.1 Introduction

Section 7 (a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of designated critical habitat, to help implement recovery plans, or to develop additional information.

9.2 Coastal Cutthroat Trout and Bull Trout Conservation Recommendations

The Service believes the following conservation recommendations are consistent with the Corps' Section 7(a)(1) obligations, and therefore should be implemented by the Corps:

9.2.1 Pile Dike Study

Coordinate with NMFS, Service, and OSHU/OGI to develop and implement a study that addresses the functioning of and continued need for pile dike fields in the lower Columbia River, estuary, and river mouth in relationship to on-going and future habitat conservation/restoration activities. The study results should be used to assess how pile dike fields might be modified

and/or removed from the lower Columbia River, estuary, and river mouth to enhance habitat conservation/restoration activities in a manner that does not compromise the integrity of the navigation channel. The results of this study should be incorporated into future consultations for the navigation channel.

9.2.2 Ecosystem Conservation/Restoration

There are a number of on-going habitat conservation/restoration activities in the lower Columbia River and estuary that are being conducted by the LCREP, the Salmon Recovery Funding Board, the Lower Columbia Fish Recovery Board, Oregon Watershed Enhancement Board, and a number of non-profit organizations. Based on the need to support this continuing work, and NMFS and the Service's future fish and wildlife recovery efforts, the Corps should continue to implement habitat conservation/restoration activities in the lower Columbia River, estuary, and river mouth. Sources of restoration action ideas and appropriate Corps authorities include: the All-H document, NMFS' FCRPS Hydropower Opinion (RPA Action items 158 - 163; 194 - 197), Sections 1135, 206, and 536 of the Water Resources Development Act (WRDA), and the Corps General Investigation Report - Section 905(b) Analysis, Lower Columbia River Ecosystem Restoration, Oregon and Washington.

The Corps should explore how to employ regulatory flexibility as they implement their authorities when working with potential partners on conservation/restoration activities.

The Corps should continue to work on the implementation of LCREP's CCMP via providing policy and technical assistance. The Corps should also work with the LCREP partners to use their annual planning and congressional appropriation process to establish and provide the appropriate level of funding to implement the CCMP (in particular, Actions 1 - 12, and 28).

9.2.3 Sediment Budget for the Lower Columbia River and Estuary

Conduct a sediment budget study that includes an analysis of historic sediment volumes in the lower Columbia River, how sediment volumes changed with development of the FCRPS, and how the deepening of the navigation channel from 0-43 feet further modified sediment inputs and distribution into the lower Columbia River and estuary ecosystems. The Corps should ensure that development and implementation of this study is consistent with Action Items 158, of NMFS' FCRPS Hydropower Opinion.

9.2.4 Near-shore and Plume Study

Develop and implement a study(ies) examining the potential for impact to near-shore and plume environments produced by ocean disposal of sediments produced by the Project. The areas included in this study(ies) should include all existing and proposed disposal sites at the mouth of the Columbia River. The study should examine salmonid use of in these areas, (abundance, distribution, food resources, habitat). This study should build upon the current research being conducted by NMFS' Northwest Fisheries Science Center.

1. The study design and plan for ocean disposal of sediments should be submitted to NMFS and the Service for final approval.

2. The results of the study and the plan for ocean disposal of sediments should be presented to the adaptive management team for consideration during the Adaptive Management Process. The results of this study should be incorporated into future consultations for the navigation channel and the any future reinitiation of consultation activities stemming from the Mouth of the Columbia River maintenance project.

9.2.5 Public Involvement in the Adaptive Management Process

For the Adaptive Management Process to be successful, the process should be a transparent one. The annual adaptive management meetings should be open to the public, other agencies, and Tribes. During each meeting, there should be an opportunity for questions, comments, and technical input from the public, with response from the adaptive management team. Copies of all public comments, data, and information discussed during the meetings should be placed on the Corp's website.

9.2.6 Involvement of the Columbia River Tribes in Project Implementation

The Columbia River Tribes, represented by the Columbia River Intertribal Fish Commission (CRITFC), have specific technical expertise that should be included into the Project implementation. The Corps should encourage CRITFC participation in the following Project activities: the adaptive management process (see section 9.2.5 above); the monitoring program, the ecosystem research program; and the annual contaminants review team activities (see table 2.5 above). The Corps should also encourage CRITFC participation with the Regional Sediment Evaluation Team that is updating the DMEF manual. The Corps should provide funding for CRITFC involvement in these Project and Project-related activities.

9.2.7 OHSU/OGI ELCIRC Modeling

The OHSU/OGI ELCIRC model analyzed Columbia River estuary habitat opportunity changes between current and future Project conditions. It would be very useful to extend this analysis to riverine portions of the Project area. The Corps should fund the expansion of the ELCIRC model to incorporate the riverine portions of the Project area, and provide those modeling outputs to the Adaptive Management Team for review and consideration.

9.2.7 Pipeline Dredge Disposal

While coastal cutthroat trout and bull trout mainly use the upper 20 feet of the Columbia River and estuary's water column, these fish may also use deeper portions of the water column for movement and migration. Pipeline dredges, when disposing of materials in or adjacent to the navigation channel, release dredged materials below 20 feet in depth. Coastal cutthroat trout and bull trout using water deeper than 20 feet may temporarily encounter a turbidity plume associated with these disposal activities. Where feasible and safe, the Service recommends that the Corps release pipeline-dredged materials into as deep a depth as possible.

9.3 Bald Eagle Conservation Recommendation

9.3.1 Provide Bald Eagle Perch Sites

When installing the Miller/Pillar pile dike fields, provide a limited number of un-capped pilings for bald eagle perching locations.

9.4 Columbian White-tailed Deer Conservation Recommendations

9.4.1 Develop Columbian White-tailed Deer Habitat Management Plan for Cottonwood-Howard Islands

The Columbian White-tailed Deer Recovery Plan (Service 1983) indicates Cottonwood Island is a "high potential" Columbian white-tailed deer transplant site. To ensure proper management of future Columbian white-tailed deer habitat on Cottonwood/Howard Islands, and to ensure this future habitat is secure and the translocated sub-population is considered viable for future Columbian white-tailed deer delisting decisions, the Corps should assist the Service and the landowners with development and implementation of a Cottonwood/Howard Islands Columbian white-tailed deer habitat management plan. The Columbian White-tailed Deer Recovery Plan indicates "secure habitat" is free from adverse human impacts (e.g. unregulated heavy grazing by domestic animals, clearing of woody material, etc.) in the foreseeable future and is relatively safe from natural phenomena that would destroy its value to Columbian white-tailed deer. The

Columbian White-tailed Deer Recovery Plan indicates a viable sub-population is one who's probability of extinction is low, as determined by annual estimates of sub-population size, and whose numbers are large enough to minimize deleterious effects of inbreeding.

The Cottonwood/Howard Islands' Habitat Management Plan should be a signed, legally-binding, long-term agreement for beneficial management of habitat for Columbian white-tailed deer. The Management Plan should specify agreements on long-term management actions that are protective of Columbian white-tailed deer and provide funding commitments for long-term habitat management. Long-term Service certainty in future management decisions by Cottonwood/Howard Islands' landowner, based on commitment to implementation of the Cottonwood/Howard Islands' Habitat Management Plan, will be a strong reason to consider the future Cottonwood/Howard Islands' Columbian white-tailed deer sub-population as secure. Over time, with successful Cottonwood/Howard Islands translocation and colonization, it is hoped that Cottonwood/Howard Islands' Columbian white-tailed deer sub-population also will prove to be viable.

9.5 Conservation Recommendations Summary

The Service is very encouraged by the Corps' commitment to implement numerous Section 7(a)(1) activities as part of the Project. The above Conservation Recommendations are additional Section 7(a)(1) activities that would be beneficial to the conservation and recovery of lower Columbia River, estuary, and river mouth listed species.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

10.0 Concluding Statement

This concludes formal consultation and conference on the action outlined in the Corps' January 3, 2002 aquatic species BA. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information, including that information developed through the Project's monitoring and adaptive management activities, reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

The Corps may ask the Service to confirm the coastal cutthroat trout conference opinion as a biological opinion issued through formal consultation if coastal cutthroat trout is listed. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

After listing of the coastal cutthroat trout as threatened, and subsequent adoption of this conference opinion as the biological opinion for the Project, the Corps shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information, including that information developed through the Project's monitoring and adaptive management activities, reveals effects of the agency action that may affect the species or critical habitat in a

manner or to an extent not considered in this conference opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement for coastal cutthroat trout provided in this conference opinion does not become effective until coastal cutthroat trout is listed and the conference opinion is adopted as the biological opinion issued through formal consultation. At that time, the Project will be reviewed to determine whether any take of coastal cutthroat trout has occurred. Modifications of this conference opinion and its' incidental take statement may be appropriate to reflect that take. No take of coastal cutthroat trout may occur between the listing of the species and the adoption of the conference opinion through formal consultation, or the completion of a subsequent formal consultation.

11.0 LITERATURE CITED

Arkoosh, M. R., E. Casillas, E. Clemons, B. McCain, and U. Varanasi. 1991. Suppression of immunological memory in juvenile chinook salmon (*Oncorhynchus tshawytscha*) from an urban estuary. Fish & Shellfish Immunology 1:261-277.

Blakely, A., B. Leland, and J. Ames. 2000. 2000 Washington salmonid stock inventory. Washington Department of Fish and Wildlife, Olympia, WA.

Bottom, D.L., K.K. Jones, and M.J. Harrington. 1984. Fishes of the Columbia River estuary. Final Report on the Fish Work Unit of the Columbia River Data Development Program. Oregon Department of Fish and Wildlife. Portland, OR.

Bottom, D.L., and K.K. Jones. 1990. Species Composition, Distribution, and Invertebrate Prey of Fish Assemblages in the Columbia River Estuary. *Progress in Oceanography* 25:243-270.

Bottom, D.L., C.A. Simenstad, A.M. Baptista, D.A. Jay, J. Burke, K.K. Jones, E. Casillas, and M.H. Schiewe. 2001 (unpublished). *Salmon at River's End: The Role of the Estuary in the Decline and Recovery of Columbia Salmon.* Draft Report. National Marine Fisheries Service, Seattle, Washington.

Buchanan, D., M. Hanson, and R. M. Hooten. 1997. Status of Oregon's Bull Trout, distribution, life history, limiting factors, management considerations and status. Oregon Department of Fish and Wildlife, Portland, Oregon.

Bryant, F.G. 1949. A survey of Columbia River and its tributaries, with special reference to its fishery resources-part II. Washington streams from the mouth of the Columbia to and including the Klickitat River (Area I). U.S. Fish and Wildlife Service Special Scientific Report 62.

Bustard, D.R, and D.W. Narver 1975. Preferences of juvenile coho salmon *Oncorhynchus kisutch* and cutthroat trout *Salmo clarki* relative to simulated alteration of winter habitat. Journal of the Fisheries Research Board of Canada 32:681-687.

Carlson, T.J., G.R. Ploskey, R.L. Johnson, R.P. Mueller, M.A. Weiland and P.N. Johnson. 2001. Observations of the behavoir and distribution of fish in relation to the Columbia

River navigation channel and channel maintenance activities. Pacific Northwest National Laboratory, Richland, WA.

Chilcote, M.W. 1980. Kalama sea-run cutthroat. Washington State Game Department, Fish Management Division Report 80-14, pp. 2-168.

Corps (U.S. Army Corps of Engineers). 1999. Columbia River Channel Improvement Study – Final Integrated Feasibility Report and Environmental Impact Statement. August 1999.

Dawley, E.M, C.W. Sims, and R.D. Ledgerwod. 1979. A study to define the migrational characteristics of chinook and coho salmon and steelhead trout in the Columbia River estuary. 1978 Annual Report to the Pacific Northwest Regional Commission. 23 pp.

Dawley, E.M., C.W. Sims, R.D. Ledgerwood, D.R. Miller, and F.P. Thrower. 1980. A study to define the migrational characteristics of chinook and coho salmon and steelhead trout in the Columbia River estuary. 1979 Annual Report to the Pacific Northwest Regional Commission. 90 pp.

Dawley, E.M., R.D. Ledgerwood, and A.L. Jensen. 1985. Beach and purse seine sampling of juvenile salmonids in the Columbia River estuary and ocean plume. 1977-1983. NMFS report F/NWC-75, Seattle, WA.

DMEF (Dredged Material Evaluation Framework) . 1998. Dredged Material Evaluation Framework-Lower Columbia River Management Area. U.S. Environmenatal Protection Agency Region 10, U.S. Army Corps of Engineers Northwestern Division (Portland and Seattle District), Washington State Department of Ecology, Oregon Department of Environmental Quality, and Washington State Department of Natural Resources.

Flemmer, D.A., B.F. Ruth, C.M. Bundrick, and G.R. Gaston. 1997. Macrobenthic Community Colonization and Community Development in Dredged Material Disposal Habitats off Coastal Louisiana. *Environmental Pollution* 96 (2):141-154.

Giger, R.D. 1972. Ecology and management of coastal cutthroat trout in Oregon. Oregon State Game Commission, Corvallis. Fisheries Research Report No. 6, 61 p.

Hooton, R. 1997. Status of coastal cutthroat trout in Oregon. *In* J.D. Hall, P.A. Bisson and R.E. Gresswell (eds.), Sea-run cutthroat trout: biology, management, and future conservation, p. 57-67. American Fisheries Society, Corvallis, OR.

Johnson, O.W., M.H. Ruckelshaus, W.S. Grant, F.W. Waknitz, A.M. Garrett, G.J. Bryant, K. Neely, and J.J. Hard. 1999. Status review of the coastal cutthroat trout from Washington, Oregon, and California. U.S. Deptartment of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-37, 292 p.

Johnston, J.M.. 1979. Sea-run cutthroat: Stillaguamish River creel census (1978) and harvest limit recommendations. Washington State Game Department, Olympia.

Larson, K.W., and C.E. Moehl. 1990. Entrainment of Anadromous Fish by Hopper Dredge at the Mouth of the Columbia River. in Effects of Dredging on Anadromous Pacific Coast Fishes, edited by C.A. Simenstad. Washington Sea Grant program, University of Washington, Seattle. 160 pp.

Leider, S.A. 1997. Status of sea-run cutthroat trout in Washington. *In* J.D. Hall, P.A. Bisson and R.E. Gresswell (eds.), Sea-run cutthroat trout: biology, management, and future conservation, p. 68-76. American Fisheries Society, Corvallis, OR.

Loch, J.J. 1982. Juvenile and adult steelhead and sea-run cutthroat trout within the Columbia River estuary. Washington Department of Game, Fish Management Division Report 82-2.

Loch, J.J and D.R. Miller. 1988. Distribution and diet of sea-run cutthroat trout captured in and adjacent to the Columbia River plume, May-July 1980. Northwest Science 62(1):41-48.

Lucas, B. 1980. Cutthroat studies in southwest Washington, 1979. In: Sea-run cutthroat census report. Washington State Department of Game report number 80-13(1-23).

Maruya, K.A. and R.F. Lee. 1998. Biota-sediment accumulation and trophic transfer factors for extremely hydrophobic polychlorinated biphenyls. Environmental Toxicology and Chemistry 17:2463-2469.

Melcher, C.E. and J.W. Watts. 1995. The 1994 lower Columbia River and Buoy 10 recreational fisheries. Oregon Department of Fish and Wildlife, Fish Division, Columbia River Management, Portland, OR.

Melcher, C.E. and J.W. Watts. 1996. The 1995 lower Columbia River and Buoy 10 recreational fisheries. Oregon Department of Fish and Wildlife, Fish Division, Columbia River Management, Portland, OR.

Mongillo P. and M. Hallock. 2001. Preliminary summary – Coastal cutthroat trout surveys in SW Washington 2000-20001. Washington Department of Fish and Wildlife, Olympia, WA.

NWFSC (Northwest Fisheries Science Center) Environmental Conservation Division. 2001, in draft. Potential impacts of toxic contaminants in salmonids and prey from the Columbia River estuary. NMFS, Seattle, WA. 26 pp.

Ogden Beeman & Associates, Inc. 1985. Studies to control shoaling of the navigation channel, lower Columbia River. Final Report. 176 pp.

Pearcy, W.G., R.D. Brodeur, and J.P. Fisher. 1990. Distribution and Biology of Juvenile Cutthroat Trout *Oncorhynchus clarki clarki* and Steelhead *O. Mykiss* in the Coastal Waters Off Oregon and Washington. Fishery Bulletin 88:697-711.

Quigley, T.M. and J.J. Arbelbide. 1997. An assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great Basins. Vol. III. Pages 1174-1185.

R2 Resource Consultants, Inc. 1999. Entrainment of Outmigrating Fish by Hopper Dredge in the Columbia River and Oregon Coastal Sites. Final, unpublished report to Army Corps of Engineers, Portland, Oregon. 23 pp.

Sabo, J. 1995. Interactions between coastal cutthroat trout *(Oncorhynchus clarki clarki)* and coho salmon *(O. kisutch)*. University of Washington, Seattle.

Schuck, M.L. 1980. The incidence and catch of sea-run cutthroat trout (Salmo clarki) in the Columbia and Washougal Rivers of southwestern Washington. In: Sea-run cutthroat census report. Washington State Department of Game report number 80-14(127-136).

Service. 1983. Revised Columbian white-tailed deer recovery plan. Portland, OR.

Servizi, J.A. and D.W. Martens. 1992. Sunlethal responses of coho salmon (Oncorhynchus kisutch) to suspended sediments. Canadian Journal of Fisheries and Aquatic Sciences 49: 1389-1395.

Sherwood, C. R., D. A. Jay, R. B. Harvey, P. Hamilton and C. A. Simenstad. 1990. Historical changes in the Columbia river estuary. Progress in Oceanography 25: 299-352.

Simenstad C.A., L.F. Small, and C.D. McIntire. 1990. Consumption Processes and Food Web Structure in the Columbia River Estuary. Progress in Oceanography 25:271-297

Stolz, J. and J. Schnell, editors. 1991. The Wildlife Series: trout. Stackpole Books, Harrisburg, PA.

Thomas, D.W. 1983. Changes in the Columbia River Estuary Habitat Types Over the Past Century. Columbia River Estuary Study Taskforce (CREST) Columbia River Estuary Data Development Program, Astoria, Oregon. 51 pp.

Thorpe, J.E. 1994. Salmonid fishes and the estuarine environment. Estuaries 7:76-93.

Trotter, P.C. 1989. Coastal cutthroat trout: a life history compendium. Transactions of the American Fisheries Society 118: 463-473.

Trotter, P.C. 1997. Sea-run cutthroat trout: life history profile. *In* J.D. Hall, P.A. Bisson and R.E. Gresswell (eds.), Sea-run cutthroat trout: biology, management, and future conservation, p. 7-15 American Fisheries Society, Corvallis, OR.

Zuranko, D.T., R.W. Griffiths, and N.K. Kaushik. 1997. Biomagnification of polychlorinated biphenyls through a riverine food wed. Environmental Toxicology and Chemistry 16:1463-1471.

Personal Communication:

Jeremy Buck, USFWS, Oregon State Office, Portland, OR. 2002. Memo.

Al Clark, USFWS, Julia Butler Hanson National Wildlife Refuge, Skamokawa, WA. 2002. Memo.

Travis Coley, USFWS, Fisheries Resource Office, Vancouver, WA. 2001. Telephone.

Pat Connolly, USGS - Biological Resources Division, Cook, WA. 2002. Memo.

Laura Hicks, Corps of Engineers, Portland District, Portland, OR. Memo.

John Loch, Washington Department of Fish and Wildlife. As cited in Appendix D of the aquatic species BA.