RECLAMATION
Managing Water in the West

Biological Assessment of Effects to Species and Critical Habitat for Thirteen Anadromous Salmon ESUs, Pacific Eulachon, Green Sturgeon, and Killer Whales in the Columbia River Basin from Implementation of the Modified Partial Groundwater Irrigation Replacement Alternative (Alternative 4A)

Odessa Subarea Special Study
Columbia Basin Project, Washington

Prepared For:

National Oceanic and Atmospheric Administration
National Marine Fisheries Service

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Columbia-Cascades Area Office

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Mission Statements

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Acronyms and Abbreviations

Action Agencies	BPA, Corps, Reclamation
Action Area	All areas directly or indirectly affected by the proposed Federal action and not merely the immediate area involved in the action
BA	Biological assessment
BiOp	Biological opinion
BPA	Bonneville Power Administration
BRT	Biological Review Team
CBP	Columbia Basin Project
CDFG	California Department of Fish and Game
cfs	Cubic feet per second
CHART	Critical Habitat Analytical Team
CHU	Critical habitat unit
Corps	U.S. Army Corps of Engineers
CR	Columbia River
DEIS	Draft Environmental Impact Statement
DO	Dissolved oxygen
DPS	Distinct population segment
ECBID	East Columbia Basin Irrigation District
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily significant unit
FCRPS	Federal Columbia River Power System
FEIS	Final Environmental Impact Statement
FMO	Foraging, migration, and overwintering
HUC	Hydrologic unit code
ICTRT	Interior Columbia Technical Recovery Team
kcfs	Thousand cubic feet per second
LCFRB	Lower Columbia Fish Recovery Board
LCR	Lower Columbia River
MPG	Major population group
MMPA	Marine Mammal Protection Act

NMFS	National Marine Fisheries Service
Odessa Subarea	Odessa Ground Water Management Subarea
ODFW	Oregon Department of Fish and Wildlife
PCE	Primary constituent element
PCE	primary constituent element
PEM	Palustrine emergent
PHS	Priority habitat species
Proposed Action	Modified Partial Groundwater Irrigation Replacement Alternative (Alternative 4A)
PUD	public utility district
QCBID	Quincy Columbia Basin Irrigation District
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RM	river mile
RPA	Reasonable and prudent alternative
SCBID	South Columbia Basin Irrigation District
SR	Snake River
State	Washington State
Study	Odessa Subarea Special Study
Study Area	Odessa Subarea Special Study area
TDG	Total dissolved gas
TMDL	Total maximum daily load
TRT	Technical Recovery Team
UCR	Upper Columbia River
USFWS	U.S. Fish and Wildlife Service
UWR	Upper Willamette River
VSP	Viable Salmonid Population
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WLC	Willamette/Lower Columbia

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1.0 INTRODUCTION

1.1 Purpose of this Biological Assessment

The U.S. Bureau of Reclamation is Consulting with the National Marine Fisheries Service (NMFS) pursuant to Section 7 (a)(2) of the Endangered Species Act (ESA). This biological assessment (BA) describes and analyzes the effects of the construction, operation, and maintenance of the Modified Partial Replacement Alternative of the Odessa Subarea Special Study (Study) on ESA listed species and designated critical habitat. This document also addresses effects on Essential Fish Habitat (EFH) as required by the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) as amended by the Sustainable Fisheries Act of 1996.

1.2 Proposed Action

Reclamation and the Washington State Department of Ecology (Ecology) are proposing to replace groundwater currently used for irrigation of lands within the boundaries of the Columbia Basin Project (CBP) with surface water from the Columbia River by constructing or modifying distribution systems and appurtenant structures. Reclamation and Ecology have prepared a *Final Environmental Impact Statement (FEIS) for the Odessa Subarea Special Study* (Reclamation 2012). The Proposed Action for this consultation appears as Alternative 4A in the FEIS. The Odessa Subarea Special Study and the FEIS evaluated several groundwater replacement alternatives (Reclamation 2012). Of those alternatives, the Modified Partial Replacement Alternative, Alternative 4A in the FEIS, is the Proposed Action evaluated in this BA. This Proposed Action would provide surface water to 70,000 acres of existing farmland currently irrigated with groundwater. Reclamation is not proposing to expand irrigated agriculture to new, undisturbed lands. Rather, surface water deliveries will be used to retire groundwater irrigation on a one for one basis.

Construction activities under the Proposed Action include enlarging the East Low Canal south of I-90, adding a second barrel to all existing siphons south of I-90; constructing a pipeline distribution system fed by eight pumping plants along the canal and three relift stations; potential reconstruction of some existing road bridges over the East Low Canal, additional easement width along the existing Weber wasteway; and new electric transmission lines to each pumping plant. Construction would occur in concurrent phases over approximately 10 years.

When fully implemented, operations will require, on average, a diversion of 164,000 acre-feet from the Columbia River (via Banks Lake). Reclamation has designed the Proposed Action to minimize impacts on Reclamation's ability to operate consistent with objectives under the reasonable and prudent alternative (RPA) for operations of Grand Coulee Dam and Lake Roosevelt identified in the NMFS biological opinion (BiOp) for the operation and maintenance of the Federal Columbia River Power System (2008/2010 FCRPS BiOp). Under the Proposed Action, Banks Lake would refill between October and March, with most pumping occurring in October and extremely limited and infrequent pumping occurring from November through March.

1.3 How to Use this Document

This document is intended to convey information regarding the biological effects of implementation of the Modified Partial Replacement Alternative to facilitate interagency consultation on ESA-listed species and designated critical habitat. Although the Proposed Action will be implemented in phases by Federal and non-federal parties, this biological assessment evaluates, using the best available information, the full scope of the Proposed Action. This information is organized as follows.

Chapter 1, “Introduction,” provides important background and contextual information including brief descriptions of the Proposed Action, a consultation history, the listed species and critical habitat in the Action Area, and the Action Area.

Chapter 2, “Proposed Action,” provides detailed descriptions of the construction and operational components of the Proposed Action.

Chapters 3 and 4, “Factors Affecting Species in the Action Area," and “Status of Listed Species,” comprise the environmental baseline. The environmental baseline provides a “snapshot” of the current status of affected species and critical habitat and describes factors, both adverse and beneficial, leading to species’ current conditions, indicating potential trends. For this consultation, the environmental baseline includes current hydrologic conditions resulting, in part, from the current operation of the CBP and FCRPS. The environmental baseline assists consulting agencies in determining the effects of the Proposed Action on listed species and critical habitat.

Chapter 5, “Effects of the Action,” provides an analysis of the anticipated effects of the Proposed Action on hydrologic characteristics, listed species, and designated critical habitat, together with the effects of other actions that are interrelated or interdependent with the Proposed Action.

Chapter 6, “Cumulative Effects,” provides information regarding beneficial and adverse impacts resulting from Tribal, State, and private actions that are reasonably certain to occur in the Action Area.

Chapter 7, “Essential Fish Habitat,” provides an analysis of the anticipated effects of the Proposed Action on Chinook and coho salmon species and habitat conditions that are designated for protection under the Magnuson-Stevens Act (MSA).

Chapter 8, “References,” provides a list of references used in preparing this BA.

1.3.1 Relationship between the FEIS and this BA

As part of compliance with the National Environmental Policy Act (NEPA), Reclamation and Ecology prepared an FEIS for alternatives addressed in the Odessa Subarea Special

Study. Much of the information in this BA is also addressed in portions of the FEIS discussing Alternative 4A. Reclamation incorporates by reference those portions of the FEIS pertaining to Alternative 4A or common to all alternatives. Although the analyses in the BA and FEIS are very similar, this BA presents information for a technical audience. Further, the effect determinations in this BA are based on regulatory standards specific to the ESA and differ in phrasing from conclusions expressed in the FEIS.

1.4 Consultation Background

Coordination between Reclamation and the U.S. Fish and Wildlife Service (Service) and NMFS on the Odessa Project began in 2006 during the development of alternatives for the Odessa Special Study. Reclamation initiated informal consultation with the Service on the Proposed Action in early 2012. Reclamation also initiated informal consultation with NMFS in March 2012. During a May 25, 2012, conference call, NMFS suggested operations with the potential to lessen impacts on listed salmon by reducing the frequency of diversions from April through June, focusing additional diversions in October, and identifying the potential for diversion from November through March. Reclamation incorporated these suggestions into the Proposed Action. These operations are titled the “Limited Spring” diversion scenario in the FEIS. Between June and September 2012, Reclamation analyzed the potential effects to listed species from the “Limited Spring” diversion scenario. Reclamation and NMFS met again in Portland on October 15, 2012, to discuss the Proposed Action. During this meeting, Reclamation and NMFS discussed the continuing potential for adverse effects resulting from April through June diversions. Due to their relatively small benefit to water storage in Banks Lake and the infrequent nature of their occurrence, Reclamation removed April-through-June diversions from the Proposed Action.

1.5 Action Area

The implementing regulations for Section 7 of the ESA define action area as “…all areas directly or indirectly affected by the proposed Federal action and not merely the immediate area involved in the action” (Service 1998; 50 CFR 402.02). In delineating the action area, Reclamation evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. The Action Area is defined as the mainstem Columbia River from Chief Joseph Dam extending downstream to the confluence with the Pacific Ocean, including the Columbia River estuary and plume. Within the Action Area, anadromous salmonid ESU/DPSs designated within the Upper Columbia, Middle Columbia, and Snake River basins utilize the entire mainstem Columbia from Chief Joseph Dam downstream to the Pacific Ocean. Those species designated within the Lower Columbia or Willamette River basins, including Pacific eulachon and green sturgeon, can occur within the mainstem Columbia River below Bonneville Dam. Killer whales (*Orcinus orca*) are found in the marine or nearshore environment and can be affected if they enter the Columbia River plume or estuary. The area of analysis addressed in this BA encompasses those areas on the mainstem Columbia River that are hydrologically influenced by the operation of the FCRPS and the Odessa

Proposed Action, and inhabited by the species relevant to this consultation or have designated critical habitat.

1.6 Species Evaluated in this Biological Assessment

The 13 listed salmon and steelhead species, as well as the other species under consultation, occupy the action area downstream of Chief Joseph Dam. Therefore, Reclamation's analysis focuses on the portion of the Action Area beginning with the Columbia River at Chief Joseph Dam downstream to the confluence of the Columbia River and the Pacific Ocean. The Columbia River estuary and nearshore marine environment is the farthest downstream point at which Reclamation's Proposed Action may influence listed anadromous salmonids and other species under the jurisdiction of NMFS.

Table 1 lists the 13 Pacific salmon ESUs and steelhead DPSs and three lower Columbia River marine species, together with species status and critical habitat designation, which occur within the collective action area for the Proposed Action.

Table 1. Species Evaluated in this BA and their Rangewide Status Listings

ESU/DPS name	Original Listing	Revised Listing(s)	Critical Habitat Designations
Upper Columbia River (UCR) Spring Chinook salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 Classification: Endangered	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Re-Classification: Endangered	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Upper Columbia River (UCR) steelhead	**FR Notice:** 62 FR 43937 **Date:** 8/18/1997 Classification: Endangered	**FR Notice**: 71 FR 834 **Date:** 1/5/2006 Re-Classification: Threatened **Date:** 6/2007 Re-Classification: Endangered **By:** Court Order **Date:** 6/2009 Re-Classification: Threatened **By:** Court Order	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Snake River (SR) Spring/Summer Chinook salmon	**FR Notice:** 57 FR 34639 **Date:** 4/22/1992 Classification: Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Re-Classification: Threatened	**FR Notice:** 64 FR 57399 **Date:** 10/25/1999
Snake River (SR) Fall Chinook salmon	**FR Notice:** 57 FR 14653 **Date:** 4/22/1992 Classification: Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Re-Classification: Threatened	**FR Notice:** 58 FR 68543 **Date:** 12/28/1993
Snake River (SR) sockeye	**FR Notice:** 56 FR 58619 **Date:** 11/22/1991 Classification: Endangered	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Re-Classification: Endangered	**FR Notice:** 58 FR 68543 **Date:** 12/28/1993
Snake River (SR) steelhead	**FR Notice:** 62 FR 43937 **Date:** 8/18/1997 Classification: Threatened	FR Notice: 71 FR 834 **Date:** 1/5/2006 Re-Classification: Threatened	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Middle Columbia River (MCR) steelhead	**FR Notice:** 64 FR 14517 **Date:** 3/25/1999 Classification: Threatened	FR Notice: 71 FR 834 **Date:** 1/5/2006 Re-Classification: Threatened	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Lower Columbia River (LCR) Chinook Salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 Classification: Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Re-Classification: Threatened	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Columbia River (CR) Chum Salmon	**FR Notice:** 64 FR 14508 **Date:** 3/25/1999 Classification: Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Re-Classification: Threatened	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Lower Columbia River (LCR) Coho Salmon	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Classification: Threatened	NA	Under development **FR Notice:** 76 FR 1392 **Date:** 1/10/2011
Lower Columbia River (LCR) Steelhead	**FR Notice:** 63 FR 13347 **Date:** 3/19/1998 Classification: Threatened	FR Notice: 71 FR 834 **Date:** 1/5/2006 Re-Classification: Threatened	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Upper Willamette River (UWR) Chinook salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 Classification: Threatened	NA	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Upper Willamette River (UWR) steelhead	**FR Notice:** 64 FR 14517 **Date:** 3/25/1999 Classification: Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 Re-Classification: Threatened	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Southern DPS of Pacific Eulachon (Thaleichthys pacificus)	**FR Notice:** 75 FR 13012 **Date:** 3/18/2010 Classification: Threatened	NA	**FR Notice:** 76 FR 65234 **Date:** 10/20/2011
Southern DPS of Green Sturgeon (Acipenser medirostris)	**FR Notice:** 71 FR 17757 **Date:** 4/7/2006 Classification: Threatened	NA	**FR Notice:** 74 FR 52300 **Date:** 10/9/2009
Southern Resident DPS of Killer Whales (Orcinus orca)	**FR Notice:** 70 FR 69903 **Date:** 11/18/2005 Classification: Endangered	NA	**FR Notice:** 71 FR 69054 **Date:** 11/29/2006

2.0 PROPOSED ACTION

The Proposed Action is the future construction, operation, and maintenance of the Modified Partial Groundwater Replacement Alternative (Proposed Action or Alternative 4A) of the Odessa Subarea Special Study. The actions described below identify construction and operation activities needed to provide surface water from the CBP to 70,000 acres of land in Douglas, Lincoln, Franklin, and Adams counties, Washington, that are currently irrigated with groundwater. This section summarizes the Proposed Action, describes facility improvements needed to facilitate this action, and outlines changes to the operations of the CBP which will result when the Proposed Action is fully implemented.

Each alternative in the FEIS varies by the facility requirements, the reservoir that supplies stored water, and the operational scenario. Alternative 4A describes the Modified Partial-Replacement Alternative, using Banks Lake and a Limited Spring diversion scenario. For the purpose of simplicity in this document, the phrase "Modified Partial-Replacement Alternative" is used to refer only to Alternative 4A. Discussion of Alternative 4A and those parts of the FEIS common to all alternatives is incorporated by reference.

2.1 Background

2.1.1 History of the Odessa Subarea Special Study

The Odessa Subarea Special Study is conducted under the authority of the Reclamation Act of 1939 and the Columbia Basin Project Act of 1943, as amended. Section 9(a) of the Reclamation Project Act of 1939 gave authority to the Secretary of the Interior (Secretary) to approve a finding of feasibility and thereby authorize construction of a project upon submitting a report to the President and the Congress. The Secretary approved a plan of development for the CBP, known as House Document No. 172 in 1945. House Document No. 172 anticipated that development of the CBP would occur in phases over a 70-year period. The Proposed Action would be implemented pursuant to these authorities. This Act, authorized by Congress, led to the implementation of the CBP to irrigate a total of 1,029,000 acres, of which about 671,000 acres are currently irrigated. The Acts gave authority to the Secretary of the Interior (Secretary) to assess feasibility, approve plans, and implement construction of the CBP.

The State issued irrigation groundwater permits in the 1960s and 1970s in the Odessa Subarea as a temporary measure to provide water to these lands until the CBP was further developed. Since the issuance of the groundwater permits, water levels in the underlying aquifer have declined significantly, requiring irrigators to pump from increasing depths (wells up to 2,000 feet deep). In addition, deep water aquifer pumping has also resulted in decreasing water quality in the aquifer. The State identified the declining Odessa Subarea aquifer as one of the highest priority issues in the Columbia River Basin. U.S. Geological Survey groundwater studies have concluded that the Columbia Plateau Regional Aquifer system is currently being pumped at an unsustainable level.

With increasing concern over the groundwater supply, Ecology, Reclamation, and the three CBP irrigation districts (East Columbia Basin, South Columbia Basin, and Quincy Irrigation Districts) entered into the Columbia River Initiative MOU in December 2004 to engage in a cooperative process for implementing water management improvements within the CBP. The State provided a cost-share through an Intergovernmental Agreement between Ecology and Reclamation in December 2005 to fund the Odessa Special Study. Subsequent to the signing of the 2004 Columbia River Initiative MOU, the State Legislature passed the Columbia River Basin Water Resource Management Act (CRWRMA) in February 2006 (RCW 90.90). The Act directs Ecology to aggressively pursue development of water benefiting both instream and out-of-stream uses. Among the activities identified in the legislation, Ecology is directed to focus on "development of alternatives to groundwater for agricultural users in the Odessa subarea aquifer."

Reclamation and Ecology conducted the Odessa Subarea Special Study to determine the feasibility and economic practicality of further replacing groundwater-irrigated lands with surface water sources via authorized deliveries from the CBP. Reclamation and Ecology have jointly prepared an environmental impact statement (EIS) to meet NEPA/SEPA requirements for the Odessa Special Study. A Draft EIS (DEIS) was released in October 2010, and the FEIS was released in August 2012 (Reclamation 2012). In response to comments received on the DEIS, Reclamation and Ecology developed the Modified Partial Groundwater Replacement Alternative.

2.1.2 The Modified Partial Groundwater Replacement Alternative (Alternative 4A)

The Modified Partial-Replacement Alternative, described in the FEIS as Alternative 4A, provides replacement water for approximately 70,000 acres of currently groundwater irrigated lands. Approximately 25,000 acres of the 70,000 acres would be located north of I-90, while the remaining 45,000 acres would be south of I-90. Compared to the full-replacement alternatives of the 2010 DEIS, the Proposed Action serves a smaller portion of lands north of I-90.

The Proposed Action contains "infill" to allow some groundwater irrigators in areas distant from the ELC to move their operations to previously disturbed lands closer to the canal. This would primarily be accomplished through land acquisitions and leases. It is anticipated that as much as 15 percent of the lands served under the Proposed Action would involve relocation of current groundwater-irrigated operations. Relocation would be limited to an acre-per-acre exchange. That is, one acre of currently groundwater-irrigated land would be retired for each acre of relocated irrigated land served with replacement water.

The average additional volume of water needed to serve the 70,000 acres would be 164,000 acre-feet per year; although it would take at least the full 10-year build-out period for that annual quantity to be fully utilized. That volume falls within 138,000 acre-feet of water per year needed for the Partial Groundwater Replacement Alternatives and 273,000 acre-feet needed for the Full Groundwater Replacement Alternatives presented in the DEIS.

The Proposed Action would involve enlarging the ELC south of I-90 and constructing canal-side pumping plants, relift pumping plants, and pressurized pipeline systems. These alternatives would be developed in a manner that would encourage direct financial participation of project area irrigators in the construction of pumping plants, relift pumping plants, and pipelines. Such participation would be part of a public-private partnership with Reclamation, the State, and the East Columbia Basin Irrigation District, the only irrigation district that would be impacted by Alternative 4A.

The principle features incorporated into the Proposed Action are presented on Figure 1. As shown on Figure 1, CBP water would be delivered through the existing ELC to currently groundwater-irrigated lands both north and south of I-90. Major facility development associated with this alternative includes enlargement of the ELC and installation of pumping plants, relift pumping plants, and pressurized pipeline systems to deliver CBP water from the canal to eligible farmlands.

No short-term impacts to Lake Roosevelt, the Columbia River, or Banks Lake during construction activities are anticipated for the Proposed Action. Therefore, short-term impacts to those features due to construction activities are not addressed further in this analysis.

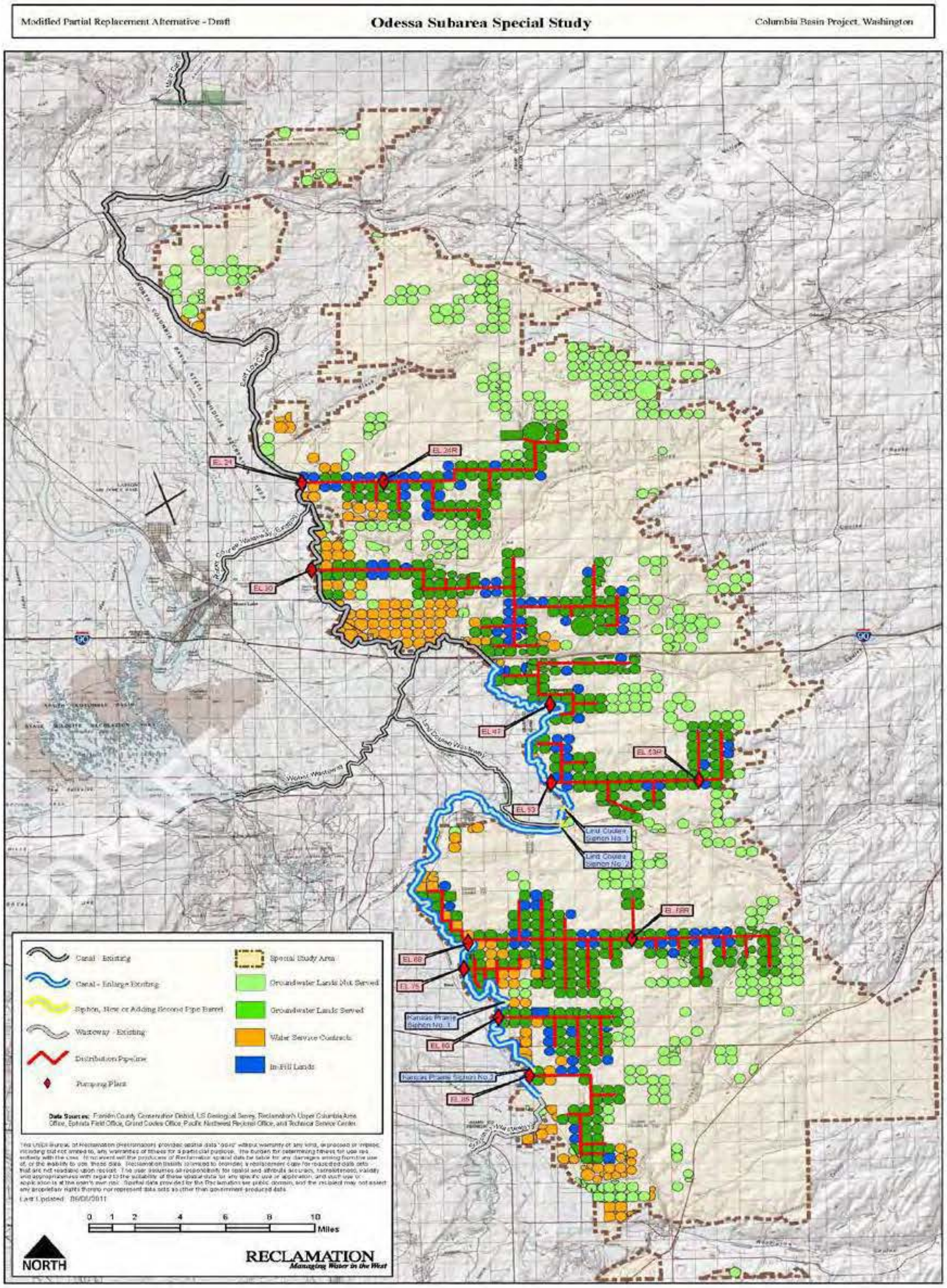

Figure 1. Odessa Study Area with the proposed layout for East Low Canal enlargement, distribution lateral system, and pumping plant locations in areas north and south of I-90.

2.2 Construction and Expansion of Facilities

This section summarizes the proposed facilities and construction activities under the Proposed Action. Additional detail of proposed construction activities appears the in FEIS in the description of Alternative 4A.

2.2.1 Facility Descriptions

Delivery system facilities and components for the Proposed Action consist of:

- Enlarging the capacity of the East Low Canal south of I-90, including adding a second barrel to all existing siphons south of I-90. The East Low Canal would be enlarged by up to 32 feet along its entire route south of I-90.
- Constructing a distribution pipeline system fed by eight pumping plants along the canal and three relift stations. This system would require numerous meter and equipment stations along the pipeline routes, primarily at farm delivery points (Table 1).
- Potential reconstruction of some existing road bridges over the East Low Canal.
- Additional easement width along the existing Weber wasteway.
- New electric transmission lines to each pumping plant.
- No extension of East Low Canal is proposed as part of Alternative 4A.

East Low Canal Enlargement

The existing earth-lined, 43.3-mile section of the ELC south of I-90 to the Scootney Wasteway was constructed at 23- to 46- percent of design capacity; design capacity was determined based on potential full development of the CBP, as described in the 1989 Draft EIS for continued phased development of the CBP (Reclamation 1989). The five siphons along this reach of canal are also below design capacity, as they were constructed with one barrel (pipe), rather than the two barrels necessary to achieve full capacity.

Beyond these limitations, many aspects of ELC development anticipated the potential for future expansion in their design and construction. Sufficient easement width was acquired to allow for canal expansion and the addition of the second siphon barrels. Siphon transitions, check structures, drainage inlets, cross-drainage facilities, and many of the roadway and other bridge crossings were built to accommodate full capacity.

Actions required along the ELC south of I-90:

- Widening the canal to increase its capacity to that needed for the Proposed Action. All excavated material would be placed within the existing easement and existing operation and maintenance (O&M) access along the canal would be maintained similar to the approach used for initial canal construction.

Concrete lining would also be added to short sections of the canal at 29 locations.

- Adding a second barrel to each of the five existing siphons (Lind Coulee 1 and 2, Warden, and Kansas Prairie 1 and 2).

Distribution Pipeline System

The proposed distribution pipeline system for the Proposed Action is described below and shown on Figure 1.

Table 2 provides a summary of facility characteristics and land requirements for construction of pumping facilities and lateral distribution systems.

Distribution Pipelines: The distribution system would require approximately 150 miles of buried pipeline. As illustrated on the map, the system is generally designed to locate the pipelines along section and half-section lines and deliver water to typical quarter sections. Reclamation would need to acquire 100- or 200-foot-wide easements (depending on pipeline size) for pipeline installation and retain long-term access to and within the easement for necessary repairs or replacements. These requirements would preclude any future structure development within the easement. However, except for the locations of relift pumping plants and equipment sites described below, agriculture or other nonstructural uses could continue once the pipeline is installed and operational.

Canal-Side Pumping Plants: The eight canal-side pumping plants that would feed the pipeline distribution system would be located on the east side of the East Low Canal at canal miles 24, 30, 47, 53, 68, 75, 80, and 85. Each plant would require about 3 acres to accommodate the pumping plant structure and equipment (no metal building would be constructed), an air chamber, and an electric power substation. Each plant would be fenced for security using chain-link topped with barbed wire. A regulating tank would also be necessary with each of these pumping plants; these tanks would be located along the pipeline up to 2 miles from the pumping plant site. Figures 2-12 and 2-13 in the Final EIS provide a conceptual site and elevation, respectively, of these pumping plants.

Relift Pumping Plants: Three relift pumping plants are required for the pipeline distribution system to boost pipeline pressure in the central parts of the service area to reach the easternmost lands. One plant would be located north of I-90 on the pipeline system and would be fed from the pump station at canal mile 24. Two additional plants would be located south of I-90—one serving the pipeline from the pumping plant at canal mile 53 and another associated with the pipeline receiving water from the pumping plant at canal mile 68. The approximate locations of these plants are shown on Figure 1. Each plant would require about 3 acres to accommodate the pumping plant structure and equipment (no metal building would be constructed), an air chamber, and an electric power substation.

Table 2. Distribution system table indicating the location of main and relift pumping plants, lengths of laterals and sublaterals constructed, and acres served as a result of delivering surface water to the Odessa Study Area.

Component	Main Pumping Plant	Relift Pumping Plant	Lateral Length (mi)	Sublaterals Length (mi)	Acres Served
North of I-90					
East Low Canal	EL #24		3.62	1.53	2279
East Low Canal		EL #24 R	10.35	7.02	9233
East Low Canal	EL #30		16.87	11.43	13824
South of I-90					
East Low Canal	EL #47		8.9	2.53	5654
East Low Canal	EL #53		6.44	7.11	7282
East Low Canal		EL #53R	3.53	2.63	3010
East Low Canal	EL #68		7.22	17.25	11663
East Low Canal		EL #68R	7.63	7.29	6082
East Low Canal	EL #75		3.07	3.20	1868
East Low Canal	EL #80		5.35	5.53	5494
East Low Canal	EL #85		8.11	2.64	4275

Duration and Phasing

Development of the delivery system for the Proposed Action would be divided into four phases, spanning a total of approximately 11 years as shown on Table 3. Each construction phase would last 3 to 4 years, with work on two or more phases overlapping at times. Construction would occur in phases to spread work as evenly as possible throughout the construction period, and bring the delivery system online in stages (see Figure 2).

Table 3. Construction phases for Alternative 4A.

Construction Year	1	2	3	4	5	6	7	8	9	10	11
Phase 1 – 25,380 Acres											
Phase 2 – 16,008 Acres											
Phase 3 – 19,642 Acres											
Phase 4 – 9,767 Acres											

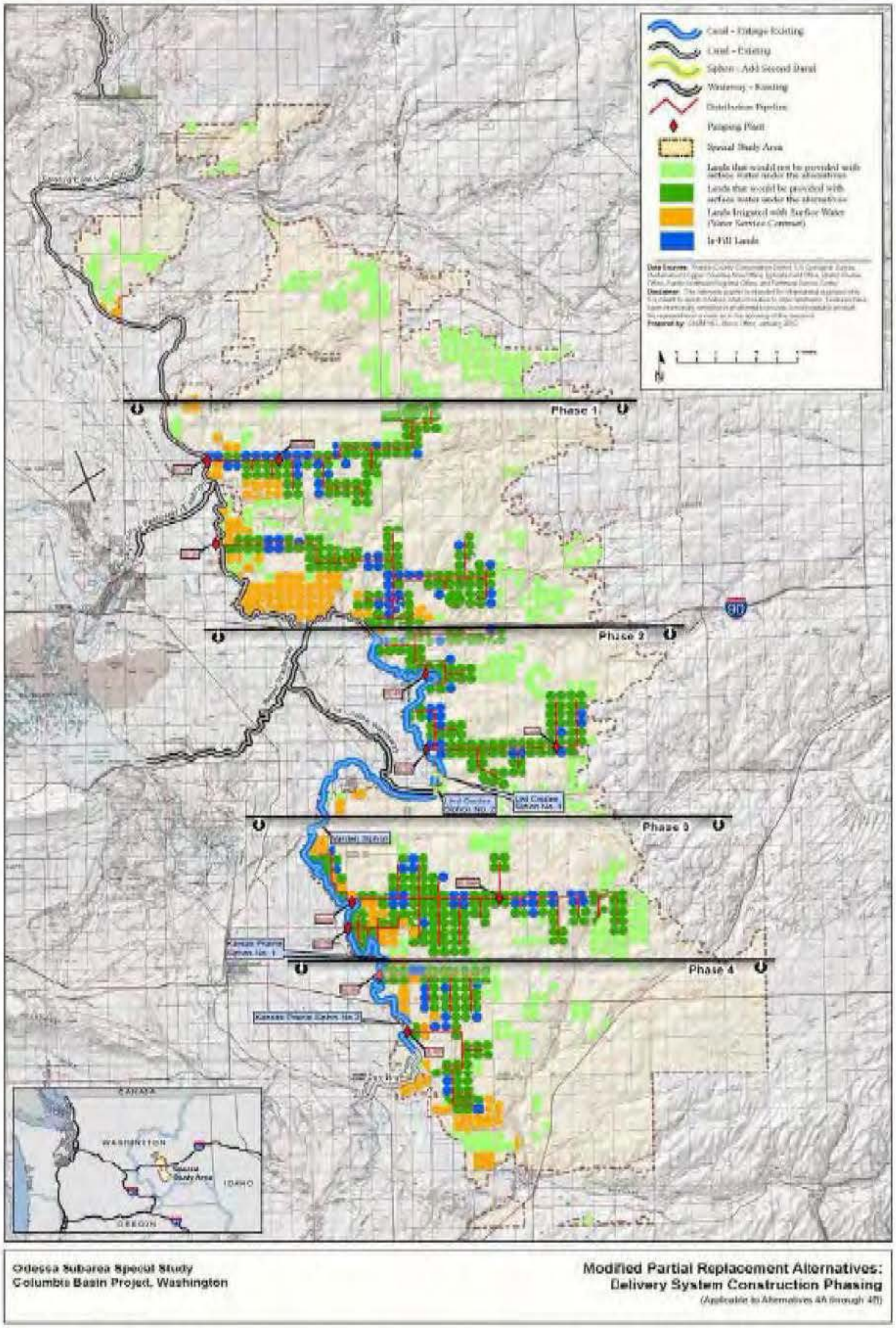

Figure 2. Modified Partial Replacement Alternatives: Delivery system construction phasing

Construction Workforce, Activities, Equipment, and Other Requirements

Construction activity would occur at multiple locations simultaneously in each phase, and move progressively through the area identified for each phase. Worksites would include the following:

- Along the East Low Canal
- Existing siphons (adding a second barrel)
- Pumping plant(s), including associated electric substations
- Distribution pipeline alignments
- Transmission line alignments
- O&M facility.

Major construction in any given area is not expected to extend beyond a year and, in many cases, would be of substantially shorter duration. Work on the existing ELC would be outside of the irrigation season to avoid disruption of existing water operations.

Access for facility construction would be primarily from existing public roads, Reclamation O&M roads along the ELC, or temporary roads along distribution pipelines within the pipeline easements. Powerlines would be installed along existing roads to the extent practical; where this is not feasible, temporary access roads would be needed along the powerline easement.

Construction of the delivery system, especially canal widening and extension, would require use of heavy equipment including hydraulic excavators, large dozers, scrapers, cranes, and compaction equipment. Other equipment normally involved with major construction would also be employed, such as dump trucks, loaders, and delivery trucks (for concrete and other materials).

Staging areas would generally be located within canal, pipeline, and transmission line easements and at the sites of pumping plants and the operations and maintenance facility. To the extent possible, staging areas would be located at least 500 feet from a residence. No disposal sites for excavated material are expected to be needed. All material excavated for canal enlargement and extension, or for installation of pipelines and transmission lines, would be stockpiled within the facility easements or backfilled, as appropriate.

2.2.2 Routine Maintenance

Numerous activities are required to maintain irrigation system infrastructure and equipment, provide for efficient operation, and minimize unplanned outages in service. These activities include regular inspections, debris removal, cleaning, painting, resurfacing, and equipment maintenance, repair, and replacement. Collectively, these activities would not require a large workforce and only minimal use of heavy equipment. All such activities would be carried out by involved irrigation districts.

2.3 Proposed Operations

In summary, the Proposed Action will deliver water from Banks Lake to lands in the Odessa subarea via the distribution system described above. Reclamation would refill Banks Lake by pumping water through the John W. Keys III Pump-Generating Plant (Keys Pump-Generating Plant) from the Columbia River at Lake Roosevelt behind Grand Coulee Dam. This section describes these operations in greater detail. Operational descriptions are based on full construction of the Proposed Action; phased operations occurring prior to full construction would follow similar parameters, but be smaller in scale. This section provides brief descriptions of the operations of major facilities as part of the Proposed Action.

2.3.1 Banks Lake

Banks Lake is a storage facility formed by two dams, North and Dry Falls, and is designed to serve as a reregulation reservoir for the irrigation portion of the CBP. It is also used as the forebay for pumped storage operations when the Keys Pump-Generating Plant is used to generate electric power. To supply water to Banks Lake, Reclamation lifts water from Lake Roosevelt through the Keys Pump-Generating Plant approximately 280 feet to the Banks Lake Feeder canal, which flows 1.6 miles to the Banks Lake equalizing reservoir.

During the irrigation season, Reclamation would supply an average volume of 164,000 acre-feet through the drawdown of Banks Lake to lands served by the Proposed Action. The pattern of drawdown and refill for Banks Lake is explained in more detail in Section 5.1, “Effects to Hydrology,” of this document. To deliver water to the Study Area, Reclamation would release water from Banks Lake into the Main Canal via Dry Falls Dam at the southern end of Banks Lake.

2.3.2 Diversions from Lake Roosevelt and the Columbia River

Diversion of water to the Study Area from the Columbia River would take place through additional pumping from Lake Roosevelt to Banks Lake. With the Proposed Action, an average additional 164,000 acre-feet of water will be diverted from the Columbia River. Lake Roosevelt storage will not be used but will be affected for a short time initially when the pumps are turned on and the outflows from Grand Coulee Dam are adjusted for the increased pumping to Banks Lake.

Reclamation will pump additional water from the Columbia River using the existing Keys Pump-Generating Plant. The facility consists of 6 individual pumps and 6 pump-generators with a combined capacity of approximately 22,000 cfs. Keys Pump-Generating Plant pumps water from Lake Roosevelt through Banks Lake for delivery to the CBP. Pumping to Banks Lake for the CBP under current operations takes place during the irrigation season in March through October. Routine facility maintenance typically occurs at the end of the irrigation season; however, operations for maintenance can occur concurrently with operations during some years.

Additional pumping to supply water to the Study Area will occur primarily in October, then on an opportunistic basis between the months of November through March in those years when the full 164,000 acre-feet cannot be diverted entirely in October based on flow conditions, pump availability, and the electrical load shaping requirements of the BPA. Although the Keys Pump-Generating Plant can pump a maximum of approximately 22,000 cfs, immediate impacts to the Columbia River depend on the outflow from Grand Coulee Dam, which operates independently of the Keys Pump-Generating Plant.

Additional diversion from the Columbia River to refill Banks Lake will follow a set of operational parameters that will constrain the timing and total volume of water withdrawn from the Columbia River. All parameters are expressed as increases in total monthly acre-feet pumped from the Columbia River under the Proposed Action. These generalized parameters are as follows:

- **Fall Diversion.** Average additional diversions of 164,000 acre-feet on average will occur in October. It is anticipated that the full diversion of 164,000 acre-feet can occur entirely in October. Modeling results indicated that the full diversion could be taken in 70 of the 70 years modeled.
- **Winter Diversions.** If the full replacement of storage is not satisfied by November 1, additional diversions of up to 21,000 acre-feet (350 cfs) per month can occur from November through March when chum salmon flow targets are met below Bonneville Dam. When chum salmon flow targets are not met, Reclamation would limit additional November through March diversions to 6,000 acre-feet per month. When diversions are proposed for the November-through-March period, Reclamation will coordinate the anticipated diversion schedule with NMFS prior to implementing those operations. Winter diversions are anticipated to occur very infrequently (between 1-2 percent of years) under the Proposed Action, if at all.
- **Spring/Summer.** No additional diversions would occur from April through September.

How these operational parameters were developed

To develop the operational parameters, Reclamation considered a number of factors, including flow conditions in the river, facility capability, and impacts on listed species. The Proposed Action primarily relies on October diversions from the Columbia River since there are no FCRPS BiOp flow objectives for listed salmonids during October. October is the end of the irrigation season for the CBP and demand decreases. At this time, there would be sufficient pump capacity to pump an additional 164,000 acre-feet of water to Banks Lake. Summer flow objectives listed in the FCRPS BiOp, as well as State of Washington policy preference, limits additional diversions from the Columbia River from July through September. Spring FCRPS BiOp flow objectives are in effect in April through June to protect outmigrating salmon and steelhead. In November through March, FCRPS objectives protect chum salmon spawning habitat downstream of Bonneville Dam. The operational parameters developed for the Proposed Action sought to minimize impacts to the chum salmon habitat in November through March and were designed to avoid impacts to salmon and steelhead spring outmigration conditions by not diverting water during the juvenile outmigration period of April through June.

To illustrate the effect on Columbia River flows from additional diversions, potential Columbia River flow reductions for four representative water-year types were modeled.

Table 4 presents a summary of seasonal changes in flow conditions for the Proposed Action relative to the environmental baseline condition for representative wet (1982), average (1995), dry (1988), and drought (1931) years. These values are expressed as the change in the monthly average outflow from Grand Coulee Dam under the Proposed Action. Table 4 presents flow changes during these years as "snapshots" of the likely increased diversion in typical conditions.

Table 4. Change in Average Monthly Flow Rate Compared to the Environmental Baseline for Modeled Representative Water Years (cfs) for the Proposed Action.

Alternative	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Water Year 1982 (Wet Year)	-2660	0	0	0	0	0	0	0	0	0	0	0
Water Year 1995 (Average Year)	-2662	0	0	0	0	0	0	0	0	0	0	0
Water Year 1988 (Dry Year)	-2666	0	0	0	0	0	0	0	0	0	0	0
Water Year 1931 (Drought Year)	-2620	0	0	0	0	0	0	0	0	0	0	0

To illustrate the full range of potential additional diversions that could occur, Table 5 presents the modeled 70-year maximum change in monthly Columbia River flows from 1929 and 1998. Table 5 also indicates the number of years with which the maximum diversion would have occurred within the 70-year model.

Table 5. Modeled change in Columbia River flows based on an analysis of the maximum diversion changes and their frequency of occurrence resulting from the Proposed Action modeled over a 70-year period between 1929 and 1998. No additional diversions are proposed for the spring and summer months (April through September) for any years.

	Oct	Nov[1]	Dec[1]	Jan[1]	Feb[1]	Mar[1]	Apr	May	Jun	Jul	Aug	Sep
Max Change in Monthly Average Outflow from Grand Coulee Dam (cfs)	-2700	-350/ -100	-350/ -100	-350/ -100	-350/ -100	-350/ -100	0	0	0	0	0	0
Frequency of Occurrence in period of record	70 of 70 years	0 of 70 years	0 of 70 years	0 of 70 years	0 of 70 years	0 of 70 years	N/A	N/A	N/A	N/A	N/A	N/A

[1] 350 cfs average diversion to meet the 21,000 acre-feet per month diversion amount during Nov.-March in years when Banks Lake cannot be refilled with October diversions alone: (diversions restricted to 100 cfs average, or 6,000 acre-feet per month, when chum salmon elevation target below Bonneville Dam is not being met).

Implementation of the Proposed Action would reduce flow in the Columbia River downstream of Grand Coulee Dam during October in every year. Modeling analysis indicates that Banks Lake can be refilled completely in October by diverting on the average an additional 164,000 acre-feet of water from the Columbia River at Grand Coulee Dam (average of approximately 2,700 cfs during the month).

To illustrate the full range of potential additional diversions that could occur, Table 5 presents the modeled 70-year maximum change in monthly Columbia River flows from 1929 and 1998. Table 5 also indicates the number of years with which the maximum diversion would have occurred within the 70-year model.

Table 5 shows that pumping in October would have been sufficient to completely refill Banks Lake in 70 out of 70 modeled years.

An analysis of pump capacity and historic pump maintenance schedules indicates that, barring unforeseen circumstances, there will be adequate pump capacity in October in the future to refill Banks Lake. The total October pumping demand for existing operations and the increased pumping requirements under the Proposed Action is approximately 320,000 acre-feet. This value is within the existing range of irrigation season operations for the Keys Pump-Generating Plant (up to 430,000 acre-feet). Accordingly, the Proposed Action is best characterized as extending duration with which the facility operates within irrigation season levels. Increased operations will likely shift some routine maintenance activities from October to November but should not impact long-term operational capabilities of the facility.

In rare instances, there may be a need to divert additional water from the Columbia River from November through March in the event that the full 164,000 acre-feet cannot be diverted in October for an unforeseen reason. In these cases when FCRPS BiOp operating objectives for chum salmon below Bonneville Dam are satisfied, the Proposed Action would divert an additional 21,000 acre-feet per month until a total of 164,000 acre-feet, on average, are replaced. The maximum impact on monthly average Columbia River flow would be 350 cfs which would have a minimal impact to chum salmon below Bonneville Dam. When operating objectives for chum salmon are not satisfied below Bonneville Dam, diversions would be limited to 6,000 acre feet per month. This would result in a reduction in average monthly Columbia River flow of 100 cfs. The impact to chum salmon below Bonneville Dam due to this reduction in flow would be immeasurable and infrequent. In the 70-year model, no additional pumping was required in any year in November through March.

Given the historic ability of the Keys Pump-Generating Plant to divert water for the CBP, and the simulated ability of this facility to reliably pump the additional 164,000 acre-feet of water in October for the Proposed Action, Reclamation is confident that all of the required water diversions to refill Banks Lake can be diverted during the month of October for the life of this consultation. As shown in Table 5, modeling indicates that additional diversion of water has never been needed to refill Banks Lake during the November-through-March period in any water-year type. Reclamation, therefore considers the need for pumping in November through March to be an extremely infrequent occurrence, if ever.

Other Water Storage and Conveyance Operations

The Proposed Action does not alter the operation of any water storage and conveyance routes in the CBP or their effects to water bodies located downstream of the Odessa Subarea, including both upper and lower Crab Creek. Water surface elevations of Potholes Reservoir may be increased as a result of increased return flow quantities to this water body from the Proposed Action. However, these minor water surface elevation increases will be reused in other portions of the CBP and will have no adverse impacts to the Columbia River. No adverse impacts on water quantity and quality are expected in these other respective water bodies as a result of Proposed Action implementation; therefore, none of these water bodies are discussed further in this BA.

2.3.3 Water Accounting and Monitoring

As a part of routine operations, Reclamation measures the water supplied for irrigation purposes as required by the existing repayment contracts between the East-, South- and Quincy Columbia Basin Irrigation Districts. Water is diverted at the main canal, mile 0.2, for irrigation and the cost distributed to the appropriate district as required under contract. Data from the monitoring and accounting protocol is necessary for assessment of repayment obligations for lands served by Reclamation facilities. Water deliveries to additional lands under the Proposed Action would fall within the existing monitoring and accounting protocol. This protocol will demonstrate the best available information on operations at each phase of implementation of the Proposed Action.

2.3.4 Environmental Commitments

Environmental commitments are measures or practices adopted by a project proponent to reduce or avoid adverse affects that could result from project operations. The following list summarizes major environmental commitments and/or mitigation measures for implementing the Proposed Action. These commitments are “action” specific, therefore it is appropriate to include within an array of documents including but not limited to construction contracts, management agreements with resource agencies, water contracts, and management plans. In addition, Reclamation, Ecology, and WDFW have entered into a Memorandum of Understanding that will facilitate coordination and communication concerning these mitigation measures and environmental commitments; Reclamation and Ecology share the responsibility to ensure obligations to protect natural resources are fulfilled.

The scale of which these mitigation measures and commitments will be implemented will likely occur in phases and are dependent of what actions are being undertaken by Reclamation and Ecology.

1. Prior to initiation of each phase of design and construction, Reclamation and Ecology will determine, in consultation with WDFW and USFWS, if terrestrial, plant, and fisheries surveys will need to be conducted along proposed alignments for pipelines, facilities, roads, and distribution and transmission lines.

2. Reclamation will hold pre-construction meetings with all contractors to ensure that there is clear understanding of all environmental commitments associated with the construction activity.

3. Reclamation will acquire lands when appropriate and financially feasible, in geographic lows (coulees) to indirectly enhance wildlife habitat.

4. Reclamation and Ecology will consult with WDFW to establish a "Banks Lake Grebe Management" area and provide and maintain floating nesting structures to mitigate impacts to grebes on Banks Lake.

5. Install clusters of artificial burrowing owl nesting boxes in the banks of the East High Canal (south of Black Rock Coulee) and in the East Low Canal expansion and extension sections where appropriate.

6. Reclamation and Ecology will work with WDFW to identify and acquire lands, particularly within the Black Rock Coulee area if reasonable and feasible, and if the area is not selected for development, acquired lands would serve as an important component to mitigate for shrub–steppe habitat impacts associated with all Action Alternatives. Mitigation will be commensurate with the level of impacts. WDFW would be required to manage these lands for Reclamation under an existing management agreement.

7. In cooperation with the USFWS and WDFW, develop and implement a Native Plant Restoration and Conservation Management Plan as a means to mitigate impacts to upland and grassland habitats impacted by all Action Alternatives for a minimum of 7 years to monitor success.

   The plan should include but is not limited to:

   a) Clear goals, objectives, performance criteria, and an implementation schedule.

   b) Provisions for reporting and evaluation of the success of native plant restoration and conservation. Part of the provisions will be to provide results to the USFWS to assist with recovery efforts of candidate, special interest, threatened and endangered species and their habitat, particularly pygmy rabbit, sharp–tailed grouse, and greater sage grouse habitats; WDFW special status species include Washington ground squirrels, black and white–tailed jackrabbits, American badger, and mule deer.

8. Reclamation and Ecology will coordinate with WDFW if infill, as identified in Section 2.6 – *Modified Partial Replacement,* of the FEIS, lands occur to reduce impacts and identify adequate mitigation.

1) Reclamation and Ecology will work with WDFW to develop wetland projects to mitigate wetland impacts at Banks Lake. Specific projects, if feasible may include but are not limited to:

   a) Construct water turnouts within irrigation delivery systems within the Odessa Subarea Study Area for all action alternatives to facilitate, where ecologically appropriate, wetland establishment and/or expansion to existing wetlands to promote wildlife use and recreational opportunities. WDFW would be required to manage these lands for Reclamation under an existing management agreement.

b) Enhance open–water habitat for waterfowl through the removal of invasive plants.

9. Reclamation will coordinate with irrigation districts, Ecology, and WDFW to locate water turnouts within irrigation delivery systems to facilitate, where ecologically appropriate, wetland establishment and/or expansion to existing wetlands to promote wildlife use and recreational opportunities within the Odessa Subarea Study Area.

10. Reclamation will coordinate/communicate flow management with the Columbia National Wildlife Refuge to the extent possible.

11. Monitor warm water fish entrainment out of the irrigation delivery systems within the Odessa Subarea into the mid–Columbia River for 2 consecutive years to ensure protection of ESA listed spring Chinook salmon and threatened steelhead salmon;

12. Adapt fishery management actions in response to new conditions, including but not limited to changes in fish stocking strategies, system rehabilitation, and changes to fishing rules for the life of the project and;

13. Report findings and recommendations for 5 consecutive years and every 3 years for the life of the projects to internal WDFW fish management staff, Reclamation, USFWS (Central Washington Field Office), and Ecology.

14. Reclamation will, in consultation with USFWS, incorporate *Mitigating Bird Collisions with Power Lines: The State of the Art in 1994* into construction designs and powerline siting.

Current BMPs will be implemented, when appropriate, to enhance resource protection and avoid additional, potential affects to surface and groundwater quality, geology, soils, fish, wildlife, and their habitats, including:

1. Haul oils or chemicals to an approved site for disposal and use vegetable–based lubricants machinery when working in or near water to prevent petroleum products from entering surface or groundwater.

2. A Stormwater Pollution Prevention Plan (SWPPP) will be generated by the contractor(s) and implemented per Washington State Department of Ecology's rules and regulations. The plan should include erosion control methods, stockpiling, site containment, shoreline protection methods, equipment storage, fueling, maintenance, and washing, and methods to secure a construction site under circumstances of an unexpected high water or rain event.

3. Contractors will be required, where appropriate, to use the Integrated Streambank Protection Guidelines (WDFW 2003) to assist with bank stabilization.

4. Construction activities will be scheduled to avoid the breeding period of Federally-protected species. Where practicable, construction activities will be scheduled to avoid the breeding period of all native and special status species.

5. Construction equipment would be equipped with environmental spill kits to contain petroleum products in the event of a leak.

6. All necessary local, State, and Federal permits will be obtained.

7. All contractors will be required to have a Spill Prevention Plan and a Toxics Containment and Storage Plan.

8. Canal construction activities would be conducted outside of the irrigation season to avoid in–water work.

9. A spill plan would be developed to implement containment of construction materials such as treated woods, contaminated soils, concrete, concrete leachate, grout, and other substances that may be deleterious or toxic to fish and other aquatic organisms.

10. A plan to implement safe handling and storage of potentially toxic construction materials, fuels, and solvents would be developed for staging sites in close proximity to receiving waters and riparian areas.

11. Stockpiles of earthen materials would be strategically placed to minimize runoff into nearby receiving waters.

12. Utilized earthen materials excavated within reservoir footprint for dam construction when possible.

13. Gravel pits and rock quarries will be sited in areas with stable side slopes to ensure safety and minimize erosion.

14. Methods such as ripping will be used to reduce soil compaction prior to reseeding efforts.

15. Reclamation and Ecology will require all contractors to inventory noxious weed populations by marking with temporary fencing to avoid spreading weeds to other areas in accordance with local, State, and Federal weed control requirements.

16. Reclamation and Ecology would continue with ongoing weed control efforts on disturbed lands following construction and revegetation in accordance with local, State, and Federal laws

17. Signage will be placed on the “tailings” piles (stockpiles) to alert people not to take soil from the site.

18. Borrow pits should be designed in areas that limit impacts to terrestrial wildlife and should be monitored to assure water collected in the pits is not contaminated.

3.0 FACTORS AFFECTING THE SPECIES IN THE ACTION AREA

3.1 Columbia River Basin

The Columbia River watershed covers an area about 260,000 square miles in the northwestern United States and southwestern Canada. The Columbia River Basin is bounded by the Rocky Mountains to the east and north, the Cascade Range on the west, and the Great Basin to the south. The Columbia River originates at Columbia Lake on the west slope of British Columbia’s Rocky Mountains. The river flows south from Canada into the U.S., and then west to the Pacific Ocean, forming the border between Oregon and Washington. The mouth of the Columbia River is near Astoria, Oregon, and its total length is approximately 1,214 miles. Numerous subbasins are formed by tributaries of the mainstem river, including the Kootenai, Flathead and Pend Oreille, Snake, and Willamette rivers. Figure 3 shows the extent of the Columbia River Watershed.

Runoff from forested slopes of the Rocky Mountains in British Columbia, western Montana, and northern Idaho contributes the main portion of the Columbia Basin’s water supply. Most of the annual precipitation occurs in the winter, with the largest share falling in the mountains as snow. Basin snowpack melts in the spring and early summer, resulting in heavy, prolonged flows during the summer months with the peak flow usually occurring in mid-June. About 60 percent of the natural runoff in the basin occurs May through July. Average annual runoff at the mouth of the Columbia River is about 198 million acre-feet. Within the U.S., only the Missouri-Mississippi River system has more runoff.

3.1.1 Columbia River System Development

Multiple dams have been constructed on the Columbia River, largely for hydroelectric power development. The Columbia River was ideally suited for large-scale hydropower development with a solid rock channel, low levels of silt, and relatively steep gradient. The hydroelectric dams on the Columbia River Basin rivers are the foundation of the Northwest’s power supply and have a maximum capacity of 22,500 megawatts. As defined in the *Appraisal Level Investigation Odessa Subarea Special Study* (Reclamation 2008 Appraisal), the Columbia River system has been extensively developed for many

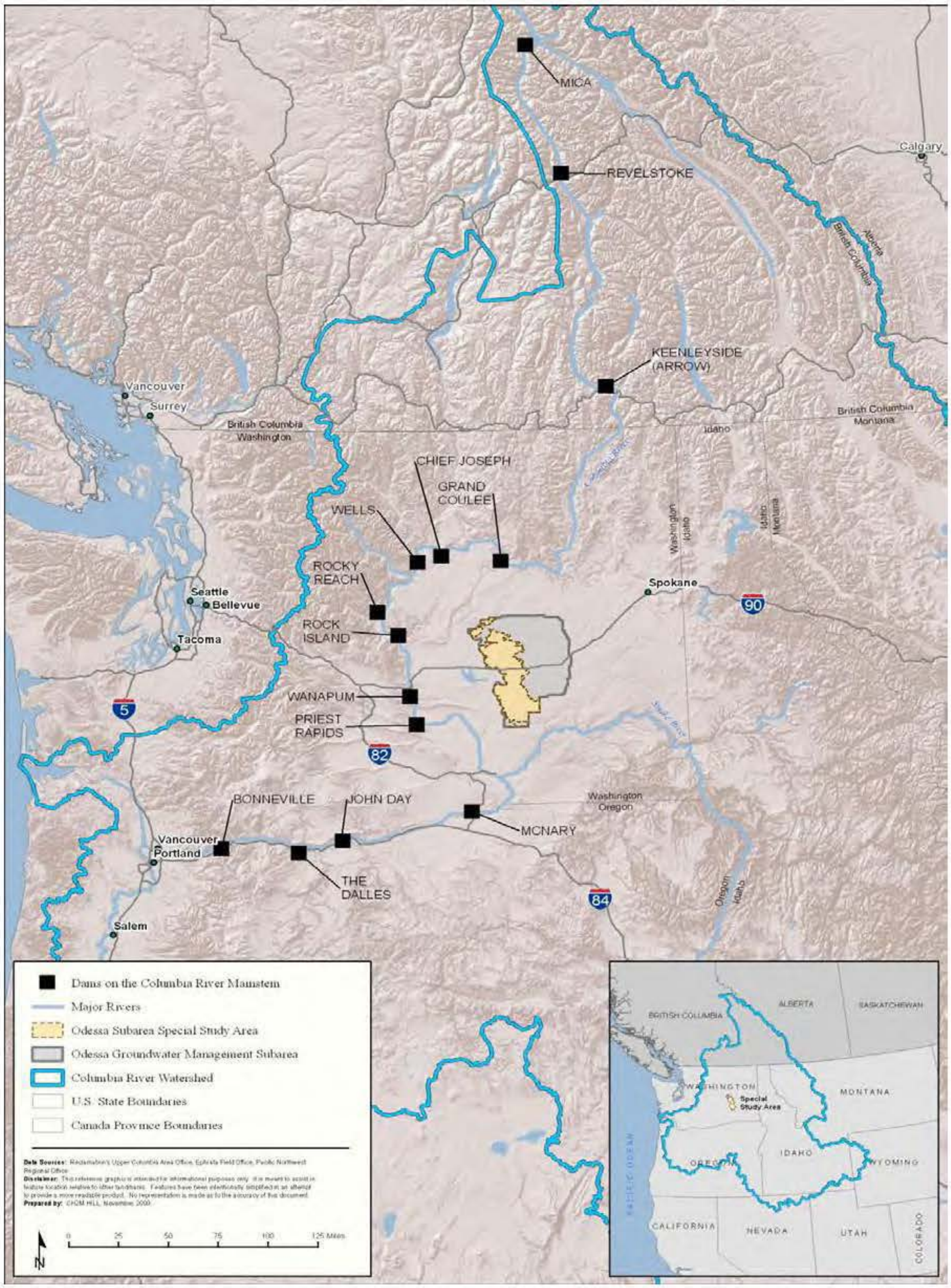

Figure 3. Overview of the Columbia River Basin including the location of the Columbia Basin Project, Odessa Subarea, and mainstem hydroelectric dams in the Oregon and Washington and Canada.

additional uses, including flood control, irrigation, navigation, recreation, and water supply.

As shown on Figure 3, there are 11 dams on the United States portion of the mainstem of the Columbia River (Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, Priest Rapids, McNary, John Day, The Dalles, and Bonneville), and 3 dams on the Canadian portion of the mainstem of the Columbia River (Mica, Revelstoke, and Keenleyside).

Mainstem Columbia River flows in the lower river are controlled by 4 federally operated dams, [Bonneville (River Mile [RM]146.1), The Dalles (RM 191.5), John Day (RM 215.6), and McNary (RM 292)]. These facilities are operated by the U.S. Corps of Engineers (Corps) and form a series of reservoirs in the lower Columbia River. Flow in the Columbia River upstream and downstream of each of these dams is affected by operations for hydropower, navigation, and anadromous fish migration. The Columbia River is free-flowing downstream from Bonneville Dam.

Five dams operated by the public utility districts (PUDs) of Grant, Douglas, and Chelan counties form a series of reservoirs in the mid-Columbia River: Priest Rapids (RM 397.1), Wanapum (RM 415.8), Rock Island (RM 453.4), Rocky Reach (RM 473.7), and Wells (RM 515.1) dams. River flows within this reach of the Columbia River are controlled by releases from these projects and releases from Federal and Canadian dams that are located upstream. Flows are controlled for hydroelectric power, recreation, irrigation, resident fish protection, and anadromous fish migration. Flows downstream from Priest Rapids Dam are mainly affected by power peaking operations that result from the cumulative systematic operation of all dams upstream from Priest Rapids. The Columbia River is free flowing from Priest Rapids Dam downstream to McNary Reservoir near the City of Richland, Washington.

Columbia River dams downstream from Chief Joseph Dam have fish passage facilities that have been designed for upstream passage of migrating anadromous fish, primarily for salmon and steelhead. Most federal and PUD operated mainstem dams have also undergone significant structural modifications to aide passage of downstream migrants. Chief Joseph Dam is owned and operated by the Corps. Fish passage facilities are not installed at this federal dam and as a result, Chief Joseph is the upper extent of anadromous fish migration in the mainstem Columbia River.

Columbia River Flows

The construction and operation of dams and reservoirs on the river’s mainstem and major tributaries have significantly impacted the annual flow patterns (hydrograph) of the Columbia River (see Figure 4). Regulation of the system through the use of dams has compressed the river’s annual discharge patterns, as original high-season flows have decreased and low-season flows have increased. These lower flows during spring and early summer, in conjunction with the slower water movement created by mainstem reservoirs, have reduced instream water velocities and slowed the migration rate of juvenile salmonids (smolts) as they migrate seaward, especially in dry years.

Based on a 70-year period of record from 1929 through 2008, the average annual discharge of the Columbia River at Grand Coulee Dam was 78 million acre-feet with an average annual flow of 108,000 cubic feet per second (cfs) and a median annual flow of 88,000 cfs. Figure 4 presents data from USGS Gage 12436500 for the Columbia River at Grand Coulee Dam. This plot represents the regulated flow below the dam and does not illustrate the variability of natural flows upstream of Lake Roosevelt. In 1929 the flows represented in Figure 4 would have been before any major dams were constructed. This graph represents changes in flows as more and more dams were constructed upstream and indicates that full development of the system occurred by the 1970s with the completion of the dams associated with the Columbia River Treaty.

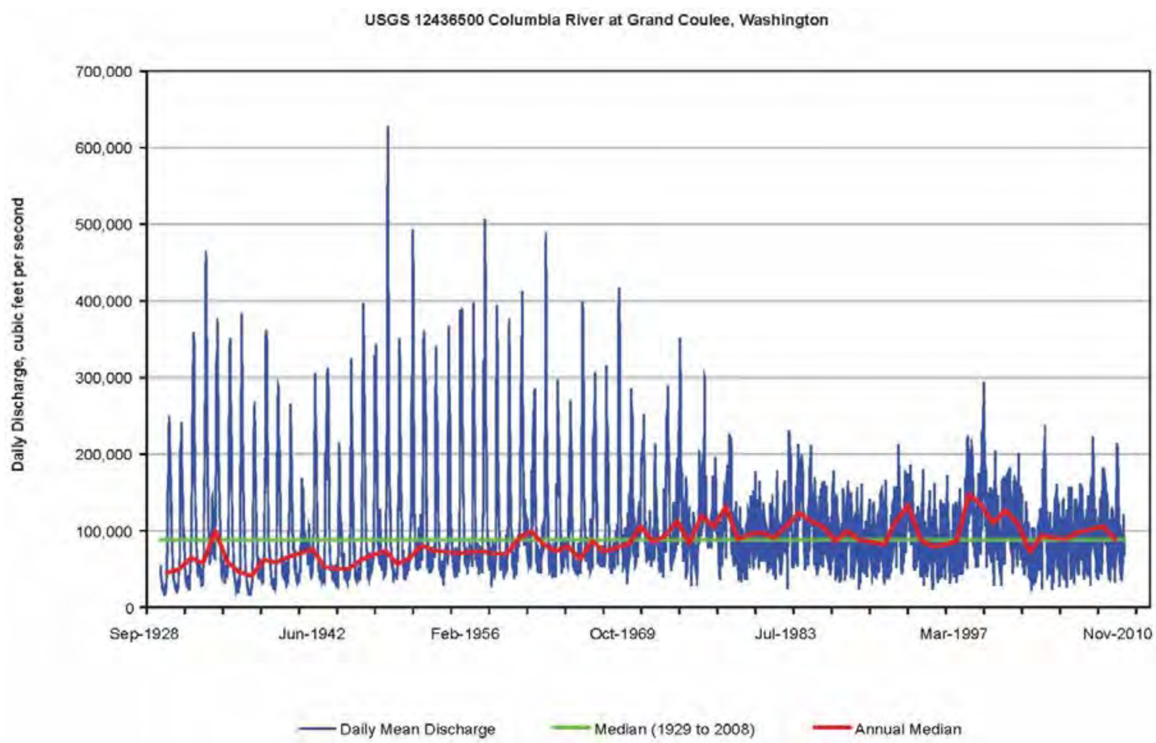

Figure 4. Columbia River daily mean, median, and annual median flows below Grand Coulee Dam between 1929 and 2008.

National Marine Fisheries Service Reasonable and Prudent Alternative

Since 1983, initially as part of the Northwest Power Planning Council's Fish and Wildlife Program, flow augmentation during spring and summer has become a key management strategy to increase smolt migration rates and survival in the system. Additional emphasis on flow augmentation has been a dominant feature of the biological opinions since the early 1990s that were prepared by NMFS following the ESA listing of 13 salmonid populations in the basin.

Primary among these documents is the NMFS FCRPS Biological Opinion (NMFS 2008/2010 FCRPS BiOp), which includes a summary storage project operations. These actions are listed in Chapter 1, Table 1-3, *Measures and Constraints on the Odessa*

Subarea Special Study based on the 2008/2010 FCRPS Biological Opinion, in the Odessa Subarea Special Study DEIS.

The NMFS 2008/2010 FCRPS BiOp Reasonable and Prudent Alternative (RPA) identifies the FCRPS operation plus additional actions necessary to ensure that the operation of the FCRPS will not jeopardize listed anadromous salmonids or adversely modify their designated critical habitat. The RPA table lists 73 actions that more specifically define the Proposed Action. Reclamation continues to work with the other Action Agencies (BPA and The Corps), and regional stakeholders to implement these actions consistent with the adaptive management process and regional coordination outlined in the NMFS 2008/2010 FCRPS BiOp.

The Federal Action Agencies operate the FCRPS based on established water management objectives outlined in the 2008 Biological Opinion (Reasonable and Prudent Alternative, primarily Action 4, NMFS 2008 BiOp). It is recognized, however, that the flow objectives mentioned in the 2008/2010 FCRPS BiOp are intended for planning and in-season management purposes and that they cannot be fully achieved in many years (especially dry) because of low runoff and limited availability of stored water.

Alternatives for the Study were developed with the assumption that they would not compromise the FCRPS' ability to operate to water management objectives under the RPA including support of flow objectives as measured at Priest Rapids and McNary Dams (Table 6). A detailed description of the FCRPS operation regarding Columbia River flows, as modified by the 2008/2010 NMFS FCRPS RPA, can be found in the NMFS 2008/2010 FCRPS BiOp and is herein incorporated by reference.

Table 6. Seasonal flow objectives and planning dates for the mainstem Columbia River.

Location	Dates	Objective (kcfs)	Dates	Objective (kcfs)
McNary Dam	4/10 to 6/30	220 to 260 [a]	7/01 to 8/31	200
Priest Rapids Dam	4/10 to 6/30	135	N/A	N/A

[a] objective varies according to water volume forecast
kcfs thousand cubic feet per second

3.2 Columbia Basin Project

The Columbia Basin Project includes Grand Coulee Dam and Lake Roosevelt, and North and Dry Falls dams and Banks Lake. The irrigation portion starts at North Dam on the north end of Banks Lake and extends 152 miles to the confluence of the Snake and Columbia Rivers. The Columbia River forms the western boundary of the CBP near Quincy, and the project extends east 60 miles to near Odessa and Lind.

The CBP includes 330 miles of main canals, 1,990 miles of smaller canals, and 3,500 miles of open drains and wasteways served by more than 240 pumping plants. The project irrigates about 671,000 acres with an average annual diversion of 2.65 million acre-feet as measured at the Main Canal during the 2000 to 2004 period. Up to 67 different crops are grown, with more than $1.4 billion of crop value each year, including alfalfa, potatoes, apples, and vegetables.

In addition to irrigation, the CBP provides power production, flood control, municipal water supply, recreation, navigation, and fish and wildlife benefits. Irrigation return flows from the CBP are discharged into the Columbia River through wasteways, creeks, and groundwater seepage.

3.2.1 Upland and Wetland Areas Associated with the CBP in the Action Area

The majority of potentially affected land in and adjacent to the Odessa Study Area is privately owned. Lands currently irrigated with groundwater in the Odessa Area (approximately 102,600 acres) are all in private ownership, except for a limited number of State-owned trust land parcels that are leased to private parties. Lands within and adjacent to the locations where facilities would be constructed for the Proposed Action are approximately 90 percent in private ownership. South of I-90, the predominant parcel size is from 160 to 640 acres. North of I-90, parcel size ranges generally from 80 to 640 acres. Land use in the action area is predominantly agriculture and open space. Small communities are present in and near the Odessa Study area, and are generally oriented to the agricultural economy. Outside of those communities, no non-agricultural developed land uses generally exist beyond isolated large-lot residential subdivisions and small commercial and industrial enterprises.

Approximately 10 percent of the land in the Study Area that would be involved with facility development, operation and maintenance related to the Proposed Action is in public ownership. Of this amount, over 50 percent is in Federal ownership under Reclamation jurisdiction, including many parcels that are associated with existing CBP facilities. State trust lands under the jurisdiction of the Washington Department of Natural Resources (WDNR) and lands administered by the Washington Department of Fish and Wildlife (WDFW) make up the remainder of public lands in the Odessa Study Area.

Uplands

The loss of native vegetation communities to agriculture conversion has been extensive across the Columbia Basin region (Daubenmire 1988). Estimated losses of shrub-steppe habitat for a four county area overlapped by the action area are provided below in Table 7 (Reclamation 2008 Appraisal).

Table 7. Acres of shrub-steppe habitat by county.

County	Historical	Remaining	Percent Lost
Adams	1,187,399	279,758	76
Franklin	753,716	230,778	69
Grant	1,614,555	571,830	65
Lincoln	1,260,032	473,674	62

Source: Reclamation 2008 Appraisal

Remaining areas of native vegetation have almost all been grazed at some time, and most continue to be grazed to some degree. Historic conversion and extensive grazing have resulted in such widespread impacts that many of the remaining native plant communities found within the action area fall into categories designated as Washington High-Quality Plant Communities and Wetland Ecosystems by the Washington Natural Heritage Program (WNHP). Another result of conversion of native vegetation agriculture is that several plant species endemic to the region now have restricted distributions and are listed as rare in Washington. Similarly, past fragmentation and disturbance of native plant communities have allowed or encouraged many nonnative species to become established within these areas.

Much of the land that exists in the action area consists of farmland and Conservation Reserve Program land. Widening of the East Low Canal as a part of the Proposed Action for this consultation would occur largely within existing easements along the currently disturbed canal route.

Native vegetation communities are primarily located along the canal improvement route. Upland areas of native vegetation within the analysis area are primarily shrub-steppe dominated by big sagebrush (*Artemisia tridentata*) and Sandberg's bluegrass (*Poa secunda*). This is one of the major shrub-steppe vegetation types described by Daubenmire (1998) for eastern Washington. Other shrub-steppe vegetation types are found scattered within big sagebrush-Sandberg's bluegrass in a wide distribution pattern across the analysis area. Two of these steppe vegetation types are found on lithosols (thin and stony soils with basalt bedrock immediately below):

- Scabland (stiff) sagebrush (*Artemisia rigida*), and Sandberg's bluegrass
- Thymeleaf buckwheat (*Eriogonum thymoides*) and Sandberg's bluegrass.

A variety of other steppe habitats are less commonly found in a few locations throughout remaining native vegetation in the action area. These include vegetation types based upon dominance of bluebunch wheatgrass (*Pseudoroegneria spicata*), inland saltgrass (*Distichlis spicata*), or needle-and-thread grass (*Hesperostipa comata*).

The Washington Department of Natural Resources (WDNR) lists 15 distinctive ecosystems within the Columbia Plateau Ecoregion, including shrub-steppe, as Priority 1 under the 2009 Natural Heritage Plan. The WDNR considers shrub-steppe ecosystems to be among the most threatened in Washington (WDNR 2009).

The shrub-steppe vegetation type is a mixture of woody shrubs, grasses, and forbs generally dominated by Wyoming big sagebrush and bluebunch wheatgrass in east-central Washington (Daubenmire 1970). Within the Odessa analysis area, upland vegetation types that have not been converted to cropland are typically shrub-steppe vegetation types (Reclamation 2008 Appraisal). Daubenmire (1988) described shrub-steppe as vegetative communities consisting of one or more layers of perennial grass with a conspicuous but discontinuous overstory layer of shrubs. The dominant shrubs include one or more species of sagebrush, rabbitbrush (*Chrysothamnus spp*.), bitterbrush (*Purshia tridentata*), greasewood (*Sarcobatus spp*.), and spiny hopsage (*Grayia spinosa*). The dominant grasses include native bunchgrasses (*Poa*, S*tipa*, and *Agropyron spp*.) and, in some areas, nonnative cheatgrass (*Bromus tectorum*).

Wetlands

Related to wetlands, the channeled scablands of eastern Washington contain a mosaic of depressional marshes, old flood channels, and ephemeral ponds. Other types of wetlands typical of the region include seeps near the bases of slopes, wetland meadows, wetlands associated with the fringes of reservoirs, wetlands associated with ephemeral, intermittent, and perennial streams and river, and man-made depressional wetlands in mined areas, agricultural fields, and suburban areas (Corps 2008). Wetlands have also developed along parts of the relatively flat east side of Banks Lake and along the ELC.

Palustrine emergent (PEM) wetlands are the most common type found in the action area. PEM wetlands are dominated by emergent vegetation. PEM wetlands have been identified at Banks Lake, and along the East Low Canal that would be widened. A total of 486.8 acres of PEM wetland, including freshwater ponds, have been identified within the action area with 413 acres located around Banks Lake, and 42.2 acres located adjacent to the ELC.

PEM wetlands observed typically contain one (emergent) or two vegetative layers (emergent and shrub). Typical vegetation associated with PEM wetlands include common cattail (*Typha latifolia*), hardstem bulrush (*Schoenoplectus acutus*), cosmopolitan rush (*Schoenoplectus maritimus*), reed canarygrass (*Phalaris arundincacea*), and Baltic rush (*Juncus balticus*) in the emergent layer with Russian olive (*Elaeagnus angustifolia*), coyote willow (*Salix exigua*) and peachleaf willow (*Salix amydgloides*) providing less than 30 percent vegetative cover in the shrub layer.

Five PEM wetland areas (39.6 acres) and two freshwater ponds (2.6 acres) were identified within the ELC analysis area (USFWS 2009). Wetland resources in this area include a narrow fringe of PEM wetland dominated by reed canarygrass along the inner ELC wall (37.8 acres) and larger lobes of PEM or PEM/PSS wetlands (1.8 acres) on the downslope side of the canal supported by irrigation water seeps from the canal. Wetland vegetation is dominated by reed canarygrass (fringe wetland community), hardstem bulrush, cosmopolitan bulrush, three square bulrush, and common cattail in the emergent layer and coyote and peachleaf willow in the shrub layer where present. The landscape position or hydrogeomorphic class (Brinson 1993; Hruby 2007) for ELC wetlands includes Slope and Depressional classes. WDNR Special Status habitats associated with the ELC in the Columbia Basin include Low Elevation Freshwater Wetlands.

3.2.2 Major Reservoirs Associated with the CBP in the Action Area

The two major reservoirs within the Odessa Special Study Area are Lake Roosevelt and Banks Lake. These reservoirs were described in the 2010 DEIS (Chapter 2, Section 2.2.3, *Water Management Programs and Requirements Common to All Alternatives*).

Lake Roosevelt

Grand Coulee Dam and Lake Roosevelt are part of the complex and regulated system of Columbia River dams and reservoirs. Lake Roosevelt fluctuates seasonally and daily in response to a complex set of demands; from irrigation and flood control, to ESA objectives and hydropower operations. Figure 5 illustrates historical drawdown in Lake Roosevelt. The deep drawdowns shown in 1969 and 1974 are due to construction of the third powerplant associated with the Grand Coulee Powerplant Complex.

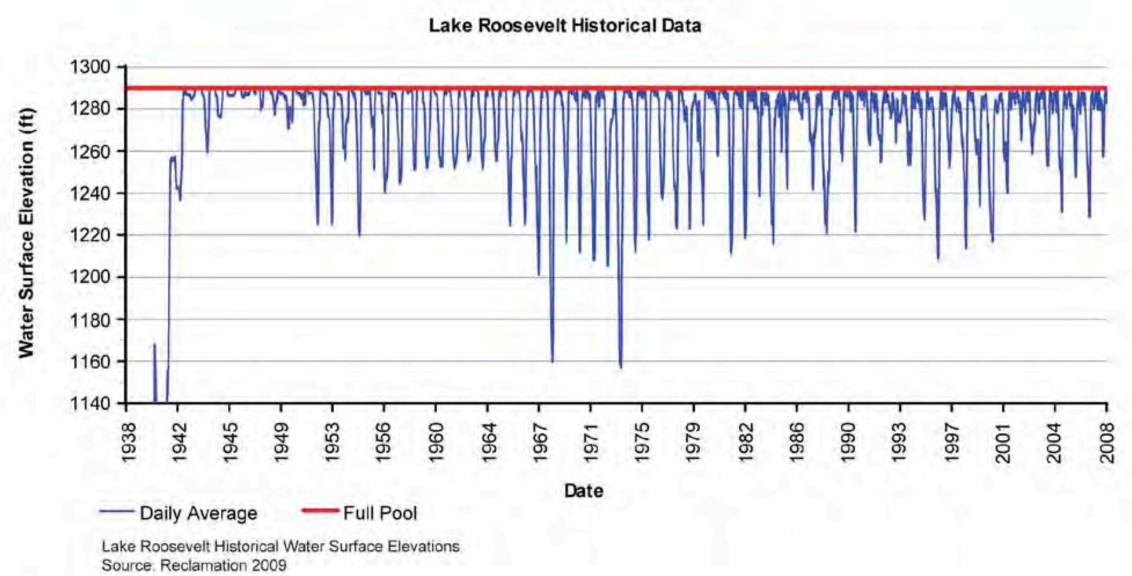

Figure 5. Lake Roosevelt historical water surface elevations (source: Reclamation 2009).

Lake Roosevelt is relatively straight and narrow over most of its 150-mile length, and is generally described as having four reaches: the Northport Reach, Upper Reach, Middle Reach, and Lower Reach. The two largest tributaries to the reservoir other than the Columbia River are the Kettle River, which enters in the Upper Reach, and the Spokane River, which enters in the Middle Reach. The moderate-sized Sanpoil River enters in the Lower Reach. Water passes through Lake Roosevelt relatively quickly. During average runoff years, the retention time is about 45 days, but it can be as low as 12 days during high runoff periods (Underwood et al. 2004). This short retention time limits the amount of temperature stratification in most years (Pavlik-Kunkel et al. 2008).

In addition to other commitments, Lake Roosevelt is operated to provide downstream flows to benefit fish in conjunction with operations at other Columbia River reservoirs. Water releases from the reservoir vary by water year type and timing of runoff. To the extent possible, water is shaped to support flow objectives in the spring and early summer. In July and August, Lake Roosevelt and Banks Lake are drafted to meet an end of August elevation, dependent on the water supply forecast, to support flows in the lower river.

Lake Roosevelt Fish Assemblage

Lake Roosevelt supports 30 species of fish (18 game and 12 nongame species). Rainbow trout, kokanee *(Oncorhynchus nerka)*, and walleye are the three primary fish harvested by anglers in the reservoir, with smallmouth bass increasing in popularity over the past 5 years.

Factors Potentially Affecting the Fisheries in Lake Roosevelt

Underwood et al. (2004) analyzed the factors influencing the fishery in Lake Roosevelt. The analysis focused on the primary game fish of concern in the reservoir, which are kokanee salmon, rainbow trout, walleye, and white sturgeon. The authors concluded that the principal factors affecting the reservoir fisheries are related to water management through the reservoir, as it alters inflow, outflow, drawdown, and retention time; specifically:

- Entrainment of fish through the turbines and the spillway
- Water temperature
- Total dissolved gas concentrations (supersaturation)
- Nutrients and plankton production.

In addition to water management issues, Underwood et al. (2004) identified chemical issues as factors affecting fish. Walleye predation on some of the other game fish is also an issue.

Lake Roosevelt Water Quality

Either no or minimal additional impacts on water quality in Lake Roosevelt would occur with implementation of the Proposed Action. Therefore, existing water quality conditions (temperature, total dissolved gas, dissolved oxygen, and metals) in Lake Roosevelt are only briefly discussed here.

Lake Roosevelt is 303(d)-listed for temperature criteria exceedances (Ecology 2007a; Ecology 2007b). The Lake Roosevelt temperature standard is driven by the reservoir's designated aquatic life use of core summer salmonid habitat. Under that category, the 7-day average of the daily maximum temperature may not exceed 16°C (60.8°F) (Washington State Legislature [WSL] 2006). EPA is leading an effort to develop a temperature TMDL for the Columbia River system, but the TMDL has not been finalized.

A total dissolved gas TMDL, *Total Maximum Daily Load for Total Dissolved Gas in the Mid-Columbia River and Lake Roosevelt* (EPA et al. 2004), was developed for Lake Roosevelt to help achieve compliance with the State standard. The State's numeric total dissolved gas criteria for core summer salmonid habitat states that total dissolved gas shall not exceed 110 percent of saturation at any point during sampling (WSL 2006). Despite TMDL implementation, maximum total dissolved gas concentrations in excess of 110 percent saturation were observed from 2002 to 2005 at six locations throughout the reservoir (LRFEP, as cited in Ecology 2008).

Lake Roosevelt is on the 303(d) list for dissolved oxygen based on criteria exceedances at multiple monitoring stations. The State's numeric dissolved oxygen criterion for core summer salmonid habitat is a minimum of 9.5 mg/L (WSL 2006). From 2002 to 2005, all sampled locations on Lake Roosevelt experienced minimum dissolved oxygen concentrations below the standard (LRFEP, as cited in Ecology 2008).

Lake Roosevelt has significant levels of zinc, lead, copper, arsenic, cadmium, and mercury contamination primarily as a result of the Cominco Ltd. lead-zinc smelter located roughly 10 miles upstream of the international border. The reservoir, particularly the lower end, also receives metals from mining within the watershed (Ecology 2001). Metals tend to bind to sediments rather than remain in solution, so sediments near a source may become highly contaminated and serve as secondary sources to potentially reintroduce metals back into the water column in the future. Metal concentrations in the reservoir's water column do not appear to inhibit aquatic life, although metals in the sediments may pose risks directly to the benthic macroinvertebrates that live in the sediment and the higher-order organisms, like fish, that feed on them (Underwood et al. 2004). Upper Lake Roosevelt shows impairment for mercury on the 303(d) list (Ecology 2007a; Ecology 2007b).

Banks Lake

Similar to Lake Roosevelt, Reclamation operates Banks Lake within established constraints to meet water delivery contractual obligations, ensure public safety, and protect property, while striving to allow for recreational use. The CBP irrigation season typically extends from mid-March through October. However, Banks Lake drawdowns generally begin on approximately August 1 and are largely the result of flow augmentation for fish rather than irrigation.

Between the late 1950s and 1986, Banks Lake was annually drawn down, typically during the spring, by about 10 to 15 feet. However, in the early 1980s, normal water surface elevations in Banks Lake were stabilized such that annual fluctuations were usually approximately only 3 feet from full pool. This was due, in part, to the findings of Stober et al. (1979), who identified potentially deleterious impacts to fish, particularly kokanee, and wildlife associated with more extreme variations in water surface elevation. Lower water surface elevations are occasionally reached in response to special operations or maintenance activities (Reclamation 2001). Since 2000, the reservoir has been drawn down 5 feet (to elevation 1565 feet amsl) by the end of August, to provide fish flow augmentation in the Columbia River through reduced pumping from Lake Roosevelt. Larger drawdowns typically correspond with maintenance or weed control efforts. Figure 6 illustrates historical drawdown in Banks Lake.

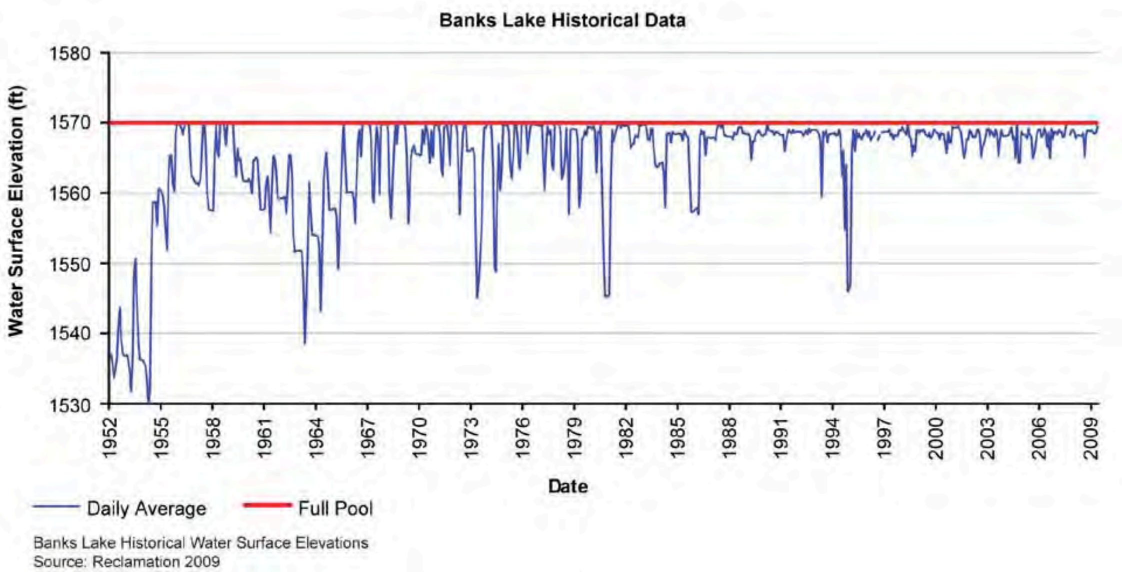

Figure 6. Banks Lake historical water surface elevations (source: Reclamation 2009).

Banks Lake Fish Assemblage

Most fish species present in Banks Lake originated from smaller lakes present in the coulee prior to reservoir inundation, and also from water pumped in from Lake Roosevelt. Although no records document fish assemblages in the smaller historic lakes, local fisherman indicated that populations of largemouth bass and pumpkinseed sunfish existed (Stober et al. 1975; Thomas 1978). Other species, including rainbow trout, kokanee, smallmouth bass, coho salmon, and Chinook salmon have been planted by WDFW (Reclamation 2004). Coho and Chinook salmon are no longer planted and presently do not occur in the lake.

Additional species known to occur in Banks Lake include yellow perch, bluegill sunfish *(Lepomis macrochirus)*, burbot, lake whitefish, mountain whitefish, walleye, longnose sucker, bridgelip sucker, largescale sucker, carp, prickly sculpin (*Cottus asper*), peamouth, brown bullhead, yellow bullhead, white catfish (*Ictalurus catus*), channel catfish, northern pikeminnow, and black crappie.

Results of the most recent fish sampling in 2008 using gill nets and boat electrofishing indicate that the dominant fish in Banks Lake are lake whitefish, walleye, yellow perch, and smallmouth bass (Polacek 2009). Based on creel surveys in 2008, the most commonly caught fish are smallmouth bass and walleye followed by yellow perch and rainbow trout. During the late fall and winter months, anglers primarily target trout and yellow perch, but shift their efforts to smallmouth bass and walleye in the spring and summer.

A local volunteer group operates a series of fish net pens along the north and south shores of Banks Lake. WDFW provides the juvenile fish, feed, and technical assistance as needed. These net pens are used primarily to raise rainbow trout for release into Banks Lake. An average of 188,000 rainbow trout has been stocked every year since 1990 (Reclamation 2004). This voluntary cooperative net-pen project has operated on Banks Lake to enhance the fishing for 23 years. Since 1996, kokanee also have been reared to fingerling and yearling size in net pens at Electric City and Coulee City according to net pen operators.

Fish Habitat

Banks Lake contains a wide variety of fish habitat types, which in turn support the diverse fish community. Habitats include deep open waters, nonvegetated embayments, vegetated embayments, gravel shoals, rocky ledges, and steep dropoffs. General characteristics of Banks Lake fish species relative to reproduction, rearing, and adult habitat requirements were outlined in a table in the Banks Lake Drawdown Final EIS (Reclamation 2004).

The Banks Lake littoral zone extends from the ordinary high waterline, just above the influence of waves and spray, to the photic zone, the depth at which light is sufficient for rooted aquatic vegetation (macrophytes) to grow and to influence the vertical migration of zooplankton. The depth of the photic zone can vary depending on turbidity levels in the lake that are influenced primarily by seasonal and environmental changes. This biologically critical zone supports aquatic macrophytes that provide spawning habitat and nursery areas for many of Banks Lake's fish species and other aquatic resources (Reclamation 2004). The quality and quantity of littoral habitat available to fish and other aquatic resources greatly influences their ability to reproduce and maintain self-sustaining populations. Most aquatic plants in the Banks Lake littoral zone occur in a band from water surface elevation 1569 feet to 1566 feet amsl. The littoral zone is currently exposed approximately 6 to 36 days annually during lake level drawdown to elevation 1565 feet amsl.

Aquatic macrophyte communities provide rearing habitat for juvenile fish species, refuge for prey species, and forage for aquatic macroinvertebrates. They are particularly important for fish during their early larval stages. Aquatic macrophyte communities help to increase juvenile fish forage efficiency and provide cover from potential large predators such as bass and walleye. Correspondingly, macrophyte barriers also restrict the foraging efficiency of many larger predatory fish species, which can lead to declines in their growth (Reclamation 2004).

Food Sources

Fish and other aquatic resources in Banks Lake feed on a wide variety of food sources including aquatic vegetation, phytoplankton, zooplankton, benthic and nearshore invertebrates, and other fish species. Zooplankton and benthic invertebrates make up the bulk of food sources available to the fishery in Banks Lake. Analysis of fish collected in 2004 and 2005 indicates the importance of zooplankton, especially *Daphnia,* in the diet of many fish species, including juvenile bass, rainbow trout, black crappie, and all sizes of lake whitefish and yellow perch (Polacek and Shipley 2007).

Zooplankton are dispersed throughout Banks Lake. However, site-specific environmental factors including water temperature, current, nutrients, wind, and predation have all been identified as contributing to varying levels of zooplankton diversity and evenness in lakes and reservoirs.

Banks Lake flow-through of water occurs from north to south. Two distinct pools are evident in the lake, and they vary in temperature, turbidity, stratification, plant nutrient level, and zooplankton biomass. The north pool has colder water temperatures, lower turbidity, less stratification, and higher plant nutrient levels than those found in the south pool (Reclamation 2004). The south pool has a higher zooplankton biomass, dominated by *Daphnia*, than the north pool. Based on studies conducted by WDFW in 2002 through 2005 (Polacek and Shipley 2007), zooplankton densities were bi-modal with the highest peak in May and a secondary peak in October-November. Lowest densities were observed in August and in the winter.

Benthic invertebrates fill a fundamental ecological niche, serving to break down plant matter, as well as providing a primary source of food for many fish species at various life stages. In Banks Lake, aquatic plants and attached organisms, such as algae, protozoans, and bacteria (periphyton), as well as detritus, provide food and habitat for a wide variety of organisms (Reclamation 2004). High invertebrate densities are typically associated with aquatic plants. Very few invertebrates or fish feed directly on the large aquatic plants; instead, they feed on the attached organisms and detritus. In addition, many benthic invertebrates collect beneath macrophytes, and utilize plant remains as food and shelter.

Fish Entrainment

Entrainment of fish from Lake Roosevelt into the north end of Banks Lake and the entrainment loss from Banks Lake via the north-end pump generating units and at the south-end Dry Falls Dam were studied by Stober et al. (1979) from 1974 to 1976. Relatively few fish (mostly kokanee, sculpin, and largescale sucker) were pumped into Banks Lake compared to the numbers of fish entrained out of the lake at Dry Falls Dam. Also, entrainment of fish back to Lake Roosevelt via the Keys pump-generating units was found to be relatively minor.

Fish entrainment at Dry Falls Dam was estimated to be 436,216 fish in the 2-year period of 1975 and 1976. Most fish were relatively large, with an average fish weight of 250 grams (8.8 ounces). Relative abundance of kokanee entrained in 1975 and 1976 was estimated at 67.4 percent and 59.6 percent of the total, respectively. The other primary species entrained were lake whitefish and yellow perch. More extensive studies in 1977 showed a reduced relative abundance of kokanee entrained (17.8 percent of the total) compared to 1975 and 1976. In response to the relatively high entrainment rates, especially of adult kokanee, Reclamation installed a barrier net in 1978 in the forebay of Dry Falls Dam. The net was found to be effective at minimizing entrainment losses of kokanee and other larger fish (Stober et al. 1979). Following construction of the hydroelectric generating plant at Dry Falls Dam in 1984, the Project licensee, Grand Coulee Project Hydroelectric Authority, installed new barrier nets, which are maintained during the irrigation season. The nets (sized to reach the bottom of the lake when the reservoir is at full pool elevation of 1570 feet) are suspended from floats between the Coulee City Park breakwater and an island, and between the island and Dry Falls Dam.

WDFW conducted fish entrainment studies in 2004 and 2005 by netting the discharge canal approximately 3.5 miles downstream of Dry Falls Dam (Polecek and Shipley 2007). The results of these studies may have been affected to some degree by fish delaying or holding up in the canal between the dam and sampling location. In 2004, it was estimated that 277,588 fish passed out of the lake at Dry Falls Dam. In 2005, the estimate was 58,708 fish. Yellow perch and sculpin accounted for 92 percent and 90 percent of the species captured in the entrainment nets in 2004 and 2005, respectively. The highest entrainment rates by far occurred in June of both years. Nearly all of the entrained fish were less than a year old. The average length of entrained fish was only 33 millimeters (1.3 inches) in 2004 and 30 millimeters (1.2 inches) in 2005. These lengths represent an average fish weight of about 1 gram. This weight compares negatively with the average entrained fish weight of 250 grams (8.8 ounces) observed prior to the installation of the first barrier net. The difference in size between the Stober et al. (1979) fish sampling and that conducted by the WDFW (Polecek and Shipley 2007) indicate that the barrier net has been successful at reducing entrainment of large fish. The numbers of fish and the very high percentage of small sub-yearling fish entrained at Dry Falls Dam after barrier net installation are consistent with findings elsewhere at reservoirs with similar fish communities (FERC 1995).

Banks Lake Water Quality

Water quality data for Banks Lake is sparse, although WDFW has collected data since 2002 and the Quincy Columbia Bain Irrigation District (QCBID) has two temperature probes in the reservoir. Banks Lake is not on the State's 303(d) list for temperature, dissolved oxygen, or turbidity impairment, although data suggests that the water body exceeds standards for temperature and dissolved oxygen.

The reservoir typically begins to warm in late spring, signs of stratification are exhibited by early- to mid-summer, and the thermocline is well defined by late summer. Banks Lake summer temperature data suggest that the reservoir exceeds the state temperature standard of 17.5°C (63.5°F; WAC 173-201A, *Water Quality Standards for Surface Waters*), which is intended to protect salmonid spawning, rearing, and migration and is measured as a 7-day average of the daily maximum.

WDFW data indicate that Banks Lake is not in compliance with the State's dissolved oxygen standard of 8.0 mg/L (WAC 173-201A, *Water Quality Standards for Surface Waters*), which is intended to be protective of salmonid spawning, rearing, and migration. Dissolved oxygen concentrations in Banks Lake have been measured by WDFW since 2002. Dissolved oxygen levels generally remained above 7 to 10 mg/L until mid-summer, but typically dropped to 5 mg/L (a critical level for fish) or less at depth greater than about 66 feet (20 meters) in August of each year.

3.2.3 Other CBP Reservoirs

No streamflow or aquatic habitat condition changes would be anticipated in Lower Crab Creek. Therefore, this area was not analyzed further in this BA. Water surface elevations of Potholes Reservoir may be increased as a result of increased return flow quantities to this water body from the Proposed Action. However, these minor water surface elevation increases will be reused in other portions of the CBP and will have no adverse impacts to the Columbia River (see *Columbia River and CBP Return Flows* below).

3.2.4 Columbia River and CBP Return Flows

The CBP is a complex irrigation project which intertwines municipal, industrial, and agricultural discharges into drainage returns that eventually end up in the Columbia River (Figure 7). The water in the CBP canal system is gravity fed in a southerly direction and has over 300 miles of main canals, 2,000 miles of laterals, and 3,500 miles of drains and wasteways (Figure 7). Return flows from the CBP enter the Columbia River over a 92-mile-long stretch. Multiple return flows enter the Columbia River at locations starting west of Quincy, Washington, and extending downstream to Pasco, Washington. The major drains and wasteways include the following: Esquatzel Wasteway; Pasco Wasteway (Figure 8); PE16.4 Wasteway; WB 5 Wasteway; WB10 Wasteway; Mattawa Drain; Priest Rapids Wasteway; Red Rock Wasteway; and Sand Hollow Wasteway (Figure 9). These nine return flow channels represent 98 percent of the CBP annual return flows to the Columbia River, all of which terminate at the Columbia River (Reclamation 2011). Since there are no major tributaries (inflows) that enter the river in this stretch and both Wanapum and Priest Rapids are run-of-river projects, the flows at Priest Rapids are considered to be representative of the Columbia River for the entire reach. Fish species from the Columbia River listed under the ESA can access only two of these wasteways: Sand Hollow and Red Rock wasteways (Reclamation 2005).

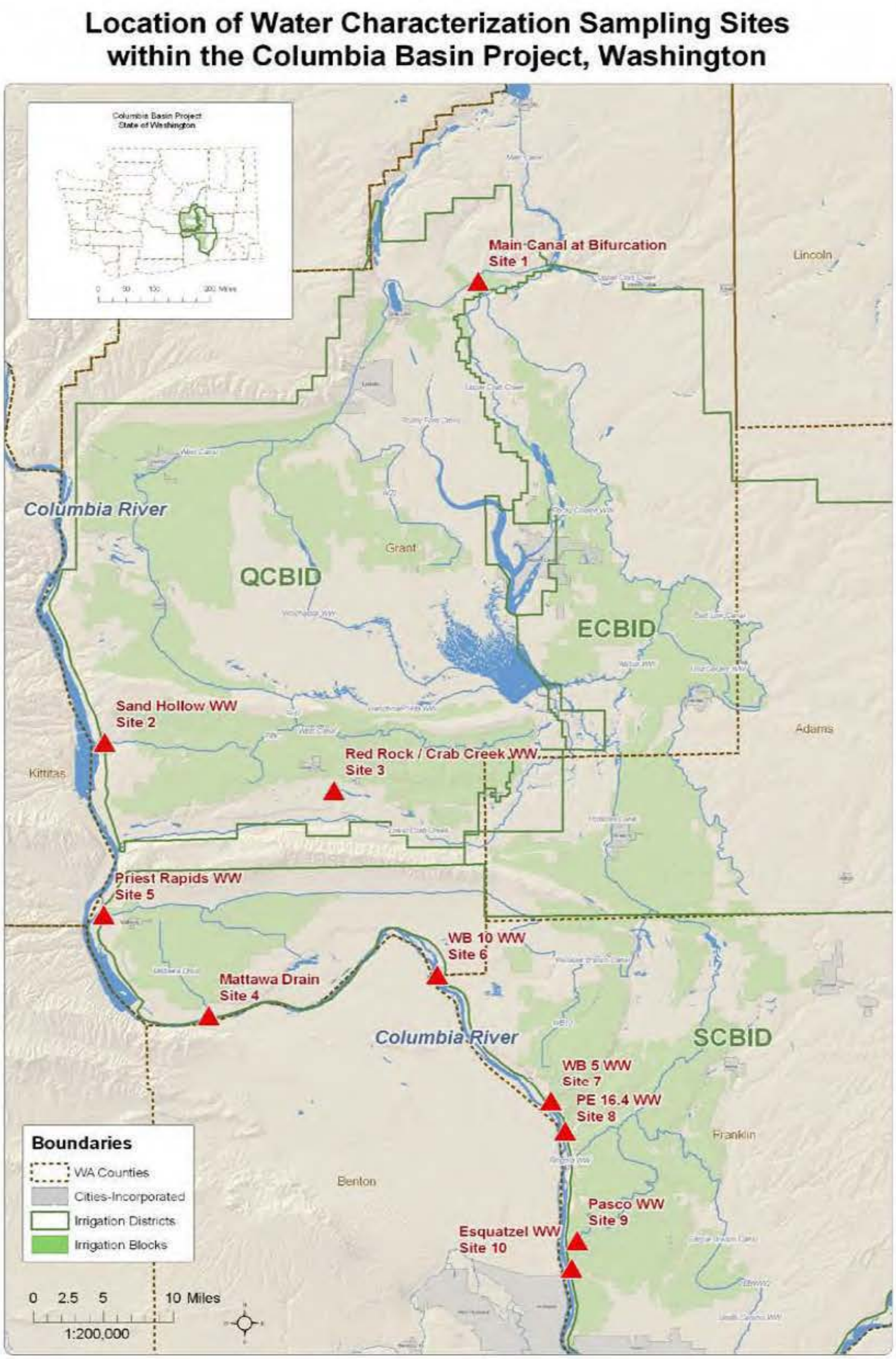

Figure 7. Location of nine CBP drains and wasteways with return flows to the Columbia River.

Figure 8. Photograph of the Pasco Wasteway, which is not accessible to fish, at its terminal end chute structure where the wasteway flows enter the Columbia River (at bottom right corner of the photo).

Figure 9. Photograph of the Sand Hollow Wasteway, which is accessible to fish, as it enters the Columbia River at Wanapum Reservoir, looking from east to west.

Sand Hollow Wasteway is the return flow farthest upstream. There is no continuous record gage at this location so its return flow data used in this report are estimations derived from contributing lateral waste data during the normal irrigation season which is typically from mid-March through October. There were no flow data collected for the period November through mid-March. Sand Hollow Wasteway has only a minor amount of spawning habitat with, depending on water temperatures, little or no year-round rearing habitat. The lower portion of the Sand Hollow Wasteway is inundated by the pool created by Wanapum Reservoir.

Red Rock Wasteway is the next wasteway downstream from Sand Hollow Wasteway. Flow data for Red Rock Wasteway is currently not available; however, the lower Crab Creek is gaged by the USGS. The USGS gage at Crab Creek was used as a surrogate for Red Rock Wasteway although the wasteway contributes only about 10 percent of the lower Crab Creek flows. Crab Creek is divided by O'Sullivan Dam and Potholes Reservoir into two watersheds—upper Crab Creek and lower Crab Creek. Access from the Columbia River to Upper Crab Creek is blocked by O'Sullivan Dam. Lower Crab Creek is a small drainage area fed by wastewater (additional flows used to transport water through the canals), seepage from O'Sullivan Dam, and small return flows from CBP lands. Discharge from Crab Creek into the Columbia River is measured at a USGS gaging station located on lower Crab Creek approximately 5 miles above its confluence with the river (USGS 12472600, Crab Creek near Beverly, Washington).

The Red Rock Wasteway has limited amounts of spawning and rearing habitat. The wasteway flows are a small percentage of the overall flows in Crab Creek. Upstream fish passage in the wasteway is blocked by a natural waterfall approximately 2 miles from the confluence of Crab Creek at the outlet of Red Rock Lake. Fall Chinook salmon and steelhead inhabit lower Crab Creek as far upstream as Red Rock Wasteway (Bowen 2003, Quinn 2001).

The other return flow wasteways in the CBP have fish passage barriers at or near their confluences with the Columbia River (Figure 7).

Table 8 displays the average monthly flows in the Columbia River and the CBP return flows for the two main wasteways as well as the cumulative total return flow of the remaining small drains in the system. At their maximum, the total flows of the CBP return flows contribute less than 1 percent of the total Columbia River flows at Priest Rapids Dam. The maximum occurs from September to October when the return flows are at their peak and the Columbia River flows are at their lowest.

Flow data were recorded by USGS at several gages in the CBP and at Priest Rapids Dam.

Table 8. Average monthly flows of the Columbia River at Priest Rapids Dam and the CBP return flows (cfs) from 1995 to 2008. Also shown are the percentages of the total Columbia River flows contributed by the CBP return flows.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Priest Rapids Dam	118,233	115,835	107,815	124,077	159,424	180,657	139,878	111,402	79,430	81,859	94,652	113,622
Red Rock/Crab Creek	202	204	171	244	230	208	188	235	302	309	204	185
Return Percent	0.17%	0.18%	0.16%	0.20%	0.14%	0.125	0.13%	0.21%	0.38%	0.38%	0.22%	0.16%
Sand Hollow	--	--	4	23	21	21	20	22	26	20	--	--
Return Percent	--	--	0.00%	0.02%	0.01%	0.01%	0.01%	0.02%	0.03%	0.02%	--	--
Combined non-fish-bearing returns	164	170	269	444	424	432	454	468	494	494	302	187
Return Percent	0.14%	0.15%	0.25%	0.36%	0.27%	0.24%	0.32%	0.42%	0.62%	0.60%	0.32%	0.16%

(table from Reclamation 2011)

Other flow data were compiled from estimates derived from contributing lateral waste data during the normal irrigation season. The percentage of each return's average yearly contribution to the total annual return flow from the CBP to the Columbia River is shown in Figure 10.

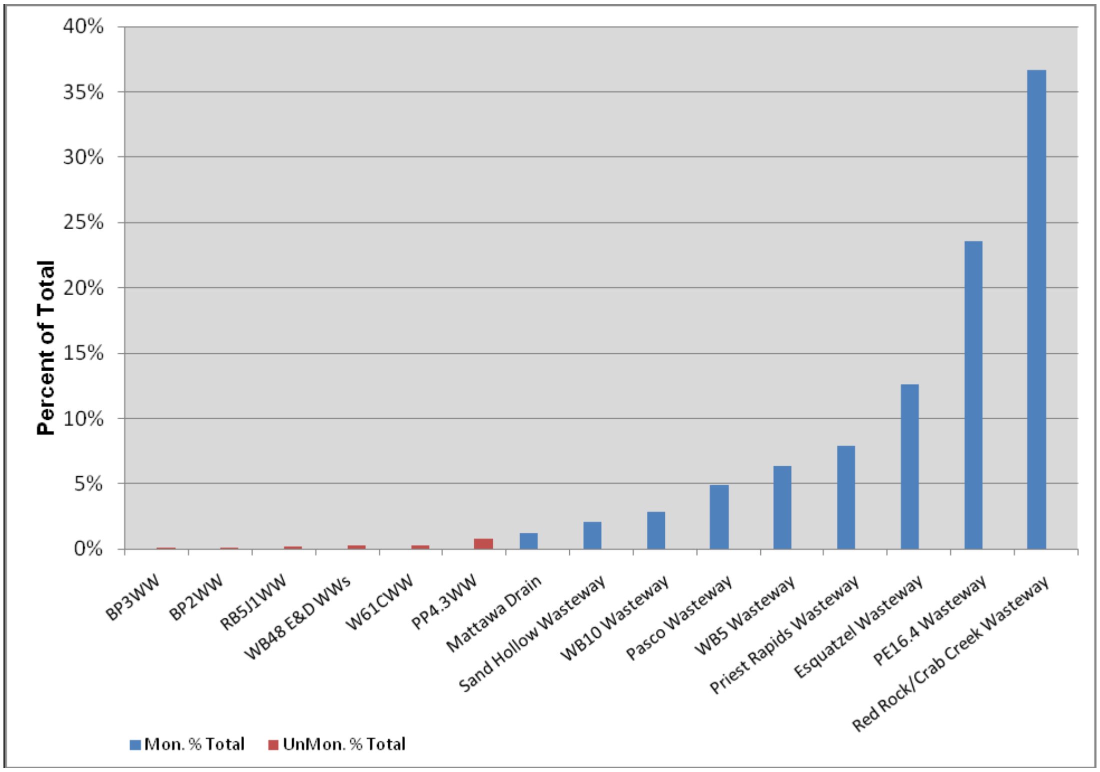

Figure 10. CBP wasteways and drains that empty into the Columbia River and the percent of each as related to the total CBP return flow for 5 consecutive years. The Red Rock/Crab Creek Wasteway totals include total flow from both watersheds.

From 1970 through 2000, the lower Crab Creek gage measured average annual rates of discharge typically in the 225-to-300-cfs range. From 1998 through 2001, there was a noticeable decrease in the annual flow in lower Crab Creek that was likely due to the implementation of the more rigorous control of lateral wastewater by QCBID during the irrigation season. While this relationship has not been quantitatively verified, operational changes and water conservation has directly reduced the rate of return flow to lower Crab Creek. Since 2000, the annual discharge rate has remained below 215 cfs.

4.0 LISTED SPECIES AND CRITICAL HABITAT STATUS

4.1 Current Species Status Determination Methods

The ESA defines species to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." NMFS adopted a policy for identifying salmon distinct population segments (DPS) in 1991 (56 FR 58612; Waples 1991). This policy states that a population or group of populations is considered an evolutionarily significant unit (ESU) if it is "substantially reproductively isolated from conspecific populations," and if it represents "an important component of the evolutionary legacy of the species." The policy equates an ESU with a DPS. Hence, the Chinook, chum, and coho salmon listing units in this BA constitute ESUs of the species *O. tshawytscha, O. keta, and O. nerka* respectively. The steelhead and other species listing units in this BA constitute DPSs of the species *O. mykiss, Acipenser medirostris, Thaleichthys pacificus, and Orcinus orca.* The ESUs and DPSs of salmon and steelhead include natural-origin populations and hatchery populations, as described below.

For the purposes of reproduction, salmon and steelhead typically exhibit a metapopulation structure (Schtickzelle and Quinn 2007, McElhany et al. 2000). Rather than interbreeding as one large aggregation, ESUs and DPSs function as a group of demographically independent populations separated by areas of unsuitable spawning habitat. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For recovery planning and development of recovery criteria, the NMFS Technical Recovery Teams (TRT) identified independent populations within the various salmon ESUs and steelhead DPSs, and grouped them into genetically similar major population groups (MPGs). The NMFS TRTs (ICTRT 2007, WLC-TRT 2003) also developed specific biological viability criteria based on the Viable Salmonid Population (VSP) concept (McElhany et al. 2000) at the population, MPG, and DPS levels and assessed the current status of each population within each Columbia River Basin ESU/DPS (ICTRT 2007, WLC-TRT 2004). At the population level, the TRTs recommended specific biological criteria based on the four viability components of VSP—abundance/productivity and spatial structure/diversity. These criteria were integrated to develop a total population viability rating. The population viability ratings, in order of increasing risk, are highly viable, viable, moderate risk, and high risk.

4.1.1 Species Status Reviews and Viable Salmonid Population Evaluation Concept

In June 2005, NMFS issued final listing determinations for 16 ESUs of Pacific Salmon (*Oncorhynchus sp.*) and in January 2006 NMFS issued final listing determinations for 10 DPSs of steelhead (*O. mykiss*, the anadromous form of rainbow trout). The ESA requires that NMFS review the status of listed species under its authority at least every 5 years and determine whether any species should be removed from the list or have its listing status changed.

To complete the status reviews, NMFS first asked scientists from the Northwest Fisheries Science Center to collect and analyze new information about ESU and DPS viability using the VSP concept. The Northwest Fisheries Science Center considered new information on the four VSP criteria. NMFS also considered new information on ESU and DPS boundaries. At the end of this process, the NMFS Biological Review Teams (BRT) prepared reports detailing the results of their analyses (Good et al. 2005; Ford et al. 2010).

In the 2005 formal status review (Good et al. 2005), the NMFS BRT categorized each ESU as either “in danger of extinction,” “likely to become endangered,” or “not likely to become endangered,” based on the ESU’s abundance, productivity, spatial structure and diversity. NMFS subsequently reviewed this and provided a summary of the current viability status for each listed ESU/DPS of the currently listed Pacific salmonid ESUs/DPSs of West Coast Pacific salmon (Ford et al. 2010). This updated status review is the most relevant and best scientific and commercial data available for this analysis.

4.1.2 Information Reviewed and Summarized for this Biological Assessment

Several information sources were reviewed and referenced to compile the best scientific and commercially available data for this consultation. Reclamation considered all relevant information, including the work of the Northwest Fisheries Science Center (Ford et al. 2010), recovery plans for the species in question, technical reports prepared in support of recovery plans, the listing record (including current listing status, designation of critical habitat and adoption of protective regulations), recent BiOps issued for 13 Columbia River salmon and steelhead ESU/DPSs, and the information and views provided by the geographically based management teams through the recovery planning processes.

Such information includes viability criteria for the ESU, DPS, and their independent populations; better understanding of and information on limiting factors and threats facing the ESU and DPS; better information on priority areas for addressing specific limiting factors; and better geographic context for assessing risk to the ESU and DPS. Documents considered include:

Past ESA consultation documents covering the mainstem Columbia River:

- 2007 Federal Action Agency Updated Proposed Action (Action Agencies 2007a)
- 2007 Federal Action Agency FCRPS Comprehensive Analysis (CA) (Action Agencies 2007b)
- 2008 FCRPS Supplemental Comprehensive Analysis (SCA) (NMFS 2008a)
- 2008/2010 FCRPS BiOp (NMFS 2008/2010)
- Federal Action Agency biological assessments and NMFS BiOps supplemental to the 2008/2010 FCRPS BiOp covering eulachon, green sturgeon, and killer whales (Action Agencies 2010)

NMFS salmon and steelhead status reviews and BRT/TRT reports:

- 2005 Status Review (Good et al. 2005)
- NMFS 2010/2011 Status Review (Ford et al. 2010)
- NMFS BRT/TRT Viable Salmonid Population Summaries (Ford et al. 2010)

Salmon and Steelhead Recovery Plans encompassing mainstem Columbia River ESU/DPSs:

- Proposed ESA Recovery Plan for Lower Columbia River (LCR) Chinook Salmon, Lower Columbia River Coho Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead (77 FR 28855; May 16, 2012)
- Final Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (76 FR 52317; August 22, 2011).
- Final Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan (74 FR 50165; September 30, 2009)
- Final Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (72 FR 57303; October 9, 2007)

4.2 Columbia River Basin Salmon and Steelhead Populations

The FCRPS Biological Opinion addresses a total of 13 salmon species, all listed under the ESA between 1991 and 2005. The seven interior Columbia Basin species pass through various parts of the hydrosystem and are the ESA-listed salmon runs most affected by its operation for electrical power, as well as by irrigation, flood control, navigation, and other purposes. The interior species are:

- Upper Columbia River Spring Chinook Salmon
- Snake River Spring/Summer Chinook Salmon
- Snake River Sockeye Salmon
- Upper Columbia River Steelhead
- Snake River Fall Chinook Salmon
- Snake River Steelhead
- Middle Columbia River Steelhead

In addition, six species that spawn primarily below the hydrosystem are indirectly affected by its operation. The lower Columbia River species are:

- Columbia River Chum Salmon
- Lower Columbia River Coho
- Upper Willamette River Steelhead
- Lower Columbia River Chinook Salmon
- Lower Columbia River Steelhead
- Upper Willamette River Chinook Salmon

4.2.1 Upper Columbia River Spring-run Chinook Salmon

On March 24, 1999, NMFS listed UCR spring-run Chinook salmon as an endangered species (64 FR 14308) and their endangered status was affirmed on June 28, 2005 (70 FR 37160). This ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. The ESU also includes six artificial propagation programs: the Twisp River, Chewuch River, Methow Composite, Winthrop NFH, Chiwawa River, and White River spring-run Chinook salmon hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural populations than what would be expected between closely related natural populations within the ESU (70 FR 37160). The spring-run Chinook salmon hatchery program at the Entiat National Fish Hatchery was determined to be a threat to the ESU and was discontinued in 2007.

For recovery planning and development of recovery criteria, the Interior Columbia Technical Recovery Team (ICTRT) identified independent populations within the UCR spring-run Chinook salmon ESU and grouped them into genetically similar MPGs (ICTRT 2003). Within the UCR spring-run Chinook salmon ESU, there are four independent populations (three extant and one extinct) that all belong to one genetically similar MPG (Eastern Cascades) (Figure 11). A historic population in the Okanogan River has been extirpated (ICTRT 2005).

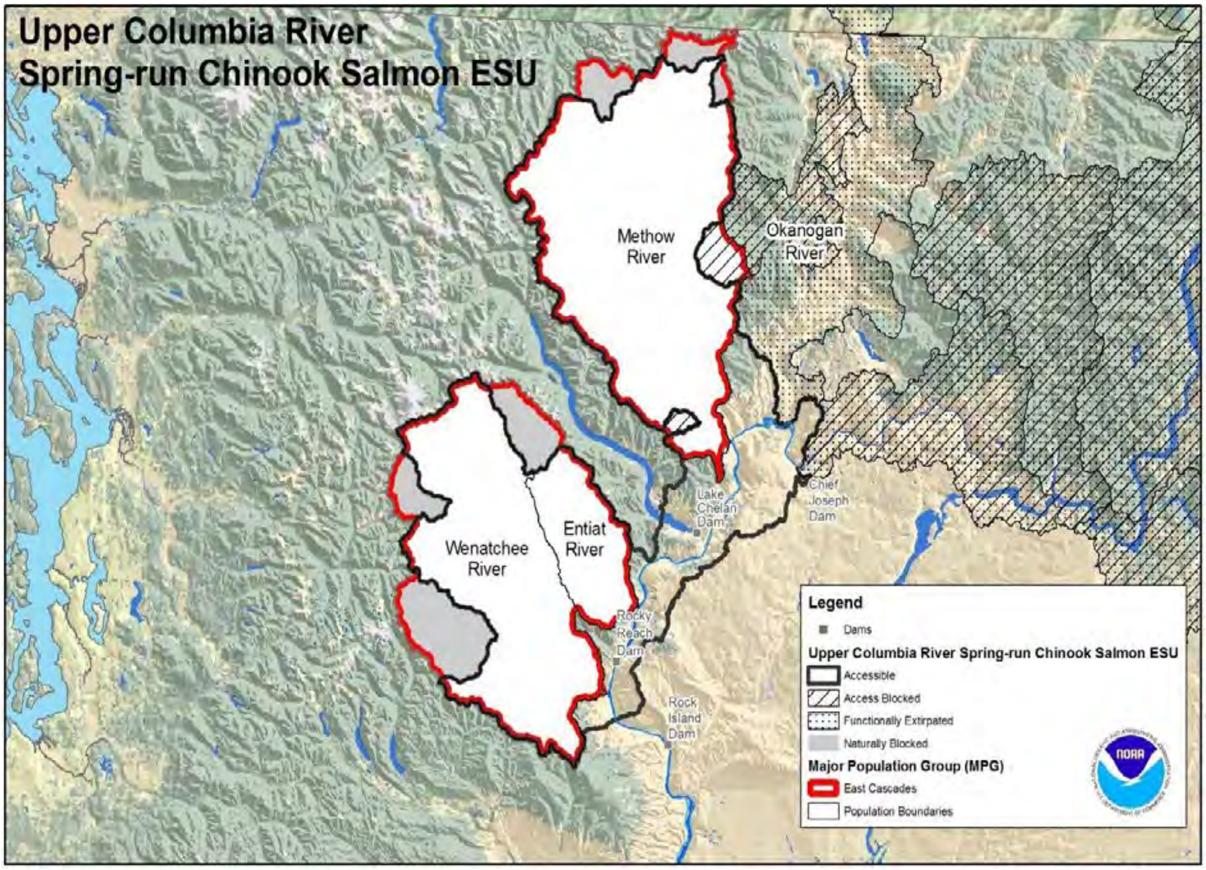

Figure 11. UCR spring-run Chinook salmon ESU population structure.

Life History. Chapter 8 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Spring-run Chinook salmon in this ESU have a stream-type life history, which means that juveniles enter marine waters during their second year and return to freshwater as preadults, maturing during their upriver spawning run. Three independent populations of spring-run Chinook salmon are identified for the ESU—those that spawn in the Wenatchee, Entiat, and Methow River Basins. Most of these fish return to the Columbia River from March through mid-May. Adults returning to the Wenatchee River enter freshwater from late March through early May; those returning to the Entiat and Methow Rivers enter freshwater from late March through June. Their arrival times tend to be earlier in low-flow years and later in high-flow years. On their way upriver, the fish hold in deeper pools or under cover until the onset of spawning. They may spawn in the areas where they hold, or move further up into smaller tributaries. Peak spawning for all three populations occurs from August to September, though the timing is highly dependent upon water temperature. Most adults return after spending 2 years in the ocean, although 20 to 40 percent return after 3 years at sea.

The egg incubation/alevin stage goes from August into December and emergence extends from that point into March. The juveniles typically spend 1 year in freshwater before migrating downstream—primarily in May and June.

Population Trends and Risks. The UCR spring-run Chinook salmon ESU continues to have habitat problems. In general, tributary habitat problems affecting this ESU include increasing urbanization on the lower reaches, irrigation and flow diversion in upriver sections of the major drainages, and impacts of grazing on middle reaches (Good et al. 2005). Limiting factors identified for this species include: (1) Mainstem Columbia River hydropower system mortality; (2) tributary riparian degradation and loss of in-river wood; (3) altered tributary floodplain and channel morphology; (4) reduced tributary streamflow and impaired passage; and (5) harvest impacts (NMFS 2005).

In March 2007, the ICTRT proposed minimum abundance thresholds for interior Columbia Basin stream-type Chinook salmon populations. Subsequently, in 2007, NMFS issued a final recovery plan for the UCR spring-run Chinook salmon ESU which adopted the ICTRT 2007 viability goals as biological delisting criteria (72 FR 57303). These recovery goals represent the numbers that, taken together, may be needed for the population to be self-sustaining or recovered in its natural ecosystem. For UCR spring-run Chinook salmon, the minimum abundance thresholds are 2,000 spawners each in the Wenatchee and Methow river basins and 500 spawners in the Entiat River basin (ICTRT 2008). The ICTRT (2008) has completed viability assessments for all but two populations of UCR Chinook salmon and found all to be not viable.

Abundance. For all populations, average abundance over the recent 10-year period is below the average abundance thresholds that the ICTRT identified as a minimum for low risk. Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above or near the recovery abundance thresholds in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 12), which shows annual abundance of combined populations. The 5-year geometric mean peaked in 1987, and continuously decreased until 1999 (Figure 12). The 5-year geometric mean remains low as of 2008 (Table 9).

In the most recent 10-year geometric mean (1997 to 2003), abundance was 222 for the Wenatchee population, 59 for the Entiat population, and 180 for the Methow population—only 9 to 12 percent of the minimum abundance thresholds, although escapement increased substantially in 2000 and 2001 in all three river systems (NMFS 2008b). Based on returns between 1980 and 2004, the average annual growth rate for this ESU is estimated at 0.93, so the population is not replacing itself (Fisher and Hinrichsen 2006). The ICTRT current status summaries characterize 100-year extinction risk, calculated from productivity and natural-origin abundance estimates of populations during the "base period," as greater than 25 percent for all three UCR spring-run Chinook salmon populations (NMFS 2008b).

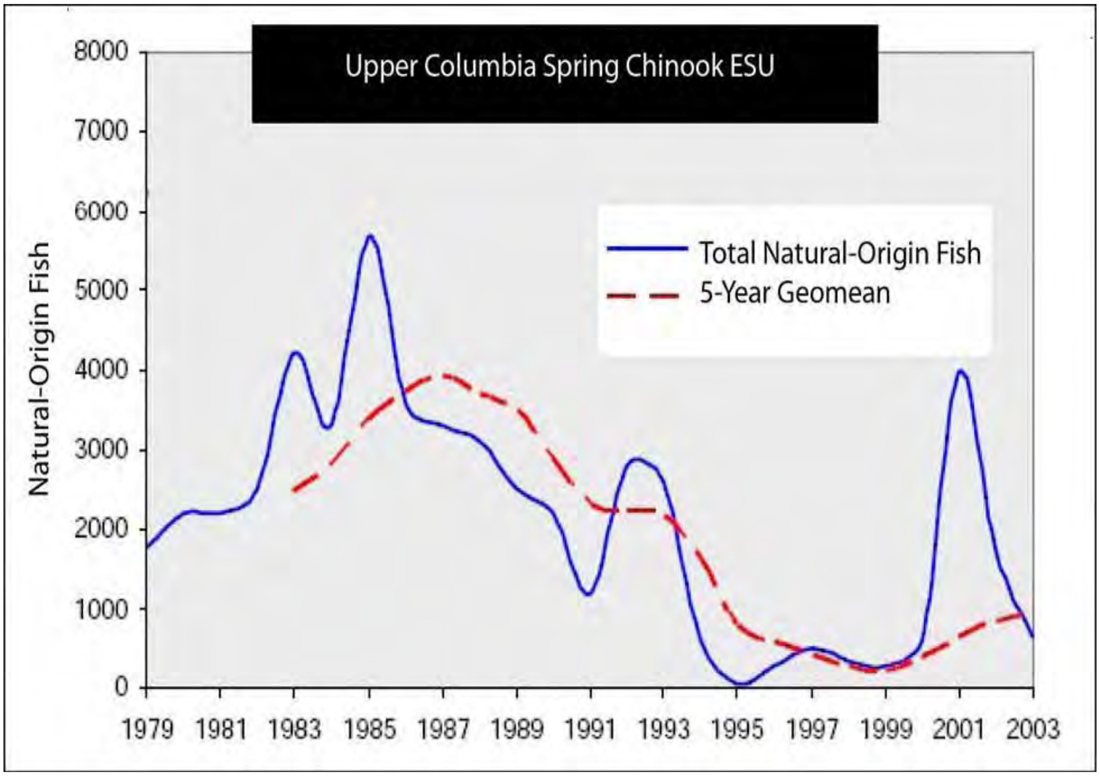

Figure 12. Upper Columbia River Spring-run Chinook salmon abundance trends (NMFS 2008b).

Table 9. Estimated spawning abundance (total spawners, natural-origin spawners, percent natural origin) for Upper Columbia spring Chinook populations (table reproduced from Ford et al. 2010).

	Natural Spawning Areas								
	Total Spawners (5-year geometric mean, *range*)			**Natural Origin (5-year geometric mean)**			**% Natural Origin (5-year average)**		
Population	Listing (1991-1996)	Prior (1997-2001)	Current (2003-2008)	Listing (1991-1996)	Prior (1997-2001)	Current (2003-2008)	Listing (1991-1996)	Prior (1997-2001)	Current (2003-2008)
Wenatchee River	167	470 (119-4,446)	1,554 (936-2,119)	NA	274	489	69%	58%	31%
Entiat River	89	111 (53-444)	253 (207-317)	NA	65	111	82%	58%	46%
Methow River	325	680 (79-9,904)	1,327 (984-1,801)	NA	282	402	78%	41%	29%

Total spawning abundance, including both natural-origin and hatchery fish, has increased relative to the levels reported in the 2005 status review. The geometric mean abundances of both natural-origin and hatchery spawners are higher for each population relative to the previous ESA status review and to the levels just prior to listing. The relative increase in hatchery-origin spawners in the Wenatchee and Methow river populations is disproportionately high, reflecting the large increase in releases from the directed supplementation programs in those two drainages.

Productivity. On average over the last 20 full brood-year returns (1979 to 1998 brood years, including adult returns through 2008), UCR spring-run Chinook salmon populations have not replaced themselves. This is true when only natural production is considered (i.e., R/S has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (ICTRT 2007). Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at less than 5-percent extinction risk (ICTRT 2007).

The short-term indices of population growth rate depict an upward trend in natural-origin returns since 1995 at a higher average rate than during the period leading up to the previous ESA status review (Ford et al. 2010). However, estimated population growth rates, assuming that hatchery-origin spawners and natural-origin spawners are contributing to natural production at the same rate, are below replacement for all three populations in this ESU. Possible contributing factors would include density dependent effects, differences in spawning distribution relative to habitat quality, and reduced fitness of hatchery-origin spawners. Overall abundance and productivity remains at high risk for each of the three extant populations in this MPG/ESU.

Spatial Structure and Diversity. The ICTRT characterizes the spatial structure risk to UCR spring-run Chinook salmon populations as “low” for the Wenatchee and Methow rivers and “moderate” for the Entiat River.

The ICTRT characterizes the diversity risk to all UCR spring-run Chinook salmon populations as “high.” The high risk is a result of reduced genetic diversity from homogenization of populations that occurred under the Grand Coulee Fish Maintenance Project between 1939 and 1943. In recent years, straying hatchery fish, compositing fish for broodstock, low proportion of natural-origin fish in some broodstocks, and a high proportion of hatchery fish on the spawning grounds have contributed to the high genetic diversity risk. Discontinuation of the Entiat River hatchery program in 2007 addressed a major limiting factor and is expected to benefit the Entiat River Chinook salmon population’s productivity and diversity.

Despite modest improvements in the distribution of fish within their historical range through replacement of culverts and removal of other passage barriers, the composite spatial structure/diversity metric for all three extant populations in this MPG/ESU remained the same, primarily because of the diversity component driven by chronically high proportions of hatchery-origin spawners in natural spawning areas and lack of genetic diversity among the natural-origin spawners (ICTRT 2008).

Updated Risk Summary

Overall abundance and productivity remains at high risk of extinction for each of the three extant populations in this MPG/ESU. The 10-year geometric mean abundance of adult natural-origin spawners has increased for each population relative to the levels for the 1981-2003 series, but the estimates remain below the corresponding thresholds identified by the ICTRT (Table 10). Estimated productivity (spawner-to-spawner return rate at low to moderate escapements) was, on average, lower over the years 1987-2009 than for the previous 1981-2003 period. The combinations of current abundance and productivity for each population result in a high risk rating relative to the ICTRT viability curves.

Table 10. Viability assessments for Upper Columbia spring Chinook salmon populations in the North Cascades MPG. Spatial structure and diversity risk ratings from ICTRT (2008) (table reproduced from Ford et al. 2010).

	Abundance/Productivity Metrics				Spatial Structure and Diversity Metrics			Overall Viability Rating
Population	ICTRT Minimum Threshold	Natural Spawning Abundance	ICTRT Productivity	Integrated A/P Risk	Natural Processes Risk	Diversity Risk	Integrated SS/D Risk	
Wenatchee River 1987-2009	2000	449 (119-1,050)	0.61 (0.40-0.95)	High	Low	High	High	HIGH RISK
1981-2003		222 (18-1,050)	0.93 (0.57-1.53)	High				
Entiat River 1999-2009	500	105 (27-291)	1.08 (0.75-1.55)	High	Moderate	High	High	HIGH RISK
1981-2003		59 (10-291)	0.72 (0.59-0.93)	High				
Methow River 1999-2009	2000	307 (79-1,979)	0.45 (0.26-0.8)	High	Low	High	High	HIGH RISK
1981-2003		180 (20-1,979)	0.80 (0.52-1.24)	High				
Okanogan River	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The composite spatial structure/diversity (SS/D) risks for all three of the extant populations in this MPG/ESU are at high risk of extinction. The spatial structure component of the SS/D metric is at a low-risk rating for the Wenatchee River and Methow River populations and at moderate-risk rating for the Entiat River population. All three of the extant populations in this single MPG/ESU are at high risk of extinction for the diversity metric. Chronically high proportions of hatchery-origin spawners in natural spawning areas and lack of genetic diversity among the natural-origin spawners (ICTRT 2008) drive this diversity risk factor.

Based on the combined ratings for abundance/productivity and SS/D, all three extant populations of UCR spring-run Chinook salmon remain at an overall high risk of extinction.

ESU Summary

Although there has been an increase of abundance for all three UCR spring-run Chinook salmon populations, overall productivity has decreased and the ESU remains at a high risk of extinction. Since the ESU-level recovery criteria require that all the extant populations within this single MPG be rated as viable for the ESU to be viable, more progress must be made before the UCR spring-run Chinook salmon ESU can be considered recovered.

Several factors cited in the previous and current status review (Good et al. 2005, Ford et al. 2010) remain concerns or key uncertainties for all three extant populations. Increases in natural-origin abundance relative to the extremely low spawning levels observed in the mid-1990s are encouraging. However, average productivity levels remain extremely low. Large-scale directed supplementation programs are underway in the Wenatchee and Methow populations. These programs are intended to mitigate short-term demographic risks while actions to improve natural productivity and capacity are implemented. While these programs may provide short-term demographic benefits, there are significant uncertainties regarding the long-term risks of relying on high levels of hatchery influx to maintain natural populations.

Overall, the new information considered does not indicate a change in the biological risk category since the time of the last status review in 2010. The viability of the UCR spring-run Chinook salmon ESU has likely improved somewhat; however, the ESU remains at a moderate-to-high risk of extinction. None of the populations meet the ICTRT's 2007 biological recovery criteria (ICTRT 2007b).

4.2.2 Upper Columbia River Steelhead

The UCR steelhead distinct population segment (DPS) was listed as endangered on August 18, 1997 (62 FR 43937). Their status was upgraded to threatened on January 5, 2006 (71 FR 834) and then reinstated to endangered status per U.S. District Court decision in June 2007. This DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border (62 FR 43937). Six artificial propagation programs are considered part of the DPS—the Wenatchee River, Wells Hatchery (in the Methow and Okanogan rivers), Winthrop National Fish Hatchery (NFH), Omak Creek, and the Ringold steelhead hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural populations than what would be expected between closely related natural populations within the DPS (71 FR 834).

The ICTRT has identified five independent populations within this DPS—the Wenatchee River, Entiat River, Methow River, Okanogan Basin, and Crab Creek (ICTRT 2005).

Within the UCR steelhead DPS, there are only four independent extant populations belonging to one genetically similar MPG (Figure 13). The Crab Creek anadromous component was determined to be functionally extirpated by NMFS (ICTRT 2007).

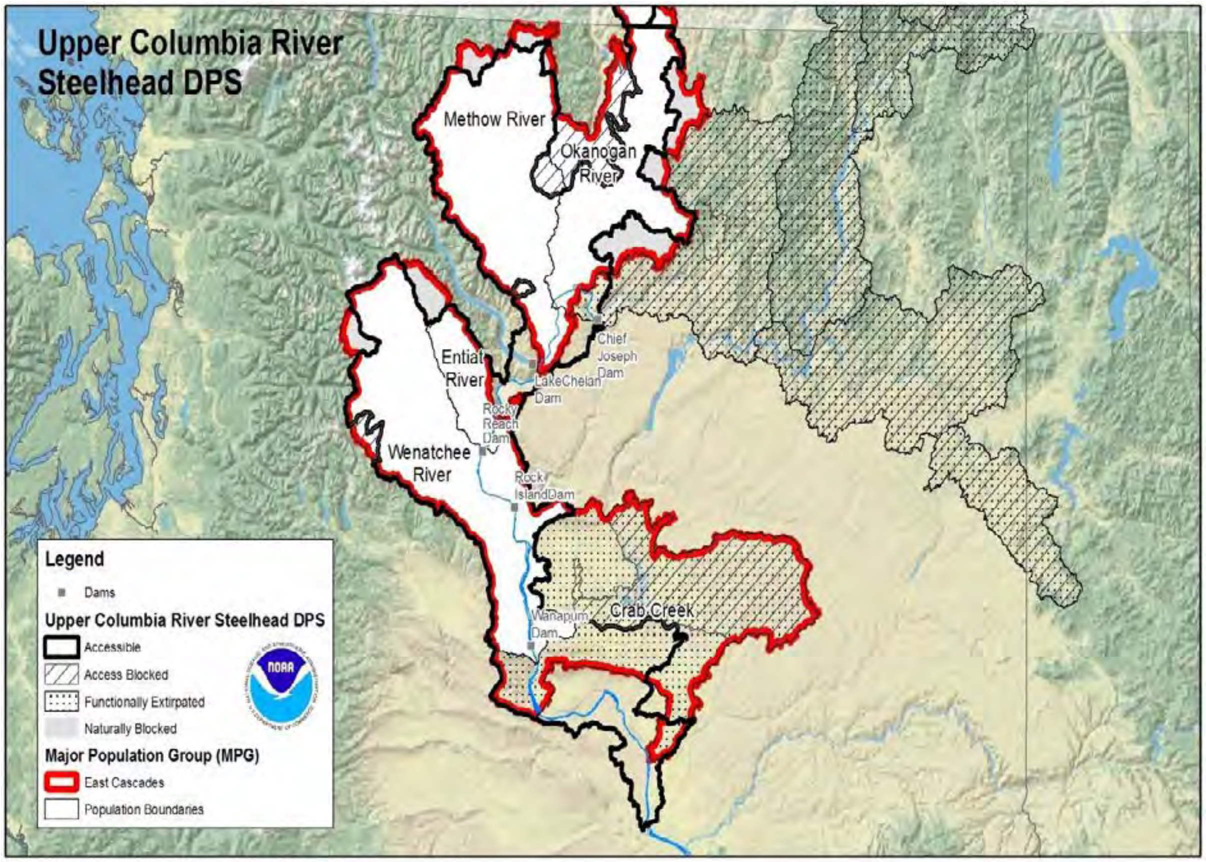

Figure 13. UCR steelhead DPS population structure

Life History. Chapter 9 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Life-history characteristics for UCR steelhead are similar to those of other inland steelhead DPSs. Unlike Pacific salmon, steelhead are capable of spawning more than once before death and adults attempt to migrate back to the ocean after spawning. These fish are known as kelts, and those that survive will migrate from the ocean to spawn again. However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females. Steelhead can be divided into two basic run types based on their level of sexual maturity at the time they enter freshwater and the duration of the spawning migration. The stream-maturing type, or summer steelhead, enters freshwater in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters freshwater with well developed gonads and spawns relatively shortly after river entry. Fish in the UCR steelhead ESU are made up entirely of summer steelhead.

Upper Columbia River steelhead spawn in cool, clear streams with suitable gravel size, depth, and current velocity. They sometimes also use smaller streams for spawning. The adult steelhead enter freshwater between May and October. During summer and fall before spawning, they hold in cool, deep pools. They migrate inland toward spawning areas, overwinter in the larger rivers, resume migration to natal streams in early spring, and then spawn. In general, adults in this ESU spawn later than in most downstream populations—often remaining in freshwater for a year before spawning.

Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months before hatching. Rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers. Productive steelhead habitat is characterized by complexity—primarily in the form of large and small wood.

The dry habitat conditions in the Upper Columbia River are less conducive to steelhead survival than in many other parts of the Columbia River Basin. Although the life history of this ESU is similar to that of other inland steelhead, smolt ages are some of the oldest on the West Coast (up to 7 years old), probably due to the area's cold water temperatures. The cold stream temperatures also lead to the possibility that many fish in this ESU may be thermally-fated to a resident (rainbow trout) life history regardless of whether they are the progeny of resident or anadromous parents. Most current natural production occurs in the Wenatchee and Methow river systems, with a smaller run returning to the Entiat River. Very limited spawning also occurs in the Okanagan River Basin. Most of the fish spawning in natural production areas are of hatchery origin. The limited data available indicate that smolt age in this ESU is dominated by 2- year-olds. It also appears that steelhead from the Wenatchee and Entiat rivers return to freshwater after 1 year in salt water, whereas Methow River steelhead primarily return after 2 years of ocean residence.

Population Trends and Risks. The UCR steelhead DPS continues to experience problems including genetic homogenization from hatchery supplementation (reducing genetic variations from levels that support viability), high harvest rates on steelhead smolts in rainbow trout fisheries (reducing abundance), and the degradation of freshwater habitats within the region (negatively affecting spatial structure and productivity, especially the effects of grazing, irrigation diversions, and hydroelectric dams) (Good et al. 2005). Limiting factors identified for the UCR steelhead include: (1) Mainstem Columbia River hydropower system mortality; (2) reduced tributary streamflow; (3) tributary riparian degradation and loss of in-river wood; (4) altered tributary floodplain and channel morphology; and (5) excessive fine sediment and degraded tributary water quality (NMFS 2005).

In March 2007, the ICTRT proposed minimum abundance thresholds for interior Columbia Basin steelhead populations. Subsequently in 2007, NMFS issued a final recovery plan for the UCR steelhead DPS which adopted the ICTRT 2007 viability goals as biological delisting criteria (72 FR 57303). These recovery goals represent the numbers that, taken together, may be needed for the population to be self-sustaining, or recovered, in its natural ecosystem. For UCR steelhead, the minimum abundance thresholds are 1,000 spawners each in the Wenatchee, Methow, and Okanogan river basins, and 500 spawners in the Entiat River basin (ICTRT 2007). The recovery strategies outlined in the recovery plan are targeted to achieve, at a minimum, the biological criteria for the UCR steelhead DPS.

Abundance. The most recent estimates (5-year geometric mean) of total and natural-origin spawner abundance are higher for all four independent populations of the DPS, and for the Priest Rapids Dam aggregate run, since the last status review in 2005. Annual returns since 2005 were all above the population-specific ranges reported in the previous review. In spite of the recent increases, however, natural-origin returns remain well below target levels.

For all populations, average abundance over the most recent 10-year period is below the average abundance thresholds that the ICTRT has identified as a minimum for low risk. Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels above or near the recovery abundance thresholds (all populations except the Okanogan) in a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 14 and Table 11).

Aggregate abundance of the four populations and a rolling five-year geometric mean of abundance for the DPS are shown in Figure 14. Geometric mean abundance since 2001 has substantially increased for the DPS as a whole. Geomean abundance of natural-origin fish for the 2001 to 2003 period was 3,643 compared to 1,146 for the 1996 to 2000 period, a 218 percent improvement (Fisher and Hinrichsen 2006). The recent geometric mean abundance was influenced by exceptional returns in 2002, yet returns of natural-origin adults have been well above the 1996 to 2000 geomean in years since 2000.

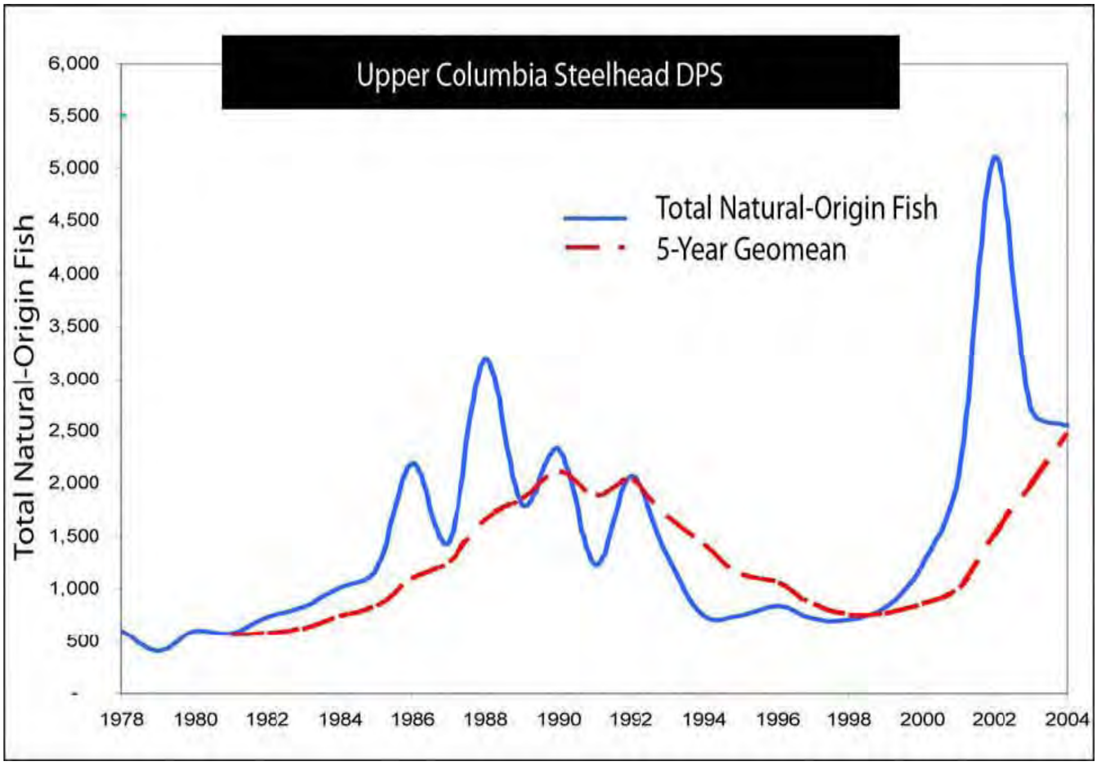

Figure 14. Upper Columbia River steelhead DPS population trends (NMFS 2008b).

Table 11. Estimated spawning abundance (total spawners, natural-origin spawners, percent natural origin) for Upper Columbia steelhead populations (table reproduced from Ford et al. 2010).

	Natural Spawning Areas								
	Total Spawners (5-year geometric mean, *range*)			**Natural Origin (5-year geometric mean)**			**% Natural Origin (5-year average)**		
Population	Listing (1991-1995)	Prior (1997-2001)	Current (2005-2009)	Listing (1991-1995)	Prior (1997-2001)	Current (2005-2009)	Listing (1991-1995)	Prior (1997-2001)	Current (2005-2009)
Wenatchee River	1,880	696 (343-1,655)	1,891 (931-3608)	458	326 (241-696)	819 (701-962)	24%	48%	47%
Entiat River	121	265 (132-427)	530 (300-892)	59	46 (31-97)	116 (99-137)	48%	19%	23%
Methow River	1,184	1,935 (1417-3,325)	3,504 (2,982-4,394)	251	162 (68-332)	505 (361-703)	21%	9%	15%
Okanogan River	723	1,124 (770-1,956)	1,832 (1,483-2,260)	84	53 (22-109)	152 (104-197)	12%	5%	9%

Productivity. On average over the last 20 full brood-year returns (1980-1981 through 1999-2000 brood years, including adult returns through 2004-2005), UCR steelhead populations have not replaced themselves when only natural production is considered (i.e., average returns per spawner (R/S) has been less than 1.0). In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high in the most recent brood years (ICTRT 2007).

Hatchery-origin returns continue to constitute a high fraction of total spawners in natural spawning areas for this DPS. Estimates of natural-origin spawner abundance are higher for the most recent five year cycle. Current patterns in the proportion of natural-origin spawners among populations are similar to that reported in the previous status review. The proportions of natural-origin spawners are highest in the Wenatchee River, and remain at extremely low levels in the Methow and Okanogan Rivers.

Spatial Structure and Diversity. The ICTRT has characterized the spatial structure risk to UCR steelhead populations as “low” for the Wenatchee and Methow, “moderate” for the Entiat, and “high” for the Okanogan. The ICTRT considers the risk high for the Okanogan population because only the lower of two major spawning areas in the United States is occupied.

The ICTRT has characterized the diversity risk to all UCR steelhead populations as “high.” The high risk is a result of reduced genetic diversity from homogenization of populations that occurred during the Grand Coulee Fish Maintenance Project from 1939 to 1943, and then again from 1960 to 1981. In addition, the Methow and Okanogan populations have particularly high proportions of hatchery-origin spawners, and recent monitoring confirms that hatchery fish are straying into nontarget areas, likely contributing to the continued homogenization of the populations.

Although modest improvements in the distribution of fish within their historical range have been achieved through replacement of culverts and removal of other passage barriers, the spatial structure and diversity metrics have not changed since the completion of the 2008 ICTRT status assessments. The proportions of hatchery-origin returns in natural spawning areas remain extremely high across the DPS, especially in the Methow and Okanogan river populations, and continue to be a major concern.

Updated Risk Summary

All four populations of the UCR steelhead DPS remain at high risk of extinction since the 2005 status review. The most recent estimates of natural-origin abundance (10-year geometric mean) and natural-origin productivity are at low-to-moderate parent abundance and remain well below the ICTRT-defined viability curve minimum for the DPS (Table 12). Spawning escapements into natural areas, especially for the Methow and Okanogan populations, continue to show a high proportion of hatchery-origin fish. Productivity, assuming that the hatchery-origin and natural-origin spawners are contributing to natural production at the same effectiveness, is below replacement for all four populations (even at low-to-moderate spawning levels). Geometric mean natural-origin abundance and productivity estimates since the previous status review are the highest for the Wenatchee River population that contains the lowest relative proportion of hatchery spawners.

Table 12. Viability assessments for UCR steelhead populations. Updated to reflect return years through 2009 (table reproduced from Ford et al. 2010).

	Abundance/Productivity Metrics				Spatial Structure and Diversity Metrics			Overall Viability Rating
Population	ICTRT Minimum Threshold	Natural Spawning Abundance	ICTRT Productivity	Integrated A/P Risk	Natural Processes Risk	Diversity Risk	Integrated SS/D Risk	
Wenatchee River 2000-2009	1000	795 (365-1947)	0.87 (0.44-1.74)	High	Low	High	High	HIGH RISK
1994-2003		559 (241-1947)	0.84 (0.68-1.39)	High				
Entiat River 2000-2009	500	112 (52-263)	0.55 (0.35-0.88)	High	Moderate	High	High	HIGH RISK
1994-2003		79 (31-263)	0.48 (0.3-0.66)	High				
Methow River 2000-2009	1000	468 (256-703)	0.32 (0.14-0.72)	High	Low	High	High	HIGH RISK
1994-2003		289 (68-554)	0.28 (0.12-0.81)	High				
Okanogan River 2000-2009	750	147 (84-212)	0.15 (0.06-0.35)	High	High	High	High	HIGH RISK
1994-2003		95 (22-181)	0.12 (0.07-0.21)	High				

DPS Summary

Although there has been an increase in abundance and productivity for all four UCR steelhead populations, the improvement has been minor, and none of the populations meet the recovery criteria established in the UCR Recovery Plan. Since the DPS-level recovery criteria require that all four populations be viable, more progress must be made before the UCR steelhead can be considered recovered.

Several factors cited in the previous status review (Good et al. 2005) remain concerns or key uncertainties in the most recent 2010 status review (Ford et al. 2010). UCR steelhead populations have increased in natural-origin abundance in recent years, but productivity levels continue to remain low. The proportion of hatchery-origin returns in natural spawning areas remains extremely high across the DPS, especially in the Methow and Okanogan River populations. Recent improvements in natural returns, although modest, are most likely the result of several years of relatively good ‘natural’ ocean and tributary habitat survival conditions.

Overall, the new information considered does not indicate a change in the biological risk category since the time of the last status review. Direct biological performance measures for this DPS indicate modest progress to date toward meeting viability criteria. New information considered during this review confirms that all populations within this DPS are at high risk and the DPS, as a whole, is not viable.

4.2.3 Middle Columbia River Steelhead

The MCR steelhead DPS was listed as threatened on March 25, 1999 (64 FR 14517) and its threatened status was reaffirmed on June 28, 2005 (70 FR 37160). This DPS includes all naturally spawned populations of steelhead in streams from above Wind River, Washington, and the Hood River, Oregon, upstream to, and including, the Yakima River, Washington, excluding steelhead from the Snake River basin (SRB). Seven artificial propagation programs are considered part of the DPS—The Touchet River Endemic, Yakima River Kelt Reconditioning Program (in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River), Umatilla River, and the Deschutes River steelhead hatchery programs. NMFS determined that these artificially propogated stocks are no more divergent relative to the local natural populations than what would be expected between closely related natural populations within the DPS (71 FR 834).

Major watersheds within this DPS include the Klickitat, Fifteenmile, Deschutes, John Day, Umatilla, Yakima, and Walla Walla basins. The ICTRT (2007) identified 20 populations in four MPGs (Eastern Cascades, John Day River, the Umatilla/Walla Walla, and the Yakima River). There are three extinct populations in the Eastern Cascades MPG (the White Salmon and Crooked river populations), and the Willow Creek population in the Umatilla Rivers/Walla Walla MPG (Figure 15).

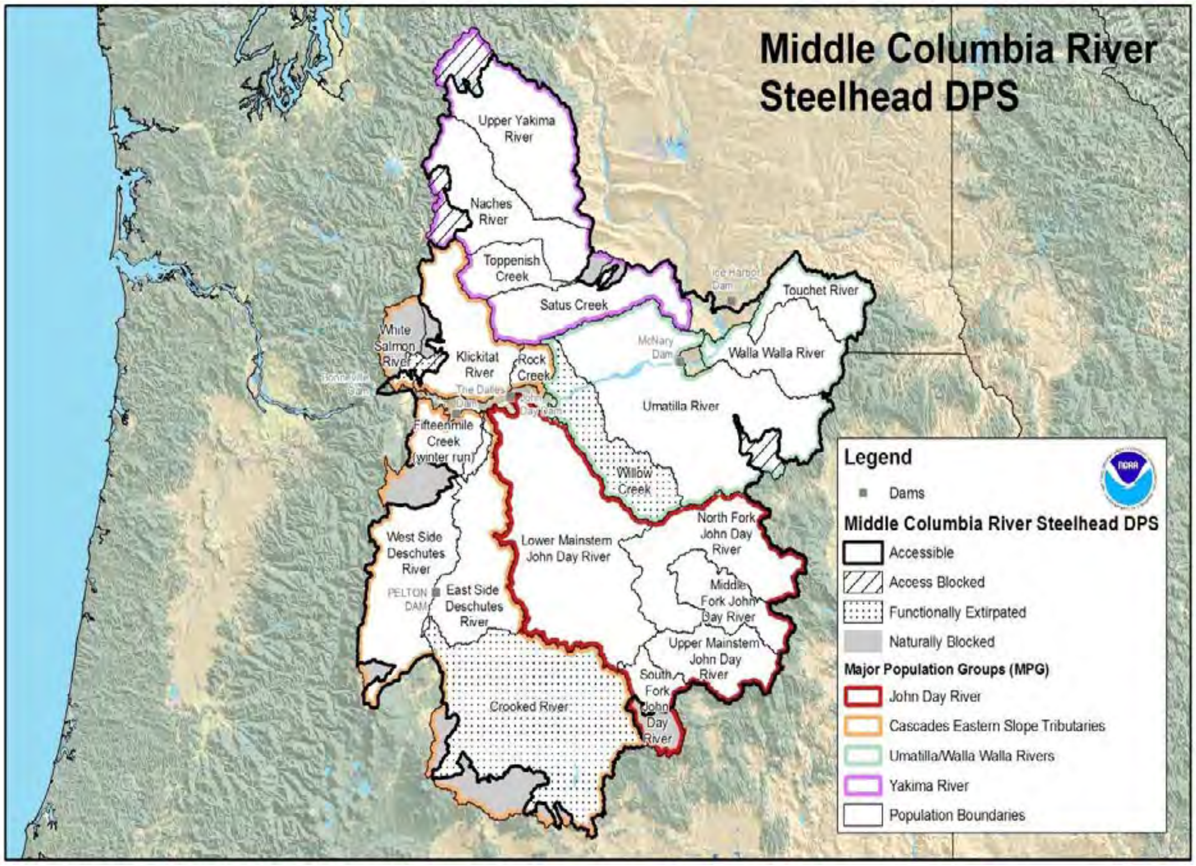

Figure 15. MCR steelhead DPS population structure.

Life History. Chapter 10 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Life-history characteristics for MCR steelhead are similar to those of other inland steelhead DPSs. Unlike Pacific salmon, steelhead are capable of spawning more than once before death. However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females. Steelhead can be divided into two basic run types based on their level of sexual maturity at the time they enter freshwater and the duration of the spawning migration. The stream-maturing type, or summer steelhead, enters freshwater in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters freshwater with well developed gonads and spawns relatively shortly after river entry. Fish in the MCR steelhead ESU are predominantly summer steelhead. All steelhead upstream of The Dalles Dam are summer-run (Reisenbichler et al. 1992) fish that enter the Columbia River from June to August. However, winter-run fish are found in lower numbers in the Klickitat River, Washington, and Fifteenmile Creek, Oregon.

Both types of steelhead spawn in cool, clear streams with suitable gravel size, depth, and current velocity. They sometimes also use smaller streams for spawning. Summer steelhead enter freshwater between May and October. During summer and fall before spawning, they hold in cool, deep pools. They migrate inland toward spawning areas, overwinter in the larger rivers, resume migration to natal streams in early spring, and then spawn. Winter steelhead enter freshwater between November and April in the Pacific Northwest, migrate to spawning areas, and then spawn in late winter or spring.

Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months before hatching. Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers. Productive steelhead habitat is characterized by complexity—primarily in the form of large and small wood.

Most fish in this ESU smolt at 2 years and spend 1-2 years in salt water before reentering freshwater, where they may remain for up to a year before spawning. Age-2-ocean steelhead dominate the summer steelhead run in the Klickitat River, whereas most other rivers with summer steelhead produce about equal numbers of both age-1- and age-2 ocean fish. Juvenile life stages (i.e., eggs, alevins, fry, and parr) inhabit freshwater/ riverine areas throughout the range of the ESU. Parr usually undergo a smolt transformation as 2-year-olds, at which time they migrate to the ocean. Subadults and adults forage in coastal and offshore waters of the North Pacific Ocean before returning to spawn in their natal streams. A nonanadromous form of *O. mykiss* (redband and rainbow trout) co-occurs with the anadromous form in this ESU, and juvenile life stages of the two forms can be very difficult to differentiate. In addition, hatchery steelhead are also distributed within the range of this ESU.

Populations Trends and Risks. Numerous factors across the MCR steelhead DPS that led to its listing in 1999 continue to exert substantial influence on anadromous fish production. These factors include declines in abundance of naturally produced fish, heavy harvest pressures, significant habitat loss, losses associated with mainstem Columbia River hydropower projects, grazing, irrigation diversions, and pervasive hatchery impacts that affect the viability of steelhead populations (McClure et al. 2003). Limiting factors identified for MCR steelhead include: (1) Hydropower system mortality at mainstem Columbia River dams; (2) Reduced streamflow in tributaries; (3) Impaired passage in tributaries; (4) Excessive fine sediment in stream substrates; (5) Degraded water quality; and (6) Altered channel morphology (NMFS 2005a).

In 2009, NMFS issued a final recovery plan for MCR steelhead, which adopted the ICTRT viability criteria as biological delisting goals (NMFS 2009). The recovery strategies outlined in the MCR recovery plan are targeted to achieve, at a minimum, the biological criteria for each MPG in the DPS. The criteria are, ". . . [t]o have all four major population groups at viable (low risk) status with representation of all the major life-history strategies present historically, and with the abundance, productivity spatial structure and diversity attributes required for long-term persistence." The Plan recognizes that there may be several different combinations of population status that could satisfy the biological criteria for each MPG and identifies the combinations most likely to result in achieving viability for each MPG (NMFS 2009; Ford et al. 2010).

In addition to recommending recovery criteria, the ICTRT also assessed the current status of each population within the DPS (ICTRT 2007b). Each population was rated against the biological criteria identified in the recovery plan and assigned a current viability rating. Information provided below was summarized from Ford et al. (2010)—Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Northwest.

Abundance. For three of the 14 populations for which recent abundance has been estimated, average abundance over the most recent 10-year period is above the average abundance thresholds that the ICTRT identifies as a minimum for low risk. The remaining 11 populations have lower average abundance than the ICTRT abundance thresholds. Abundance for most populations was relatively high during the late 1980s, declined to low levels in the mid-1990s, and increased to levels similar to the late 1980s during the early 2000s (Figure 16).

Figure 16 shows the aggregate abundance of all populations and rolling 5-year geometric mean of abundance for the DPS as a whole. The 1980-to-2002 and the 1990-to-2002 DPS-level trends indicate a declining trend over 1980 to 2002 and an increasing trend for 1990-2002. Geometric mean abundance since 2001 has substantially increased for the DPS as a whole. Geomean abundance of natural-origin fish for the 2001 to the most recent period was 17,553 compared to 7,228 for the 1996 to 2000 period, a 143 percent improvement (Fisher and Hinrichsen 2006). The 5-year geometric mean in 2002 was still less than the 5-year geometric mean in 1988.

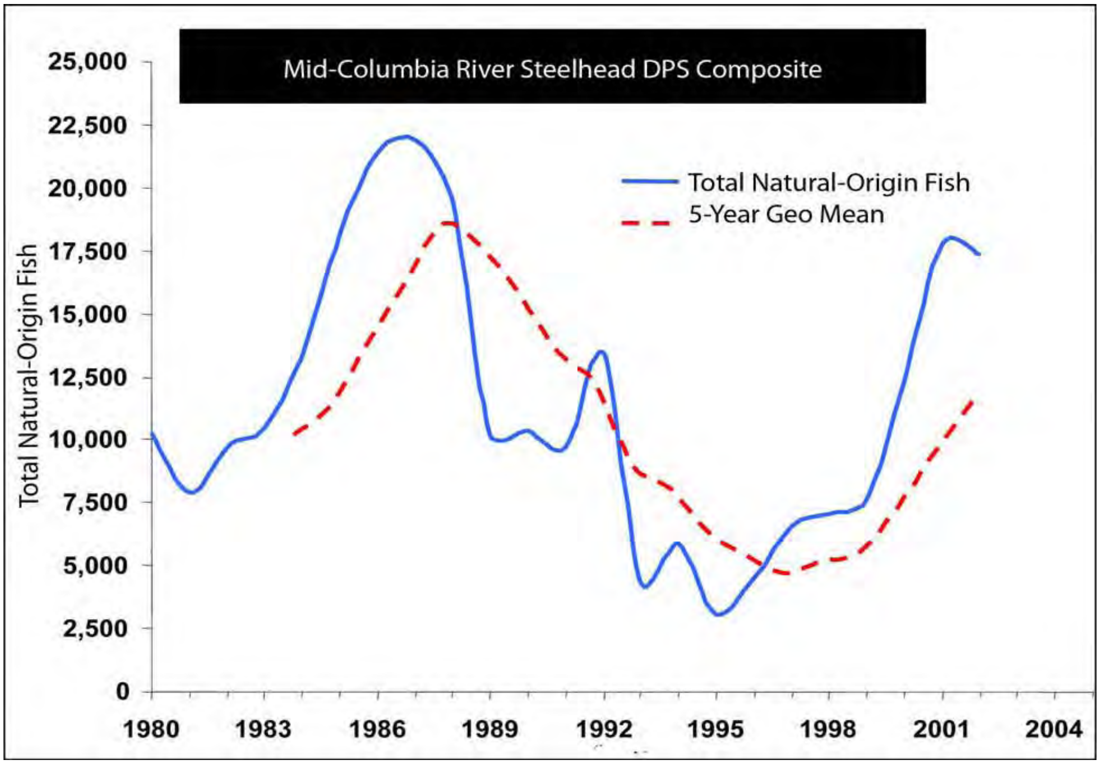

Figure 16. Middle Columbia River steelhead population trends (NMFS 2008b).

Cascades Eastern Slope Tributaries MPG

Abundance data are available for three (Fifteenmile Creek, East Side Deschutes, and West Side Deschutes) of the five extant populations in the Cascades Eastern Slope Tributaries MPG along with 2 years of estimates for a fourth population (Klickitat River). Total spawning abundance for the most recent 5-year series (2005-2009) is below the levels reported in the last status review for the three populations. However, natural-origin spawner abundance is higher for the more recent estimates (for all three populations with more than 2 years of abundance estimates). Estimates of the proportion of natural-origin spawners were higher for all three (Fifteenmile Creek, East Side Deschutes, and West Side Deschutes) populations in the most recent brood cycle (Ford et al. 2010). Based on mark-recapture analysis during 2006-2007, an average of 1,450 natural and 1,670 hatchery steelhead passed upstream of the Klickitat Falls and into spawning reaches in the Klickitat River.

John Day River MPG

Total escapement and natural-origin escapement were down from the levels reported in the previous status review for four (Upper Mainstem, North Fork, Middle Fork, and Lower Mainstem) out of the five John Day populations. Both total and natural-origin spawning escapements in the South Fork John Day River were higher in the more recent brood cycle than in 1997-2001. Estimates of the fraction of natural-origin spawners were relatively unchanged for the upstream John Day populations, but had increased for the Lower Mainstem John Day River (Ford et al. 2010).

Yakima River MPG

Total and natural-origin escapement estimates were higher in the most recent brood cycle for all four of the Yakima River populations than in the cycle associated with the 2005 status review. Steelhead escapements into the Upper Yakima River, although increased relative to the previous review, remain very low relative to the total amount of habitat available. The proportion of natural-origin fish remained high in the Yakima River basin (estimated for aggregate run at Prosser Dam) (Ford et al. 2010).

Umatilla/Walla Walla Rivers MPG

Total spawning escapements have increased in the most recent brood cycle over the period associated with the last status review for all three populations in the Umatilla/Walla Walla Rivers MPG. Natural-origin escapements are higher for two populations (Umatilla River and Walla Walla River) while remaining at approximately the same level as in the prior review for the Touchet River (Ford et al. 2010).

Productivity. Over the last 20 full brood-year returns of the MCR steelhead populations for which estimates are available, most have replaced themselves and a few have not when only natural production is considered. These estimates are based on brood years starting in 1979-1985, depending on population, and ending in 1998 or 1999, including adult returns through 2004 or 2005. In general, productivity was relatively high during the early 1980s, lower during the late 1980s and 1990s, and high again in the most recent brood years (NMFS 2008b).

In the most recent 10-year geometric mean (1995-2004), abundance in the Yakima MPG was 85 for the Upper Yakima, 472 for the Naches, 322 for Toppenish, and 379 for Satus (NMFS 2008b). Based on 1980-2002 returns, the average annual growth rate for this DPS is estimated at 0.98, so the population is not replacing itself (Fisher and Hinrichsen 2006). The ICTRT current status summaries characterize the 100-year extinction risk, calculated from productivity and natural-origin abundance estimates of populations during the "base period" as "moderate" (6-25 percent 100-year extinction risk) for most MCR steelhead populations. One population (North Fork John Day) has "very low" (<1 percent) risk and four populations (Rock Creek, Touchet, Toppenish, and Upper Yakima) have "high" (>25 percent) risk (NMFS 2008b).

Spatial Structure and Diversity. The ICTRT characterizes the spatial structure risk to MCR steelhead populations as "very low" to "moderate" for all populations except the Upper Yakima. The Upper Yakima population has "high" diversity risk because 7 of 10 historical major spawning areas are not occupied.

The ICTRT characterizes the diversity risk to all but one MCR steelhead population as "low" to "moderate." The Upper Yakima is rated as having "high" diversity risk because of introgression with resident *O. mykiss* and loss of presmolt migration pathways. The ICTRT found moderate risks to the DPS' productivity, spatial structure, and diversity, with the greatest relative risk being attributed to the DPS' abundance.

Updated Risk Summary

Cascades Eastern Slope Tributaries MPG

The current status of two of the five populations in the Cascades Eastern Slope Tributaries MPG, Fifteenmile and the East Side Deschutes River, is rated as viable using the ICTRT criteria incorporated into the recovery plan.

The West Side Deschutes population remains rated at high risk because of relatively low estimates for current productivity and natural-origin abundance. The data series for the Klickitat River population is not sufficient to allow for a rating. However, available mark-recapture based estimates for 2 recent years indicate that the population may be functioning at, or near, viable levels. Data are not available for the remaining extant population (Rock Creek), and the White Salmon River and Crooked River populations are both classified as extinct by the ICTRT.

John Day River MPG

The North Fork John Day population continues to be rated highly viable when data through the 2009 spawning year are incorporated into the assessment. The remaining four populations in the John Day River MPG remain rated as maintained status. Natural-origin abundance estimates (10-year geometric mean) are higher in the current assessments for four populations and lower for the Middle Fork John Day River. Productivity estimates (geometric mean of brood year spawner/spawner ratio at low-to-moderate parent escapements) were generally lower in the updated data series than the estimates generated for the ICTRT status reviews ending in spawning year 2005.

Yakima River MPG

The ratings for individual populations in the Yakima River MPG should be interpreted with caution given the basis for estimating population-specific returns from Prosser Dam counts. The overall viability ratings improved from maintained status to viable for the Satus Creek and Toppenish Creek populations, but remained at maintained status for the Naches River and at high risk for the Upper Yakima River population. The changes in ratings reflect the relatively high annual returns in most years since 2001. Productivity estimates based on the return series updated through 2009 (previously through 2005) have increased or remained at approximately the same levels as estimated in the recovery plan/ICTRT status assessments.

Umatilla/Walla Walla Rivers MPG

The overall rating for the Umatilla River and Walla Walla River populations remain at maintained status after incorporating the updated abundance and productivity data. The current status of the Touchet River population remains at high risk, primarily driven by relatively low productivity. Natural-origin abundance estimates increased for the Umatilla River and the Walla Walla River populations relative to the levels reported in the recovery plan/ICTRT status assessments (through return year 2005). Productivity estimates for all three extant populations in this MPG are lower than in the previous reviews. The Willow Creek population is classified as extinct by the ICTRT.

DPS Summary

Although there have been improvements in the viability ratings for some of the component populations, none of the MPGs are meeting the recovery criteria and only 3 of the 17 extant populations are considered to be viable. Since the DPS-level recovery criteria require that all four MPGs be rated as viable, more progress must be made before this MCR steelhead DPS can be considered recovered.

Several factors cited in the previous status review (Good et al. 2005) remain concerns or key uncertainties in the 2010 status review (Ford et al. 2010). Natural-origin spawning estimates are highly variable relative to minimum abundance thresholds across the populations in the DPS. Some populations, such as the North Fork John Day, are rated highly viable and have consistently high abundance, while several other populations remain at high risk. Updated information indicates that straying levels into at least the Lower John Day River population are also high. Returns to the Yakima River Basin and to the Umatilla and Walla Walla rivers have been higher over the most recent brood cycle while natural-origin returns to the John Day River have decreased. Out-of-basin hatchery stray proportions, although reduced, remain very high in the Deschutes River Basin.

Overall, the new information considered in the 2010 status review does not indicate a change in the biological risk category since the time of the last status review. Although direct biological performance measures for this DPS indicate little realized progress to date toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly. The DPS remains well distributed throughout its historical range in the Middle Columbia River Basin and at least some populations are considered to be viable. The percentage of natural-origin spawners is relatively high (70-99 percent; Ford et al. 2010) and the estimates of total DPS abundance indicates that the DPS is not at immediate risk of extinction. New information considered during the 2010 review confirmed that this DPS remains at moderate risk of extinction.

4.2.4 Snake River Spring/Summer Chinook Salmon

The NMFS listed Snake River (SR) spring/summer Chinook salmon as threatened, and protective regulations were issued under Section 4(d) of the ESA, on April 22, 1992 (57 FR 14653). Their threatened status was reaffirmed on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of SR spring/summer Chinook salmon in the mainstem Snake River, Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins (57 FR 23458). Fifteen artificial propagation programs are also considered to be part of the ESU:

- Tucannon River Conventional Hatchery,
- Tucannon River Captive Broodstock Program,
- Lostine River,
- Catherine Creek,
- Lookingglass Hatchery Reintroduction Program,

- Upper Grande Ronde,
- Imnaha River,
- Big Sheep Creek,
- McCall Hatchery,
- Johnson Creek Artificial Propagation Enhancement,
- Lemhi River Captive Rearing Experiment,
- Pahsimeroi Hatchery,
- East Fork Captive Rearing Experiment,
- West Fork Yankee Fork Captive Rearing Experiment, and
- Sawtooth Hatchery spring/summer-run Chinook hatchery programs.

NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural populations than what would be expected between closely related natural populations within the ESU (70 FR 37160).

NMFS is currently writing a recovery plan for the four ESA-listed Snake River salmon and steelhead species addressed in the 2010 5-year status review; therefore, final or interim recovery criteria are not currently available. NMFS has initiated recovery planning for the Snake River listed species based upon three management unit (MU) plans–Idaho, northeast Oregon and southeast Washington–encompassing the Snake River drainage. The ICTRT recommended MPG-level scenarios consistent with the ICTRT biological criteria for each ESU/DPS and will be used to develop proposed recovery strategies for each ESA-listed SR salmon and steelhead species in the draft Snake River recovery plan.

For the purposes of reproduction, salmon and steelhead typically exhibit a metapopulation structure (Schtickzelle and Quinn 2007, McElhany et al. 2000). Rather than interbreeding as one large aggregation, ESUs and DPSs function as a group of demographically independent populations separated by areas of unsuitable spawning habitat. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For the purposes of recovery planning and development of recovery criteria, the ICTRT identified independent populations for each SR ESA-listed species, and grouped them together into genetically similar MPGs (ICTRT 2003). The SR spring/summer Chinook salmon ESU is comprised of 28 extant populations in five MPGs—Lower Snake River, Grande Ronde/Imnaha, South Fork Salmon River, Middle Fork Salmon River, and the Upper Salmon River (Figure 17). Historic populations above Hells Canyon Dam are considered extinct (ICTRT 2005).

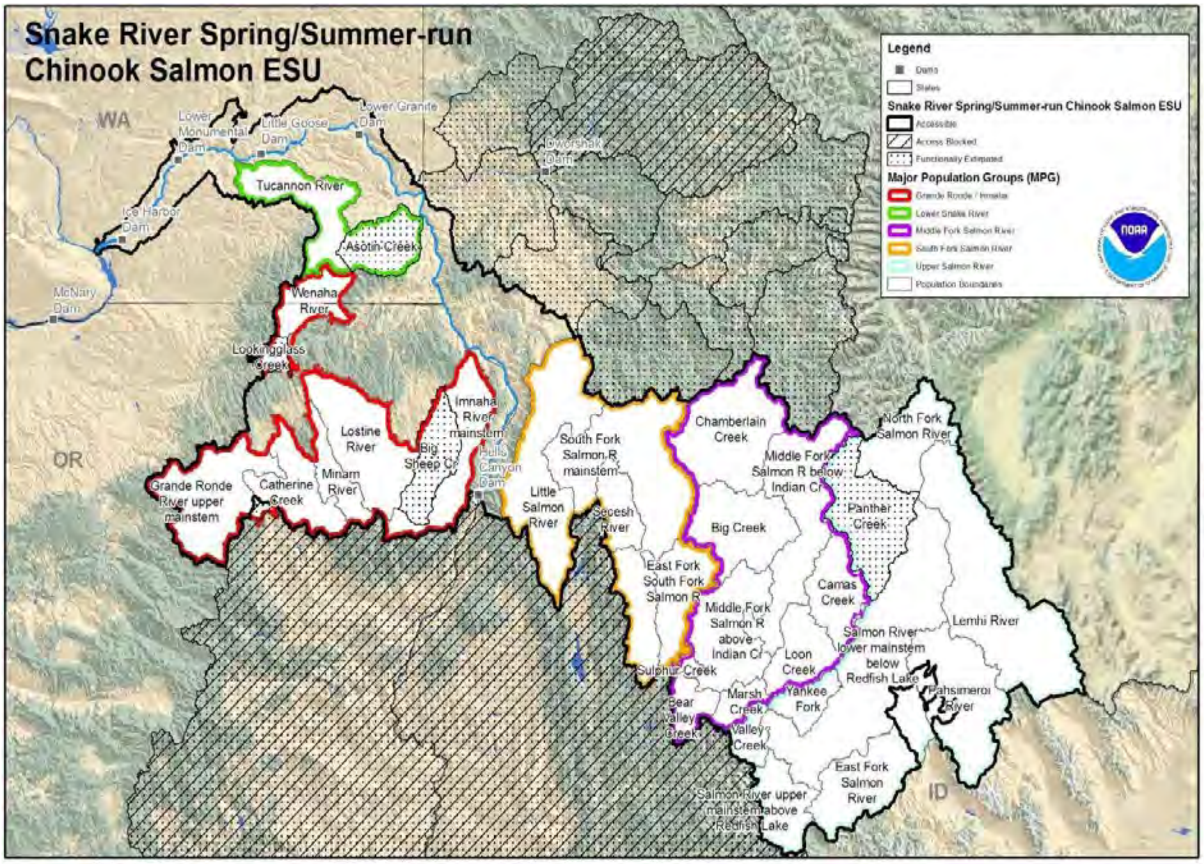

Figure 17. Snake River Spring/Summer Chinook Salmon ESU population structure.

Lower Snake River MPG

This MPG contained two populations historically; Asotin Creek is identified as extirpated. The ICTRT criteria call for both populations to be restored to viable status. The ICTRT recommended that recovery planners should give priority to restoring the Tucannon River to highly viable status, and deferring an evaluation of the potential for reintroducing production in Asotin Creek as recovery planning progresses.

Grande Ronde/Imnaha MPG

This MPG has eight historical populations (two identified as extirpated–Big Sheep Creek and Lookingglass Creek). The ICTRT criteria call for a minimum of four populations to be at viable or highly viable status. The potential scenario identified by the ICTRT would include viable populations in the Imnaha River (representing important run-timing diversity), the Lostine/Wallowa River (representing a large-size population) and at least one from each of the following pairs: Catherine Creek or Upper Grande Ronde (representing large-size populations); and Minam River or Wenaha River.

South Fork Salmon River MPG

Four populations comprise this MPG, with two classified as large-size and two as intermediate-size. The South Fork Salmon River drainage contains three of the populations; the fourth lies outside of the drainage. At least two of the populations (one intermediate and one large) must be at viable status for the MPG to be considered viable, and one of these two must be highly viable. One population in the MPG (Little Salmon River) is a spring/summer run type and the remaining three are the summer-only run type. The ICTRT MPG–level viability criteria require that the Little Salmon River population be viable for the MPG to be considered viable. The ICTRT recommends that the populations in the South Fork drainages be given priority relative to meeting MPG viability objectives because of the relatively small size and the high level of potential hatchery integration for the Little Salmon River population. The viability for this MPG relies on the production of summer-run type populations with the South Fork Salmon River drainage, rather than the inclusion of a minor amount of spring-run type production from outside the main drainage. Therefore, a recovery scenario for this MPG should not emphasize the life-history strategy requirement of MPG viability. Rather, this recovery scenario should emphasize the need to achieve viable status for the Secesh River population which has no supplementation and will satisfy the intermediate-size requirement for MPG viability. The South Fork Salmon River population is the initial choice by NMFS to meet the requirements of a large population.

Middle Fork Salmon River MPG

The ICTRT criteria call for at least five of the nine populations in this MPG to be rated as viable, with at least one demonstrating highly viable status. When all six MPG-level viability criteria are considered, there are 45 possible scenarios in which five populations, selected from the nine, could achieve MPG viability. The Big Creek population must be viable in any scenario because of its unique historic intrinsic potential in the MPG. It is the only population that meets the ICTRT large size category, and is one of two populations that include both spring- and summer-run fish. At least two of the three intermediate size populations (Chamberlain Creek, Middle Fork Salmon River above Indian Creek, and Bear Valley Creek) must be included among the minimum of five viable populations. In order to satisfy the intermediate-size population requirement, a viable status is targeted for the Chamberlain Creek and Bear Valley Creek populations. This is based on management opportunity and historic production potential. Two other populations must be viable to meet the minimum requirement of five viable populations.

The choices include Middle Fork Salmon River below Indian Creek, Camas Creek, Loon Creek, Middle Fork Salmon River above Indian Creek, Sulphur Creek, and Marsh Creek. The Loon Creek and Marsh Creek populations are targeted for desired viable status, because of their geographic distribution in the MPG and historic intrinsic production potential.

Upper Salmon River MPG

This MPG included nine historical populations, one of which (Panther Creek) is considered functionally extirpated. The ICTRT criteria recommend that only three of the five very large and large populations be included. However, because the single intermediate-size population (Panther Creek) is extirpated, an additional population from one of the larger size categories must be substituted for the intermediate-size population in the scenario. The Pahsimeroi River population must be viable because of its unique life-history strategy (it is the only summer-run population) in the MPG. The Pahsimeroi is classified as a large-size population. Therefore, at least three of the other four very large and large populations (Lemhi River, Salmon River Lower Mainstem below Redfish Lake Creek, East Fork Salmon River, and Salmon River Upper Mainstem above Redfish Lake Creek) must be included in the minimum set of five viable populations. Based on spatial distribution, management opportunity, and historical production potential in the MPG, the Lemhi River and Salmon River Upper Mainstem population need to be viable to satisfy the criterion for proportional representation of size class. The East Fork Salmon River population is an initial choice to achieve viable status. Finally, Valley Creek is an initial choice to round out the population selections.

Life History. Chapter 5 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Snake River spring/summer-run Chinook salmon exhibit a stream-type life history. Juvenile fish mature in freshwater for 1 year before they migrate to the ocean in the spring of their second year. Adults reenter the Columbia River in late February and early March after 2 or 3 years in the ocean. In high-elevation areas, mature fish hold in cool, deep pools of larger river systems until late summer and early fall, when they return to their native tributary streams to spawn. Eggs incubate through the fall and winter and emergence begins in the late winter and early spring. Juveniles migrate through the Columbia River mainstem from early May through mid-June.

Population Trends and Risks. The 1991 ESA status review (Matthews and Waples 1991) of the SR spring/summer Chinook salmon ESU concluded that the ESU was at risk. Aggregate abundance of naturally produced SR spring/summer Chinook salmon runs had dropped to a small fraction of historical levels. Short-term projections (including jack counts and habitat/flow conditions in the brood years producing the next generation of returns) were a continued downward trend in abundance. Risk modeling indicated that if the historical trend in abundance continued, the ESU as a whole was at risk of extinction within 100 years. The 1991 review identified related concerns at the population level within the ESU. Given the large number of potential production areas in the SRB and the low levels of annual abundance, risks to individual subpopulations may be greater than the extinction risk for the ESU as a whole. The 1998 Chinook salmon status review (Myers et al. 1998) summarized and updated these concerns. Both short- and long-term abundance trends had continued downward. The report identified continuing disruption from mainstem hydroelectric development, including altered flow regimes and impacts on estuarine habitats. The 1998 review also identified regional habitat degradation and risks associated with the use of outside hatchery stocks in particular area, including major sections of the Grande Ronde River basin (Good et al. 2005). Limiting factors identified for this species include: (1) Mainstem lower Snake and Columbia River hydrosystem mortality; (2) reduced tributary streamflow; (3) altered tributary channel morphology;

(4) excessive fine sediment in tributaries; and (5) degraded tributary water quality (NMFS 2005).

In March 2007, the ICTRT proposed minimum abundance thresholds for SR spring/summer Chinook salmon. They represent the numbers that, taken together, may be needed for the population to be self-sustaining, or recovered, in its natural ecosystem. For SR spring/summer-run Chinook salmon, the minimum abundance thresholds are 2,000 spawners each in the Lemhi and Lower Mainstem SR; 1,000 spawners in the Lostine/Wallowa River, Upper Grande Ronde River, Catherine Creek, South Fork Mainstem, East Fork/Johnson Creek, Big Creek, Pahsimeroi, Upper Salmon East Fork, and Upper Salmon Mainstem; 750 in the Imnaha River Mainstem, Minam River, Wenaha, River, Secesh River, Bear Valley, Upper Mainstem North Fork, and Chamberlain Creek; and 500 in Camas Creek, Loon Creek, Marsh Creek, Lower Mainstem Middle Fork, Sulphur Creek, Valley Creek, Yankee Fork, and North Fork Salmon River (ICTRT 2007).

The overall viability ratings for all populations in the SR spring/summer Chinook salmon ESU remain at high risk after the addition of more recent year abundance and productivity data. Under the approach recommended by the ICTRT, the overall rating for an ESU depends on population-level ratings nested by MPG. The following brief summaries describe the current status of populations within each of the extant MPGs in the ESU, contrasting the current ratings with assessments previously done by the ICTRT using data through the 2008 return year.

Abundance. For all populations, average abundance over the most recent 10-year period is below the average abundance thresholds that the ICTRT identified as a minimum for low risk. Abundance for most populations declined to extremely low levels in the mid-1990s, increased to levels near the recovery abundance thresholds in a few years in the early 2000s, and is now at levels intermediate to those of the mid-1990s and early 2000s.

Although recovery criteria rely on the abundance of individual spawning populations evaluated at the MPG and ESU level, the quality of information varies among populations. The aggregate abundance of all populations of natural-origin SR spring/summer Chinook salmon has been measured since 1962 by counts at the four dams on the lower Snake River. Since 1975, Chinook salmon have been counted at Lower Granite Dam, which encompasses most populations within the ESU. Abundance and a rolling 5-year geometric mean of abundance for the aggregate of most populations in the ESU are shown in Figure 18. Geometric mean abundance peaked in the late 1960s and continued to decrease until the late 1990s. Geometric mean abundance since the late 1990s has increased substantially for the Lower Granite aggregate count. Geomean abundance of natural-origin fish for the 2001-to-2005 period was 25,957 compared to 4,840 for abundance of natural-origin fish for the 1996-to-2000 period, a 436-percent improvement (Fisher and Hinrichsen 2006). As a point of reference, the sum of the ICTRT's minimum abundance thresholds for all populations in this ESU is 26,500 (ICTRT 2007).

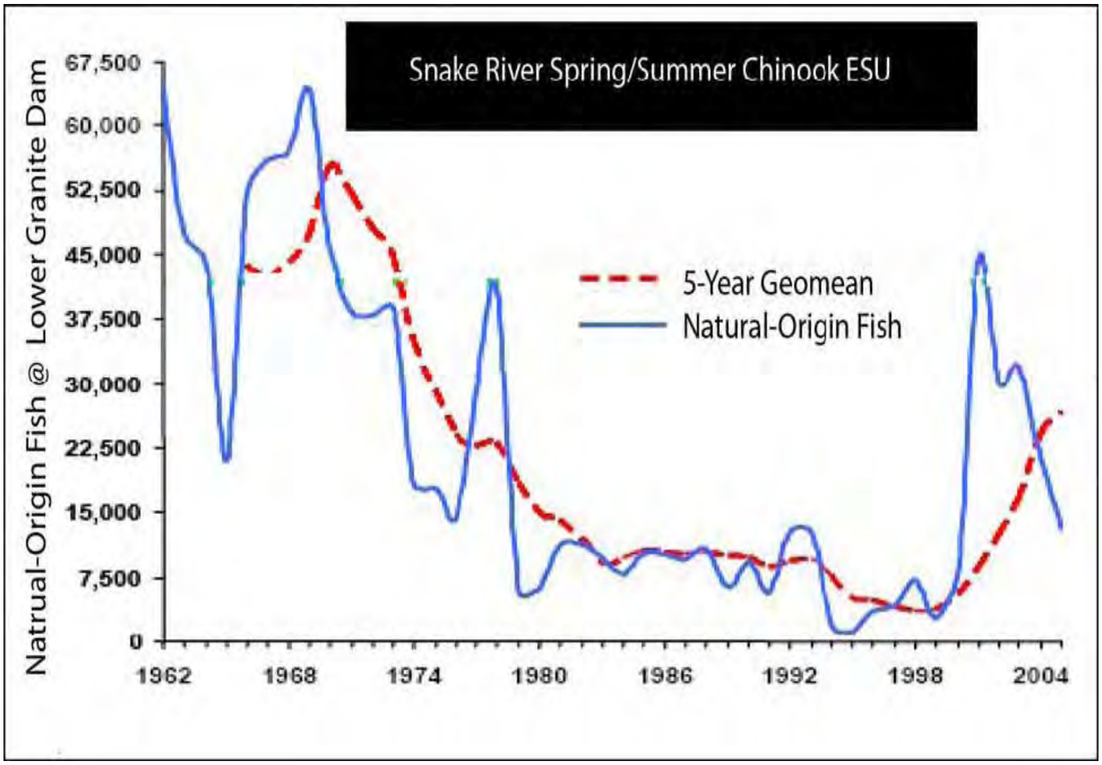

Figure 18. Snake River spring/summer-run Chinook salmon ESU abundance trends (NMFS 2008b).

Lower Snake River MPG

Abundance and productivity remain the major concern for the Tucannon River population. Natural spawning abundance (10-year geometric mean) has increased but remains well below the minimum abundance threshold for the single extant population in this MPG. Poor natural productivity continues to be a major concern.

Grande Ronde/Imnaha MPG

The Wenaha River, Lostine/Wallowa River and Minam River populations showed substantial increases in natural abundance relative to the previous ICTRT review, although each remains below their respective minimum abundance thresholds. The Catherine Creek and Upper Grande Ronde populations each remain in a critically depressed state. Geometric mean productivity estimates remain relatively low for all populations in the MPG.

South Fork Salmon River MPG

Natural spawning abundance (10-year geometric mean) estimates increased for the three populations with available data series. Productivity estimates for these populations are generally higher than estimates for populations in other MPGs within the ESU. Viability ratings based on the combined estimates of abundance and productivity remain at high risk, although the survival/capacity gaps relative to moderate- and low-risk viability curves are smaller than for other ESU populations.

Middle Fork Salmon River MPG

Natural-origin abundance and productivity remains extremely low for populations within this MPG. As in the previous ICTRT assessment, abundance and productivity estimates for Bear Valley Creek and Chamberlain Creek (limited data series) are the closest to meeting viability minimums among populations in the MPG.

Upper Salmon River MPG

Abundance and productivity estimates for most populations within this MPG remain at very low levels relative to viability objectives. The Upper Salmon Mainstem has the highest relative abundance and productivity combination of populations within the MPG.

Productivity. On average over the last 20 full brood-year returns (1980-1999 brood years including adult returns through 2006), approximately two-thirds of SR spring/summer Chinook salmon populations have not replaced themselves when only natural production is considered. In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood year R/S estimates in ICTRT Current Status Summaries). Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at <5 percent extinction risk (ICTRT 2007). While natural productivity has been low during this period for most populations, the BRT trend in abundance of natural fish has been stable or increasing for nearly all populations.

In summary, abundance of natural-origin and total spawners has been stable or increasing for most SR spring/summer Chinook salmon populations over the last 20 full brood years, based on lambda and BRT trend estimates, generally >1.0. For many populations, this stability or increase has been at least partially dependent on production from naturally spawning hatchery fish, the progeny of which are considered natural-origin fish in these calculations. For most populations, natural survival rates have not been sufficient for spawners to replace themselves, as indicated by average R/S and lambda estimates <1.0. The presence of hatchery origin natural spawners does not explain, in its entirety, the differences among the three metrics, as evidenced by populations in the Middle Fork Salmon MPG which are not affected by hatcheries.

Spatial Structure. The ICTRT characterizes the spatial structure risk to nearly all SR spring/summer Chinook salmon populations as “low” or “moderate.” “High” risk exceptions are the Upper Grande Ronde and Lemhi populations, which are a result of accessible but currently unoccupied historically significant spawning areas.

Diversity. The ICTRT characterizes the diversity risk to nearly all SR spring/summer Chinook salmon populations as “low” or “moderate.” “High” risk exceptions are found in the Upper Salmon MPG. Factors indicating high risk include loss of the summer-run life-history characteristic for the Lemhi population. Ten of the fourteen hatchery programs use fish included in the ESU and are thought to have preserved some of the remaining diversity in this ESU, particularly when individual populations declined to very low numbers in 1994 and 1995.

ESU Summary

Population-level status ratings remain at high risk across all MPGs in the ESU. Although recent natural spawning abundance has increased, all populations remain below minimum natural-origin abundance thresholds. Relatively low natural production rates and spawning levels below minimum abundance thresholds remain a major concern across the ESU. The ability of populations to be self-sustaining through normal periods of relatively low ocean survival remains uncertain. Factors cited in the 2005 and 2010 status reviews (Good et al. 2005, Ford et al. 2010) remain concerns or key uncertainties for several populations.

As a result of the current high risk facing this ESU's component populations, the SR spring/summer Chinook salmon MPGs do not meet the ICTRT viability criteria for the ESU (i.e., all five MPGs should be viable for the ESU to be viable). Therefore, the ESU is not currently considered to be viable. Overall, there is no new information to indicate an improvement in the biological risk category since the time of the 2010 status review. There is also no new information to indicate that this ESU's extinction risk has increased considerably in the past 5 years. This ESU remains well distributed over 28 extant populations in three states. Total ESU abundance is depressed but not at critically low levels. Some populations have experienced increased abundance in the last 5 years. New information considered during the 2010 review confirms that this DPS remains at moderate risk of extinction.

4.2.5 Snake River Fall Chinook Salmon

The NMFS listed SR fall-run Chinook salmon as threatened on April 22, 1992 (57 FR 14653) and their threatened status was reaffirmed on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam, and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins. Four artificial propagation programs are considered to be part of the ESU—the Lyons Ferry Hatchery, Fall Chinook Acclimation Ponds Program, Nez Perce Tribal Hatchery, and Oxbow Hatchery fall-run Chinook hatchery programs (70 FR 37160).

For the purposes of reproduction, salmon and steelhead typically exhibit a metapopulation structure (Schtickzelle and Quinn 2007, McElhany et al. 2000). Rather than interbreeding as one large aggregation, ESUs and DPSs function as a group of demographically independent populations separated by areas of unsuitable spawning habitat. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For the purposes of recovery planning and development of recovery criteria, the ICTRT identified independent populations for each SR ESA-listed species, and grouped them together into genetically similar major population groups (MPGs) (ICTRT 2003). The SR fall-run Chinook salmon ESU has one MPG that is comprised of one extant population for the SR fall-run

Chinook salmon, the lower Snake River mainstem population. This population occupies the Snake River from its confluence with the Columbia River to Hells Canyon Dam, and the lower reaches of the Clearwater, Imnaha, Grande Ronde, Salmon, and Tucannon Rivers (ICTRT 2005). (Figure 19).

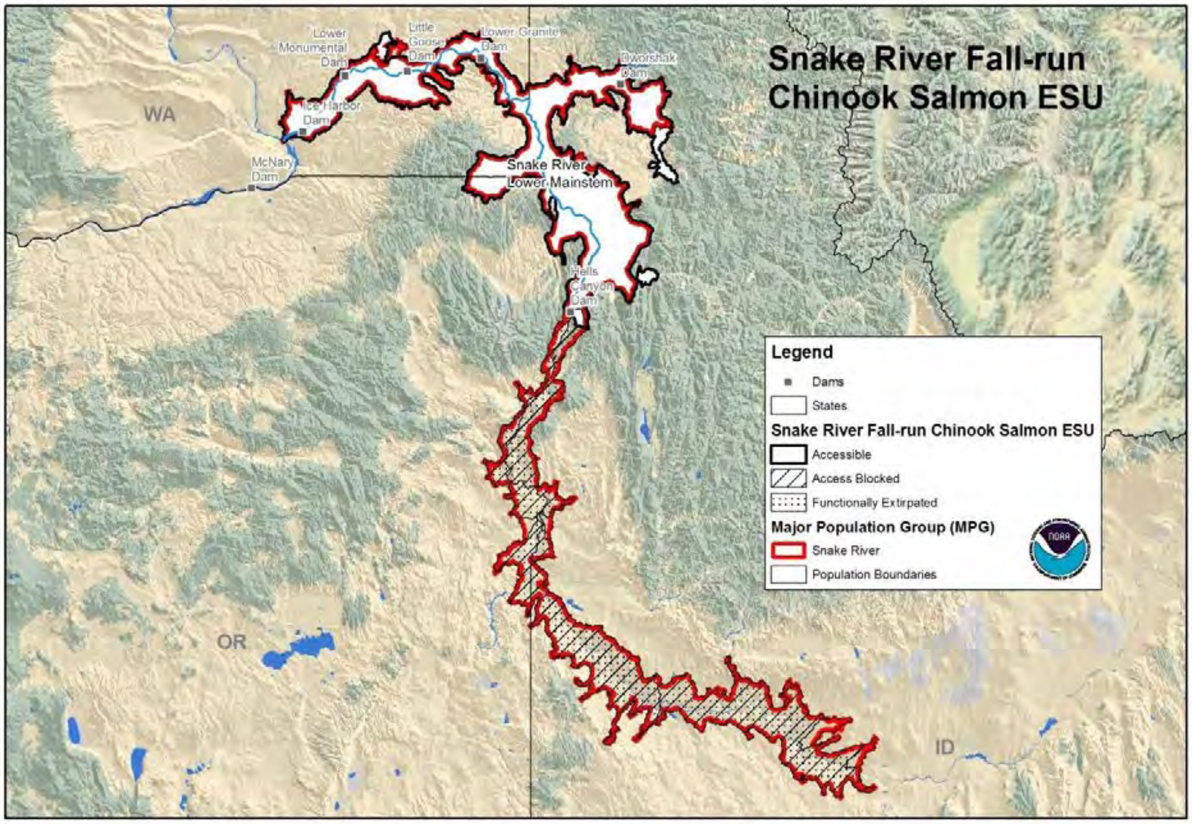

Figure 19. Snake River Fall-run Chinook Salmon ESU population structure.

Snake River Fall Chinook MPG

SR fall-run Chinook salmon are currently restricted to one extant population, the Lower Mainstem Snake River population, which occupies approximately 15 percent of the historical range of this ESU. The ICTRT considers the SR fall-run Chinook salmon ESU to consist of one MPG, with three historical populations (only one of which is extant). The two upstream populations (above the Hells Canyon hydropower complex), Marsing Reach and Salmon Falls, are extirpated. The extant Lower Mainstem population (below the Hells Canyon hydropower complex) is currently rated at moderate risk relative to ICTRT criteria. The ICTRT concluded that the single MPG must be at low risk (highly viable) for the ESU to be considered viable (ICTRT 2007). This would require the reestablishment of at least one other population to meet the minimum viability criteria established by the ICTRT for ESUs with a single MPG. The ICTRT recognized the difficulty of reestablishing fall-run Chinook salmon populations and suggested initial recovery efforts emphasize improving the viability of the extant population, while creating the potential for reestablishment of an additional population (ICTRT 2007).

The Lower Mainstem population would be considered at low risk if the combination of abundance and productivity (geometric mean spawner to spawner ratios for parent escapements less than 2,000 spawners–75 percent of the minimum abundance threshold of 3,000) exceeds a viability curve generated by simulation modeling that incorporates observed year-to-year variability in return rates. In any case, the ICTRT criteria for low-viability risk stipulate that the 10-year geometric mean natural-origin escapement should exceed 3,000, with a minimum of 2,500 natural-origin spawners in the mainstem Snake River major spawning areas. Achieving a very low-risk rating for abundance and productivity requires exceeding the same natural-origin abundance threshold combined with a productivity estimate of 1.5 or higher. The ICTRT described five major spawning areas within the Lower Mainstem population–three mainstem reaches (Salmon River confluence to Hells Canyon Dam site, Lower Granite Dam to the Salmon River confluence, and the mainstem off of and including the lower Tucannon River), and two tributary mainstems (lower Grande Ronde River and the Clearwater River). In addition, the ICTRT defined smaller spawning reaches in the Imnaha River and the Salmon River as minor spawning areas.

Life History. Chapter 4 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Fall-run Chinook salmon in this ESU are ocean-type. Adults return to the Snake River at ages 2 through 5, with age 4 most common at spawning (Waples et al. 1991). Spawning takes place in October through November and occurs in the mainstem Snake River and in the lower parts of major tributaries. Juveniles emerge from the gravels in March and April of the following year and move downstream from natal spawning and early rearing areas from June through early fall. Juvenile SR fall-run Chinook salmon move seaward slowly as subyearlings, typically within several weeks of emergence (Waples et al. 1991). Scale samples from natural-origin SR fall-run Chinook salmon taken at Lower Granite Dam continue to indicate that approximately half of the returns overwintered in freshwater. The majority of these fish are likely from the Clearwater River (Ford et al. 2010).

Population Trends and Risks. The ICTRT completed a status review of SR fall-run Chinook salmon and concluded that the species is "likely to become endangered" (Good et al. 2005). The ICTRT found moderate risk to the species for productivity and moderately high risks for abundance, spatial structure, and diversity. The ICTRT concluded that, although SR fall-run Chinook salmon numbers have been increasing in recent years, there remains a moderately high risk of extinction due to insufficient abundance (Good et al. 2005). Sustained abundance of natural-origin fish at current levels or higher will decrease long-term risks to the species. Limiting factors identified for SR fall-run Chinook salmon include: (1) Mainstem lower Snake and Columbia hydrosystem mortality; (2) degraded water quality; (3) reduced spawning and rearing habitat due to mainstem lower SR hydropower system; and (4) harvest impacts (NMFS 2005).

In March 2007, the ICTRT proposed minimum abundance thresholds for SR fall-run Chinook salmon populations. They recommend a minimum long-term average spawning abundance threshold of 3,000 natural-origin spawners, with no fewer than 2,500 of those natural-origin spawners distributed in the mainstem Snake River habitat (ICTRT 2007).

Abundance. Average abundance (1,273) of SR fall-run Chinook salmon over the last recent 10-year period was below the 3,000 natural spawner average abundance thresholds that the ICTRT identifies as a minimum for low risk. The current estimate (1999-2008 10-year geometric mean) of natural-origin spawning abundance (10-year geometric mean) of SR fall-run Chinook is just over 2,200 (Ford et al 2010). The ICTRT recommends that no fewer than 2,500 of the 3,000 natural-origin fish be mainstem SR spawners. Total returns of SR fall-run Chinook salmon over Lower Granite Dam increased steadily from the mid-1990s to the present. Natural returns increased at roughly the same rate as hatchery origin returns (through run year 2000); since then, hatchery returns have increased disproportionately to natural-origin returns. The median proportion of natural-origin has been approximately 32 percent over the past two brood cycles (Cooney and Ford 2007).

Table 13. Estimated spawning abundance (total spawners, natural-origin spawners, percent natural origin) for SR fall-run Chinook. Recent abundance and proportion natural origin compared to estimates at the time of listing and the previous BRT review (table reproduced from Ford et al. 2010.)

	Natural Spawning Areas								
	Total Spawners (5-year geometric mean, *range*)			**Natural Origin (5-year geometric mean)**			**% Natural Origin (5-year average)**		
Population	Listing (1991-1995)	Prior (1997-2001)	Current (2003-2008)	Listing (1991-1995)	Prior (1997-2001)	Current (2003-2008)	Listing (1991-1995)	Prior (1997-2001)	Current (2003-2008)
Snake River Fall Chinook	n/a	2164 (962-9875)	11321 (7784-17266)	n/a	1055 (306-5163)	2291 (1762-2983)	n/a	51%	22%

The driving factors for the recent increase (Figure 20) may include reduced harvest rates, improved inriver rearing and migration conditions, the development of life-history adaptations to current conditions, improved ocean conditions benefiting the relatively northern migration pattern, the supplementation program, or other factors. At this time, there is insufficient information to estimate the relative contributions of these factors.

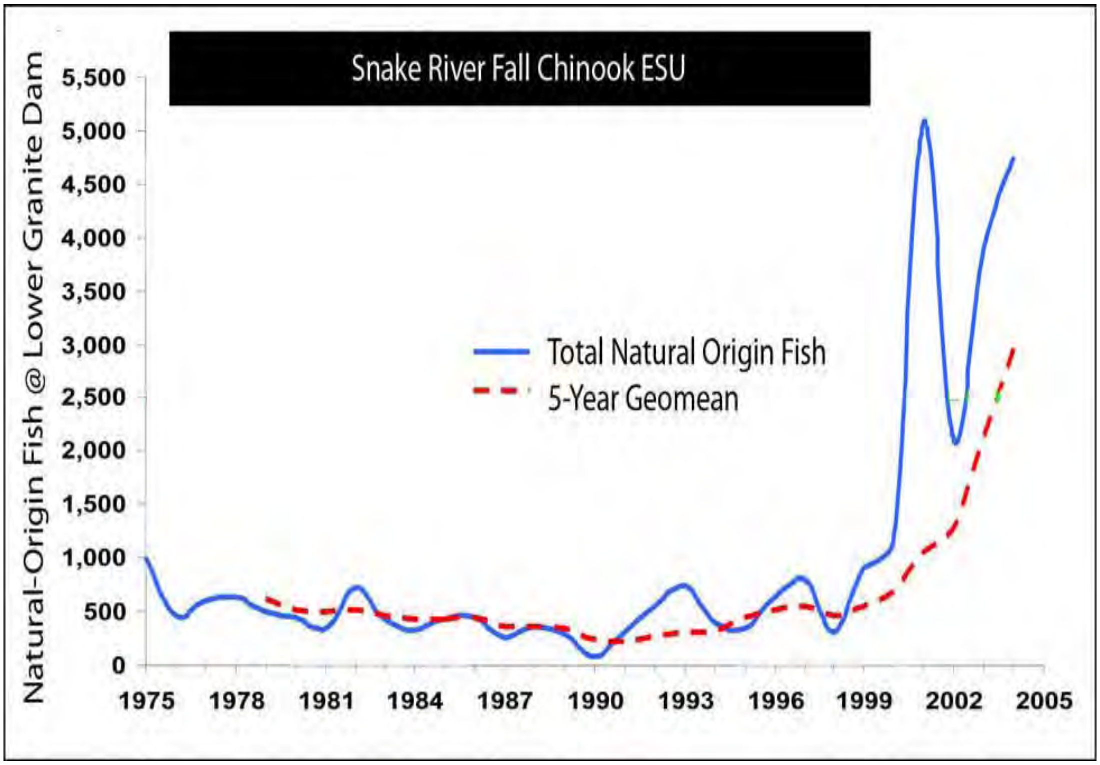

Figure 20. Snake River fall-run Chinook salmon Evolutionarily Significant Unit Abundance trends (NMFS 2008b).

Productivity. On average, over the last 23 full brood-year returns (1977-1999 brood years, including adult returns through 2004), when only natural production is considered, SR fall Chinook salmon populations have not replaced themselves. Returns per spawner productivity was below 1.0 for all but three brood years prior to 1995, and it was above 1.0 between 1995 and 1999 (Cooney and Ford 2007). Additionally, Cooney and Ford (2007) make preliminary estimates for the 2000-2003 brood years, half of which also indicate R/S >1.0.

The ICTRT recommends calculating population productivity (expected spawner-to-spawner return rate at low-to-moderate parent escapements) using the 20 most recent brood years. Previous status reviews for SR fall-run Chinook salmon included estimates based on a more recent time series to account for potential major, but unquantified, changes in downstream passage conditions (enhanced flows and transport regimes) initiated in 1990.

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at <5 percent extinction risk (ICTRT 2007).

The BRT trend in abundance was >1.0 during the 1980-2004 period. Median population growth rate (lambda), when calculated with an assumption that hatchery-origin natural spawners do not reproduce effectively (HF=0), also was greater than 1.0 (increasing) for

SR fall-run Chinook salmon. When calculated with the HF=1 assumption, lambda has been less than 1.0.

The updated productivity based on the 1990 to present series was 1.28. The estimate for the longer series (1983-2003) brood years was 1.07 (Table 14). When the current natural spawning escapement estimate of 2,200 is combined with either of the productivity estimates, the result is a "moderate" risk rating for the ESU with respect to both abundance and productivity. However, NMFS noted that there is considerable uncertainty in both the abundance and productivity estimates due to the inability to discriminate between hatchery and naturally produced fish.

Table 14. Viability assessments for Snake River fall-run Chinook salmon populations. Updated to reflect return years through 2009 (table reproduced from Ford et al. 2010)

	Abundance/Productivity Metrics				Spatial Structure and Diversity Metrics			
Population	ICTRT Minimum Threshold	Natural Spawning Abundance	ICTRT Productivity	Integrated A/P Risk	Natural Processes Risk	Diversity Risk	Integrated SS/D Risk	**Overall Viability Rating**
Snake River Fall Chinook	3000	2208 (905-5163)			Low	Moderate	Moderate	Maintained
1990-2004			1.28 (0.82-1.63)	Moderate				
1985-2004			1.07 (0.93-1.75)	Moderate				

Spatial Structure. The ICTRT does not yet characterize the spatial structure risk to SR fall-run Chinook salmon, although generic spatial structure criteria have been described in ICTRT (2007). However, the BRT (Good et al. 2005) characterizes the risk for the "distribution" VSP factor as "moderately high" because approximately 85 percent of historical habitat is inaccessible and the distribution of the extant population makes it relatively vulnerable to variable environmental conditions and large disturbances.

Diversity. The ICTRT has not yet characterized the diversity risk to SR fall-run Chinook salmon, although generic diversity criteria and the presence of five major spawning areas within currently occupied habitat are described in ICTRT (2007). However, the BRT (Good et al. 2005) characterizes the risk for the diversity VSP factor as "moderately high" because of the loss of diversity associated with extinct populations and the significant hatchery influence on the extant population. The median proportion of hatchery-origin has been approximately 68 percent over the past two brood cycles.

ESU Summary

SR fall-run Chinook salmon abundance has increased substantially since they were listed. The pattern for population productivity is less certain because of imprecision in the underlying data and the lack of metric standardization for the effects of density dependence on recruitment performance. In light of this evidence, the population remains at a moderate risk of going extinct (probability between 5 percent and 25 percent in 100 years). The extant population of SR fall-run Chinook salmon is the only one remaining from an ESU that historically included two large mainstem populations upstream of the current location of the Hells Canyon Dam complex. The recent increases in natural-origin abundance are encouraging. However, hatchery-origin spawner proportions have increased dramatically in recent years–on average, 78 percent of the estimated adult spawners have been hatchery origin over the most recent brood cycle.

Given the combination of current ratings for abundance/productivity and spatial structure/diversity summarized above, the SR fall-run Chinook salmon ESU is rated at moderate risk relative to ICTRT criteria. There is a high level of uncertainty associated with the overall rating for this population, primarily driven by uncertainties regarding current average natural-origin abundance and productivity levels. It is difficult to separate variations in ocean survival from potential changes in hydropower impacts without comparative measures of juvenile passage survivals under current operations or a representative measure of ocean survival rates. Overall, the new information considered indicates an improvement in ESU abundance. However, uncertainty about population productivity and the large proportion of hatchery-origin returns indicate that the biological risk category has not changed since the last status review.

4.2.6 Snake River Sockeye Salmon

NMFS listed SR sockeye salmon as an endangered species on November 20, 1991 (56 FR 58619), and their endangered status was reaffirmed on June 28, 2005 (70 FR 37160). The ESU includes all anadromous and resident sockeye salmon from the Snake River basin (SRB), Idaho (extant populations occur only in the Stanley Basin), as well as residual sockeye salmon in Redfish Lake, Idaho, and one captive propagation hatchery program. Artificially propagated sockeye salmon from the Redfish Lake captive propagation program are considered part of the ESU. In 1993, NMFS determined that the residual population of SR sockeye that exists in Redfish Lake is substantially reproductively isolated from kokanee (i.e., nonanadromous populations *of O. nerka* that become resident in lake environments over long periods of time), represents an important component in the evolutionary legacy of the biological species, and thus was included in the SR sockeye ESU (70 FR 37160). The SR sockeye salmon hatchery program has not changed substantially from the previous ESA status review. Jones et al. (2011) did not recommend further review of this program.

There are five populations in this ESU (Figure 21). However, four historical populations are extirpated (Alturas Lake, Pettit Lake, Yellowbelly Lake, and Stanley Lake). Therefore, the single extant historical population of SR sockeye salmon is currently restricted to Redfish Lake in the Sawtooth Valley. At the time of listing in 1991, the only confirmed population that belonged to this ESU was the beach-spawning population of sockeye from Redfish Lake. Historical records indicate that sockeye once occurred in several other lakes in the Stanley Basin but no adults were observed in these lakes for many decades and once residual sockeye salmon were observed, their relationship to the Redfish Lake population was uncertain (McClure et al. 2005). Since listing, progeny of

Redfish Lake sockeye have been outplanted to Pettit and Alturas lakes within the Sawtooth Valley.

The Stanley Basin and Sawtooth Valley lakes are relatively small compared to other lake systems that historically supported sockeye production in the Columbia Basin. Stanley Lake is assigned to the smallest size category, along with Pettit and Yellowbelly Lakes. Redfish Lake and Alturas Lake fall into the next size category–intermediate. The average abundance targets recommended by the Snake River Recovery Team (Bevan et al. 1994) were incorporated as minimum abundance thresholds into a sockeye viability curve. It was generated using historical age structure estimates from Redfish Lake sampling in the 1950s-1960s, and year-to-year variations in brood-year replacement rates generated from abundance series for Lake Wenatchee sockeye. The minimum spawning abundance threshold is set at 1,000 for the Redfish and Alturas Lake populations (intermediate category), and at 500 for populations in the smallest historical size category (e.g., Alturas and Pettit Lakes). The ICTRT recommended that long-term recovery objectives should include restoring at least three of the lake populations in the ESU to viable or highly viable status.

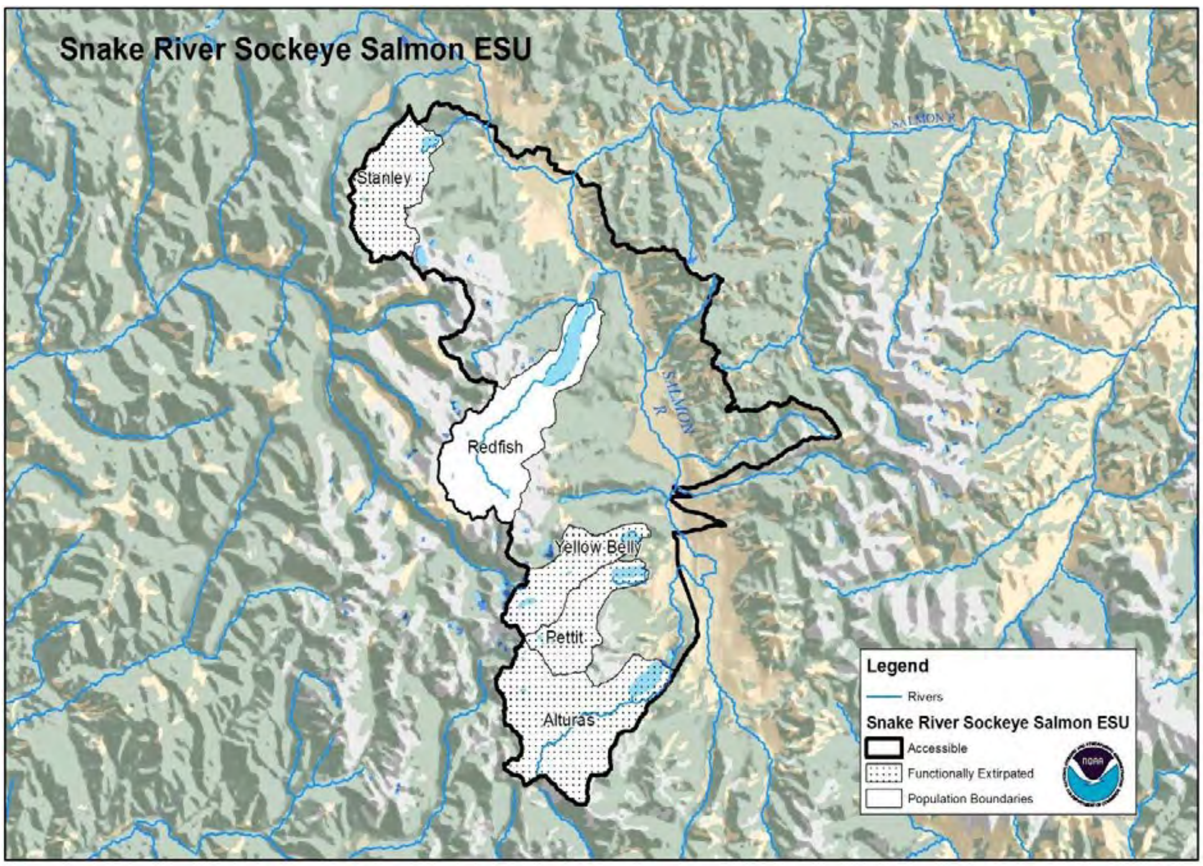

Figure 21. Snake River Sockeye Salmon ESU population structure.

Life History. Chapter 6 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Snake River sockeye salmon adults enter the Columbia River primarily during June and July. Arrival at Redfish Lake, which now supports the only remaining run of SR sockeye salmon, usually occurs in August, and spawning occurs primarily in October (Bjornn et al. 1968). Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for 3 to 5 weeks, emerge in April through May, and move immediately into the lake. Once there, juveniles feed on plankton for 1 to 3 years before they migrate to the ocean. Migrants leave Redfish Lake from late April through May (Bjornn et al. 1968) and travel almost 900 miles to the Pacific Ocean. Smolts reaching the ocean remain inshore or within the influence of the Columbia River plume during the early summer months. SR sockeye salmon usually spend 2 to 3 years in the Pacific Ocean and return in their fourth or fifth year of life.

Snake River sockeye salmon are unique. Sockeye salmon returning to Redfish Lake in Idaho's Stanley Basin travel a greater distance from the sea (approximately 900 miles) to a higher elevation (6,500 feet) than any other sockeye salmon population and are the southern-most population of sockeye salmon in the world (Bjornn et al. 1968). Stanley Basin sockeye salmon are separated by 700 or more river miles from two other extant upper Columbia River populations in the Wenatchee River and Okanogan River drainages. These latter populations return to lakes at substantially lower elevations (Wenatchee at 1,870 feet, Okanogan at 912 feet) and occupy different ecoregions.

Five lakes in the Stanley Basin historically contained sockeye salmon—Alturas, Pettit, Redfish, Stanley, and Yellowbelly (Bjornn et al. 1968). It is generally believed that adults were prevented from returning to the Sawtooth Valley from 1910 to 1934 by Sunbeam Dam. Sunbeam Dam was constructed on the Salmon River approximately 20 miles downstream of Redfish Lake. Whether or not Sunbeam Dam was a complete barrier to adult migration remains unknown. It has been hypothesized that some passage occurred while the dam was in place, allowing the Stanley Basin population to persist (Bjornn et al. 1968, Waples 1991). Adult returns to Redfish Lake during the period of 1954 through 1966 ranged from 11 to 4,361 fish (Bjornn et al. 1968). Sockeye salmon in Alturas Lake were extirpated in the early 1900s as a result of irrigation diversions, although residual sockeye may still exist in the lake (Chapman and Witty 1993). From 1955-1965, the Idaho Department of Fish and Game eradicated sockeye salmon from Pettit, Stanley, and Yellowbelly lakes, and built permanent structures on each of the lake outlets that prevented reentry of anadromous sockeye salmon (Chapman and Witty 1993). In 1985, 1986, and 1987, 11, 29, and 16 sockeye, respectively, were counted at the Redfish Lake weir (Good et al. 2005). Only 18 natural-origin sockeye salmon have returned to the Stanley Basin since 1987. The first adult returns from the captive brood stock program returned to the Stanley Basin in 1999. From 1999 through 2005, a total of 345 captive brood program adults that had migrated to the ocean returned to the Stanley Basin.

Population Trends and Risks. NMFS proposed an interim recovery level of 2,000 adult SR sockeye salmon in Redfish Lake and two other lakes in the Snake River basin. Limiting factors identified for SR sockeye include: (1) Reduced tributary streamflow; (2) impaired passage; and (3) mainstem lower Columbia hydropower system mortality (NMFS 2005).

Abundance. Low numbers of adult SR sockeye salmon preclude a CRI- or QAR-type quantitative analysis of the status of this ESU. Because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley basin between 1990 and 2000, however, NMFS considers the status of this ESU to be dire under any criteria.

Recent annual abundances of natural-origin sockeye salmon in the Stanley Basin have been extremely low. No natural-origin anadromous adults have returned since 1998 and the abundance of residual sockeye salmon in Redfish Lake is unknown. This species is entirely supported by adults produced through the captive propagation program at the present time. Current smolt-to-adult survival of sockeye originating from the Stanley Basin lakes is rarely greater than 0.3 percent. The current average productivity likely is substantially less than the productivity required for any population to be at low (1-5 percent) extinction risk at the minimum abundance threshold. The ICTRT determined that the Snake River sockeye salmon remains in danger of extinction (Good et al. 2005).

The 2005 BRT review included a summary of adult returns through the 2002 run year. Estimates of annual returns are now available through 2009. Adult returns in 2008 and 2009 were the highest since the current captive brood based program began with a total of 650 and 809 adults counted back to the Stanley Basin (Ford et al. 2010). Approximately two-thirds of the adults captured in each year were taken at the Redfish Lake Creek weir, the remaining adults were captured at the Sawtooth Hatchery weir on the mainstem Salmon River upstream of the Redfish Lake Creek confluence. Returns for 2003-2007 were relatively low, similar to the range observed between 1987 and 1999.

The average abundance targets recommended by the Snake River Recovery Team (Bevan et al. 1994) were incorporated as minimum abundance thresholds into a sockeye viability curve. It was generated using historical age structure estimates from Redfish Lake sampling in the 1950s-1960s, and year-to-year variations in brood-year replacement rates generated from abundance series for Lake Wenatchee sockeye. The minimum spawning abundance threshold is set at 1,000 for the Redfish and Alturas Lake populations (intermediate category), and at 500 for populations in the smallest historical size category (e.g., Alturas and Petit Lakes). The ICTRT recommended that long-term recovery objectives include restoring at least three of the lake populations in the ESU to viable or highly viable status.

Increased returns in recent years have supported substantial increases in the number of adults released above the Redfish Lake Creek weir in recent years (Table 15). Annual adult releases since 2003 have ranged from 173 to 969 compared to the range for the 5-year period ending in 2002 (0 to 190 sockeye). The large increases in returning adults in recent years reflects improved downstream and ocean survivals as well as increases in juvenile production since the early 1990s (Table 15). Presmolt outplants into Redfish, Alturas, and Petit Lakes were initiated in the mid-1990s; releases have averaged approximately 80,000 per year since 1995. On average, approximately 30,000 per year of the presmolt releases are detected leaving the three lakes the following spring. Direct smolt plants in the lower section of Redfish Lake Creek and in the Salmon River (Sawtooth weir) have increased to over 100,000 per year. The number of captive reared or returning anadromous adults allowed to pass over the Redfish Lake weir or outplanted into the lake has also increased substantially in recent years. Unmarked juvenile migrants emigrating from the three lake systems have also dramatically increased in recent years – annual estimates have ranged from 16,000 to 61,000 over the 2005 through 2009 outmigrations. Estimates of the total annual outmigration across all of these components have ranged from 143,500 to 210,300 during the most recent 5-year period (2005-2008) compared to a range of 19,600-146,300 for 1998-2002, the period corresponding to the 2005 BRT review.

Table 15. Estimated annual numbers of smolt outmigrants from the Stanley Basin. Includes hatchery smolt releases, known outmigrants originating from hatchery presmolt outplants, and estimates of unmarked juveniles migrating from Redfish, Alturas, and Stanley Lakes. Data for All Lakes Combined.

Year	# of pre-smolts planted	Estimated outmigration from pre-smolt plants	# of smolts planted	# of pre-spawn adults planted	# of eyed-eggs planted	Estimated unmarked outmigration	Total estimated outmigration
1993	0	0	0	20	0	569	569
1994	14,119	0	0	65	0	1,820	1,820
1995	91,572	823	3,794	0	0	357	4,974
1996	1,932	14,715	11,545	120	105,000	923	27,183
1997	255,711	401	0	120	105,767	304	705
1998	141,871	61,877	81,615	0	0	2,799	146,291
1999	40,271	38,750	9,718	21	20,311	3,108	51,576
2000	72,114	12,716	148	271	65,200	6,502	19,621
2001	106,166	16,595	13,915	79	0	1,991	32,501
2002	140,410	25,716	38,672	190	30,924	8,156	72,544
2003	76,788	26,116	0	315	199,666	4,952	31,068
2004	130,716	22,244	96	241	49,134	5,660	28,000
2005	72,108	61,474	78,330	173	51,239	22,135	161,939
2006	107,292	33,401	86,052	464	184,596	61,312	180,765
2007	82,105	25,848	101,676	494	51,008	16,023	143,547
2008	84,005	28,269	150,395	969	67,984	22,240	200,904
2009	59,538	24,852	173,055	1,349	72,478	12,429	210,336

Spatial Structure and Diversity. Ford et al. (2010) did not provide any updated information on the spatial structure/diversity metric for SR sockeye salmon. It is unlikely that these metrics have changed since the last status review.

ESU Summary

The sockeye captive broodstock program has met its initial objectives by preventing the extinction of the ESU in the short term and preventing any further loss of genetic diversity. In recent years, the numbers of returning adults have exceeded those needed for broodstock collection. Therefore, the program has initiated efforts to evaluate alternative supplementation strategies in support of reestablishing natural production of anadromous sockeye. These include releasing adults to spawn naturally, planting boxes with eyed-eggs for incubation and early rearing, and releasing hatchery-reared smolts for volitional emigration from the Sawtooth Valley lakes. Limnological studies are being conducted to determine production potentials in three of the Sawtooth Valley lakes that are candidates for sockeye restoration. The Corps of Engineers was able to initiate studies of survival of marked SR sockeye smolts through the mainstem Federal Columbia River Power System (FCRPS) in 2010. Prior to this, the survival of unlisted sockeye from the Upper Columbia ESU through the lower Columbia reach has been extrapolated to the Snake River to estimate the relative effectiveness of inriver improvements (e.g., surface bypass) versus transport operations in supporting efforts to increase the viability of the ESU. Although the captive brood program has been successful in providing substantial numbers of hatchery sockeye for supplementation efforts, reestablishing sustainable natural production will require substantial increases in survival rates across all life-history stages. The increased abundance of hatchery reared SR sockeye reduces the risk of immediate extinction, but levels of naturally produced sockeye returns remain extremely low.

Although the status of the SR sockeye salmon ESU appears to be improving, this ESU remains at a high risk of extinction. Recent returns are still a fraction of historic abundance and substantial increases in survival rates across all life-history stages must occur in order to reestablish sustainable natural production. The new information considered does not indicate a change in the biological risk category since the time of the last status review (Ford et al 2010).

4.2.7 Snake River basin Steelhead

The NMFS listed SR steelhead as a threatened species on August 18, 1997 (62 FR 43937), and protective regulations were issued under Section 4(d) of the ESA on July 10, 2000 (65 FR 42422). Their threatened status was reaffirmed on June 28, 2005 (70 FR 37160). The DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho. Six artificial propagation programs are considered part of the DPS—the Tucannon River, Dworshak NFH, Lolo Creek, North Fork Clearwater, East Fork Salmon River, and the Little Sheep Creek/Imnaha River Hatchery steelhead hatchery programs (71 FR 834). The ICTRT (2007) identified 26 populations in the following six MPGs for this species—Clearwater River, Grande Ronde

River, Hells Canyon, Imnaha River, Lower SR, and Salmon River. The North Fork population in the Clearwater River is extirpated. The ICTRT noted that SRB steelhead remain spatially well distributed in each of the six major geographic areas in the SRB (Good et al. 2005). Environmental conditions are generally drier and warmer in these areas than in areas occupied by other steelhead species in the Pacific Northwest. Snake River basin steelhead were blocked from portions of the upper SR beginning in the late 1800s and culminating with the construction of Hells Canyon Dam in the 1960s.

For the purposes of reproduction, salmon and steelhead typically exhibit a metapopulation structure (Schtickzelle and Quinn 2007, McElhany et al. 2000). Rather than interbreeding as one large aggregation, ESUs and DPSs function as a group of demographically independent populations separated by areas of unsuitable spawning habitat. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For the purposes of recovery planning and development of recovery criteria, the ICTRT identified independent populations for each SR ESA-listed species, and grouped them together into genetically similar major population groups (MPGs) (ICTRT 2003). The SR steelhead DPS is comprised of five extant MPGs with 24 extant populations—Clearwater River, Grande Ronde River, Imnaha River, Lower Snake River, and the Salmon River (Figure 22). The SR basin steelhead DPS also includes the Hells Canyon Tributaries MPG but does not contain an extant population and therefore is not expected to contribute to recovery of the DPS. This DPS consists of A-run steelhead which primarily return to spawning areas beginning in the summer and the larger sized B-run steelhead which begin the migration in the fall.

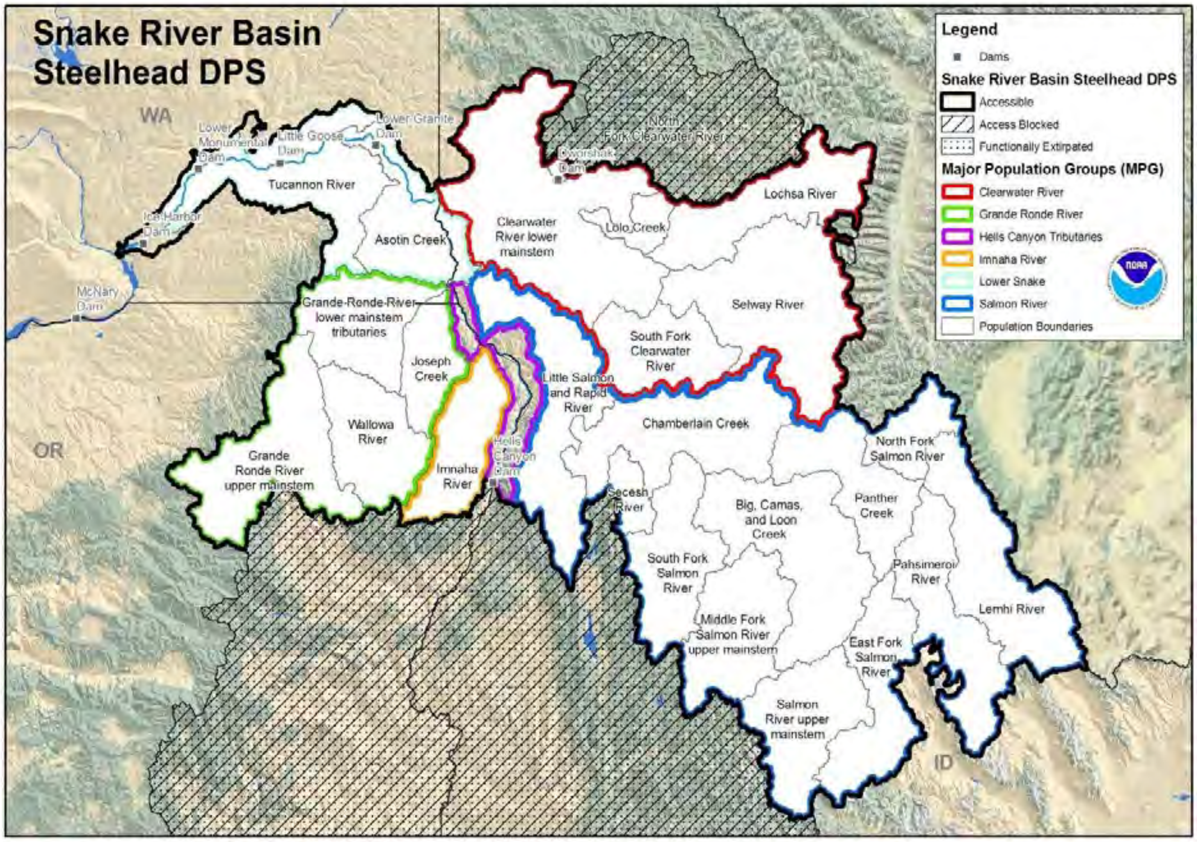

Figure 22. Snake River steelhead DPS population structure.

Clearwater River MPG

This MPG includes five extant and one extirpated (North Fork Clearwater River) populations. Three populations must meet viability criteria, one of which must meet the criteria for high viability. There are three populations that must achieve viable status, including the Clearwater lower mainstem (the only A-run life-history type), Lolo Creek (the only A/B-run life-history type) and South Fork Clearwater (the only intermediate-size population). Additionally, either the Lochsa River or Selway River population must be viable for the MPG to be considered viable, since the ICTRT criteria require at least two of the three large-size populations to be viable. Because the predominant historic production was from fish of B-run type life-history strategy and the entire North Fork Clearwater drainage is blocked to that type of production, the recovery planning objective in this MPG is to achieve viable status for the Lochsa River population. The Lochsa River population was selected because of greater ability to assess status using current monitoring programs. Those four populations that currently occupy historical habitat must be rated as viable for the MPG to be considered viable. All the remaining extant populations should be at a "maintained" status.

Grande Ronde River MPG

Two of the four populations must achieve viable status to meet the ICTRT criteria for this MPG. In addition, at least one of these populations must be rated as highly viable. The

ICTRT example scenario includes the Upper Grande Ronde River (large-size population), and either Joseph Creek (currently low-risk status) or the Lower Grande Ronde River be at viable status for the MPG to be rated viable.

Hells Canyon Tributaries MPG

This MPG historically contained three independent populations. However, all three of these populations were above Hells Canyon Dam (Powder River, Burnt River and Weiser River) and are now extirpated. A small number of steelhead occupy some tributaries below Hells Canyon Dam; however, none of these tributaries (nor all combined) appear to be large enough to support an independent population. Based on the extirpated status of populations in the MPG, it is not expected to contribute to recovery of the DPS.

Imnaha River MPG

This MPG contains one population. The Imnaha River population should meet highly viable status for this MPG to be rated as viable under the basic ICTRT criteria.

Lower Snake MPG

The Lower Snake MPG contains two populations. The ICTRT recommends that both populations (Tucannon River and Asotin Creek) be restored to viable status, with at least one meeting the criteria for highly viable.

Salmon River MPG

This relatively large MPG includes 12 extant populations. Two populations are characterized as large-size, ten are intermediate-size, and two are basic-size populations. The ICTRT recommends a minimum of six populations, at least four of which are intermediate-size and one large-size, and be at viable status for the MPG to be viable. At least one of the minimum six populations must be highly viable. The initial recovery planning objective targets the South Fork Salmon River, Secesh River, Chamberlain Creek, and Upper Middle fork Salmon River populations to achieve viable status for the MPG. The South Fork Salmon River population was selected because of its genetic distinctiveness, historic B-run production potential, and lack of hatchery influence or effects. The Chamberlain Creek population (which includes fish spawning in French, Sheep, Crooked, Bargamin, and Sabe Creeks, the Wind River, and Chamberlain Creek) was delineated on the basis of life history and basin topography. All streams in this population are classified as supporting A-run steelhead. The Chamberlain Creek population was selected to represent wild A-run steelhead life-history strategy in the MPG. The Secesh River population, which includes the mainstem Secesh and its tributaries, is identified in the recovery planning objective because of its genetic distinctiveness, historic B-run production potential and lack of hatchery influence or effects. The Upper Middle Fork Salmon River population was selected because of its lack of hatchery influence and geographic separation from the previous three populations. At least two of the remaining populations must be rated viable for the Salmon River MPG to be rated viable.

Life History. Chapter 7 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

The Snake River steelhead ESU is distributed throughout the Snake River drainage system, including tributaries in southeast Washington, eastern Oregon, and north/central Idaho. Snake River steelhead migrate a substantial distance from the ocean (up to 930 miles) and use high-elevation tributaries (typically 3,300-6,600 feet above sea level) for spawning and juvenile rearing. Snake River steelhead occupy habitat that is considerably warmer and drier (on an annual basis) than other steelhead ESUs.

Snake River basin steelhead are generally classified as summer run, based on their adult run timing patterns. Summer steelhead enter the Columbia River from late June to October. After holding over the winter, summer steelhead spawn during the following spring (March to May). Managers classify upriver summer steelhead runs into two groups based primarily on ocean age and adult size upon return to the Columbia River. Those classified as A-run steelhead are predominately age-1 ocean fish, while B-run steelhead are larger, predominately age-2 ocean fish.

Unlike other anadromous *Oncorhynchus* species, some adult steelhead survive spawning, return to the sea, and later return to spawn a second time. After hatching, juvenile SR steelhead typically spend 2-3 years in freshwater before they smolt and migrate to the ocean, primarily between April and June. The SR steelhead B-run population levels remain particularly depressed.

Population Trends and Risks. The primary concern regarding SR steelhead identified in the 1998 status review was a sharp decline in natural stock returns beginning in the mid-1980s. Nine of 13 trend indicators were in decline in the mid-1980s, while 4 were increasing. In addition, Idaho Department of Fish and Game (IDFG) parr survey data indicated declines for both A-run and B-run steelhead in wild and natural stock areas. The high proportion of hatchery fish in the run was also identified as a concern, particularly because of the lack of information on the actual contribution of hatchery fish to natural spawning. The review recognized that some wild spawning areas have relatively little hatchery spawning influence including the Selway, lower Clearwater, and Middle, South Fork, and lower Salmon rivers. In other areas, such as the upper Salmon River, there is likely little or no natural production of locally native steelhead. The review identified threats to genetic integrity from past and present hatchery practices as a concern. A concern for the North Fork Clearwater stock was also identified. The stock is currently maintained through the Dworshak Hatchery program since Dworshak Dam blocks upstream migration. The 1998 review also highlighted concerns for widespread habitat degradation and flow impairment throughout the SRB and for substantial modification of the seaward migration corridor by hydroelectric power development on the Snake and mainstem Columbia rivers (Good et al. 2005). Limiting factors identified for the SRB steelhead include: (1) Mainstem lower Snake and Columbia River hydrosystem mortality; (2) reduced tributary streamflow; (3) altered tributary channel morphology; (4) excessive fine sediment in tributaries; (5) degraded tributary water quality; and (6) harvest- and hatchery-related adverse effects (NMFS 2005).

In March 2007, the ICTRT proposed minimum abundance thresholds for SRB steelhead populations. They represent the numbers that, taken together, may be needed for the population to be self-sustaining, or recovered, in its natural ecosystem. For SRB steelhead, the minimum abundance thresholds are 1,500 spawners each in the Upper Grande Ronde River and Lower Mainstem SR; 1,000 spawners in the Tucannon, Wallowa, Lower Grande Ronde, Imnaha, Selway, South Fork Salmon, Lochsa, Lemhi, Upper Salmon East Fork, Upper Salmon, Upper Middle Fork, Lower Middle Fork, Pahsimeroi, and Little Salmon rivers; and 500 spawners in the Asotin River, Joseph Creek, Lolo Creek, Chamberlain Creek, Panther Creek, Secesh River, and North Fork Salmon River (ICTRT 2007).

Abundance. Population-specific adult abundance is generally not available for SR steelhead due to difficulties conducting surveys in much of their range. To supplement the few population-specific estimates, the ICTRT used Lower Granite Dam counts of A-run and B-run steelhead and apportioned those to A-run and B-run populations proportional to intrinsic potential habitat. The ICTRT generated 10-year geometric mean abundance estimates for the Joseph Creek and Upper Grande Ronde populations in the Grande Ronde MPG and reported average A-run and average B-run abundance as an indicator for the other populations. Average abundance for the Joseph Creek population exceeds the ICTRT abundance threshold while average abundance for the Upper Grande Ronde population is below the threshold. For the other populations, both the A-run and B-run averages are below the average abundance thresholds that the ICTRT identifies as a minimum for low risk. Abundance for Grande Ronde populations, and the average A-run and B-run populations, declined to low levels in the mid-1990s, increased to levels at or above the recovery ICTRT abundance thresholds for a few years in the early 2000s, and are now at levels intermediate to those of the mid-1990s and early 2000s (Figure 23). Both populations with specific spawning abundance data series are in the Grande Ronde River MPG. The overall viability rating for the Joseph Creek population remained as highly viable after updating the analysis to include returns through the 2009 spawning year.

The most recent 5-year geometric mean total run (wild plus hatchery origin) to Lower Granite Dam was up substantially from the corresponding estimates for the prior BRT review and the time period leading up to listing (Table 16). Natural-origin and hatchery-origin returns each showed increases, although hatchery fish increased at a higher rate. Both the aggregate A- and B-run estimates have increased relative to the levels associated with prior assessments.

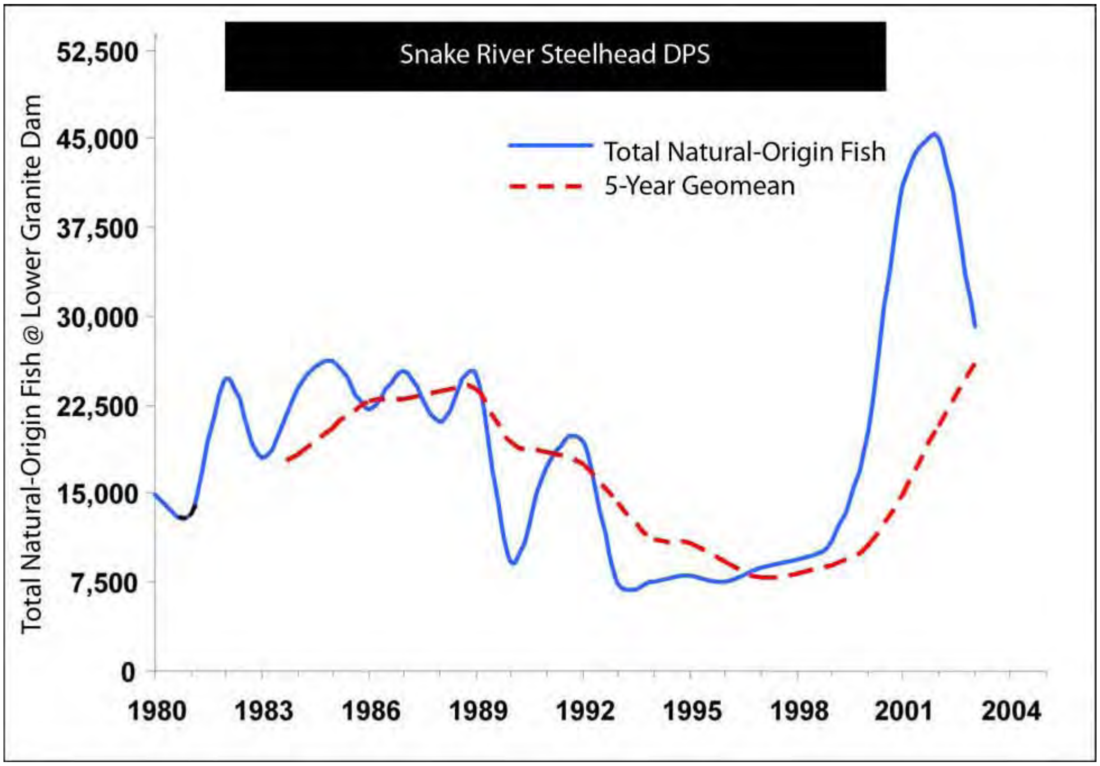

Figure 23. Snake River basin Steelhead Distinct Population Segment Abundance trends (NMFS 2008b).

Table 16. Recent abundance and proportion natural origin for aggregate returns of SR steelhead to Lower Granite Dam with comparisons to estimates at the time of listing and in the previous BRT review. Estimates represent run prior to upstream harvest and prespawning mortalities and include fish returning to hatchery racks as well as fish that will spawn in natural areas.

	Natural Spawning Areas								
	Total Spawners (5-year geometric mean, *range*)			**Natural Origin (5-year geometric mean)**			**% Natural Origin (5-year average)**		
Population	Listing (1991-1996)	Prior (1997-2001)	Current (2003-2008)	Listing (1991-1996)	Prior (1997-2001)	Current (2003-2008)	Listing (1991-1996)	Prior (1997-2001)	Current (2003-2008)
Joseph Creek	1337	2135 (1251-3171)	1925 (1212-3598)	1337	2134 (1251-3170)	1925 (1212-3597)	100%	100%	100%
Upper Grande Ronde River	1594	1772 (1084-2756)	1442 (949-1943)	1249	1332 (767-2277)	1425 (941-1943)	79%	76%	99%
LGR Run	77,761	85,343	162,323	11,462	10,693	18,847	15%	13%	10%
A-Run	61,727	70,130	144,230	8,869	8,888	15,395	14%	13%	11%
B-Run	15,104	14,491	33,056	2,505	1,718	3,291	17%	11%	10%

Figure 23 shows the 1980 to most recent abundance and 5-year geometric mean trends for the aggregate of all populations above Lower Granite Dam. The 5-year geometric mean increased from 1980, peaking in 1989 and decreasing throughout the 1990s. Aggregate abundance of natural-origin fish peaked in 2002 and the 5-year geometric mean has been increasing since 2000.

The ICTRT identified collecting population-specific estimates of annual abundance and obtaining information on the relative distribution of hatchery spawners at the population level as the main priorities for this DPS (ICTRT 2007). Two projects have been initiated to gain more specific data on the distribution of spawners among populations or geographic aggregations of populations. In addition, adult PIT-tag arrays are being installed in the lower sections of several watersheds, allowing for mark-recapture-based estimates for some population aggregates. The overall viability ratings for populations in the SR steelhead DPS range from moderate to high risk. Under the approach recommended by the ICTRT, the overall rating for a DPS depends on population-level ratings organized by MPG within that DPS. The increase in natural-origin abundance for the other population with a data series, the Upper Grande Ronde River, was not sufficient to change the abundance/productivity criteria rating from moderate risk.

Productivity. On average, over the last 20 full brood-year returns (1980-1999 brood years, including adult returns through 2006), A-run SR steelhead populations replaced themselves when only natural production is considered, while B-run steelhead have not. In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in the most recent brood years (brood-year R/S estimates in ICTRT Current Status Summaries).

Intrinsic productivity, which is the average of adjusted R/S estimates for only those brood years with the lowest spawner abundance levels, has been lower than the intrinsic productivity R/S levels identified by the ICTRT as necessary for long-term population viability at <5 percent extinction risk for average A-run and average B-run populations (ICTRT 2007). However, of the two individual Grande Ronde populations with sufficient data for estimates, Joseph Creek had sufficient intrinsic productivity to meet the ICTRT viability criteria and the Upper Grande Ronde did not.

In summary, abundance has been stable or increasing for A-run SR steelhead over the last 20 brood years, based on R/S, lambda, and BRT trend estimates >1.0. An exception is the Upper Grande Ronde population under one assumption for lambda. For B-run SR steelhead populations, natural survival rates are not sufficient for spawners to replace themselves each generation, as indicated by average R/S estimates less than 1.0, but abundance has been increasing, as indicated by lambda and BRT trend.

Spatial Structure. The ICTRT characterizes the spatial structure risk of nearly all SR steelhead populations as "very low" or "low." Panther Creek is an exception with "high" risk because only 30 percent of the historical range is occupied and there is a significant geographical distance between the single major spawning area for this population and the location of the next population. This is largely a result of past mining operations, which are being addressed through other processes, including the Environmental Protection Agency's Blackbird Mine Superfund Site cleanup.

Diversity. The ICTRT characterizes the diversity risk of all SR steelhead populations as "low" or "moderate."

Updated Risk Summary

The level of natural production in the two populations with long-term data series and the Asotin Creek index reaches is encouraging, but the status of most populations in this DPS remains highly uncertain. Population-level natural-origin abundance and productivity inferred from aggregate data and juvenile indices indicate that many populations are likely below the minimum levels defined by the ICTRT viability criteria. Uncertainty remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites. There is little evidence demonstrating a change in DPS viability from the most recent status review (Ford et al. 2010).

Clearwater MPG

Four of the populations in the Clearwater MPG have an overall viability rating of high risk (South Fork Clearwater, Lolo Creek, Selway River and Lochsa River). The Lower Mainstem Clearwater River has an uncertain overall viability rating of maintained. Therefore, due to these population viability ratings, the Clearwater MPG is not viable.

Grande Ronde River MPG

The Joseph Creek steelhead population has an overall viability rating of highly viable because of the abundance productivity rating of very low risk and the spatial structure and diversity rating of low risk. The Lower Grande Ronde River population does not have an overall viability rating because there is no population-specific abundance and productivity data. The Wallowa River population has an overall viability rating of high risk, though there is uncertainty associated with this rating. The Upper Grande Ronde population is rated as maintained. The ICTRT criteria recommend that a minimum of two populations achieve at least viable status for the MPG to be viable. Further, to meet the MPG viability criteria, one large and one intermediate population must meet or exceed population-level criteria; and one population in the MPG must meet highly viable criteria. Therefore, due to the population viability ratings, the Grande Ronde River MPG is not viable.

Imnaha River MPG

The Imnaha River MPG contains only one population. This population must be rated highly viable for the MPG to be considered viable according to ICTRT criteria. The ICTRT rated the Imnaha River population at moderate risk for abundance and productivity based on the uncertainty in abundance. Current data that is available for other VSP parameters, however, indicate that the population meets the criteria for a maintained population. However, this does not meet the criteria for a viable MPG because the population needs to be highly viable for the MPG to be viable. Therefore, the Imnaha MPG is not viable.

Lower Snake MPG

For the two populations in the Lower Snake MPG, the Tucannon River has an overall viability rating of high risk and the Asotin Creek population has uncertain viability rating of maintained using the ICTRT criteria. Based on these ratings, the Lower Snake MPG is not viable.

Salmon River MPG

Six of the 12 populations in this MPG have an overall viability rating of high risk (South Fork Salmon River, Secesh River, Chamberlain Creek, Lower Middle Fork Salmon River, Upper Middle Fork Salmon River, and Panther Creek). The remaining six populations are rated at maintained status (Little Salmon River, North Fork Salmon River, Lemhi River, Pahsimeroi River, East Fork Salmon River and Upper Mainstem Salmon River). Based on these ratings, the Lower Snake MPG is not viable.

DPS Summary

The viability ratings of the component populations in the Snake River steelhead DPS do not currently meet the ICTRT viability criteria for the DPS; the five MPGs should be at viable status for the DPS to be viable. Due to the high-risk population ratings, uncertainty about the viability status of many populations, and overall lack of population data, none of the MPGs are considered to be viable. Therefore, the DPS is not currently considered to be viable.

The level of natural production in the two populations with full data series and the Asotin Creek index reaches is encouraging, but the status of most populations in this DPS remains highly uncertain. Population-level natural-origin abundance and productivity inferred from aggregate data and juvenile indices indicate that many populations are likely below the minimum combinations defined by the ICTRT viability criteria. There is little evidence for substantial change in DPS viability relative to the previous status review. Although direct biological performance measures for this DPS indicate little realized progress to date toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly. The DPS remains well distributed throughout its current range in the Snake River basin and at least some populations are considered to be viable. Overall, the new information considered does not indicate a change in the biological risk category since the time of the 2010 status review (Ford et al. 2010). This DPS remains at moderate risk of extinction.

4.2.8 Columbia River Chum Salmon

On June 28, 2005, NMFS listed CR chum salmon—both natural and some artificially-propagated fish—as a threatened species (70 FR 37160). The ESU includes all naturally-spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon. Three artificial propagation programs are part of the ESU—the Chinook River (Sea Resources Hatchery), Grays River, and Washougal River/Duncan Creek Chum Hatchery Programs. A new chum hatchery program was initiated in 2010 at Big Creek Hatchery in Oregon to develop chum salmon for reintroduction into lower

Columbia River tributaries. This program will use broodstock collected in the Grays River, Washington, with the goal of developing a localized broodstock using returns to the Big Creek Hatchery and will be evaluated for membership in the ESU in the future. Under the final listing in 2005, the Section 4(d) protections, and limits on them, apply to natural and hatchery threatened salmon with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed. This document evaluates impacts on both listed natural and listed hatchery fish.

NMFS provided an updated status report on the Columbia River chum salmon ESU in 1999 (NMFS 1999). As documented in the 1999 report, the previous BRTs were concerned about the dramatic declines in abundance and contraction in distribution from historical levels. Previous BRTs were also concerned about the low productivity of the extant populations, as evidenced by flat trend lines at low population sizes. A majority of the 1999 BRT concluded that the Columbia River chum salmon ESU was likely to become endangered in the foreseeable future, and a minority concluded that the ESU was currently in danger of extinction.

The most recent status update for CR chum was in 2005 (Good et al. 2005). In the 2005 BRT, nearly all votes for the Columbia River chum salmon ESU fell in the “likely to become endangered” (63 percent) or “danger of extinction” (34 percent) categories. The BRT had substantial concerns about every VSP element. Most or all risk factors the BRT previously identified remain important concerns. The Willamette Lower Columbia Technical Recovery Team (WLC-TRT) estimated that close to 90 percent of this ESU’s historical populations are extinct or nearly so, resulting in loss of much diversity and connectivity between populations. The 2005 BRT was concerned that populations that remained are small, and overall abundance for the ESU was low. The ESU had shown low productivity for many decades, even though the remaining populations were at low abundance and density-dependent compensation might be expected. The BRT was encouraged that unofficial reports for 2002 suggested a large increase in abundance in some (perhaps many) locations, but was unclear on the cause of the increase and whether it would be sustaining for multiple years.

A report on the population structure of Lower Columbia salmon and steelhead populations was published by the WLC-TRT in 2006 (Myers et al. 2006). The chum population designations in that report were updated in the 2010 status review and were used for status evaluations in recent recovery plans by ODFW and Lower Columbia Fish Recovery Board (LCFRB). In 2010, ODFW completed a recovery plan that included Oregon populations of the Columbia River chum ESU. Consistent with previous BRT and other analyses (e.g. McElhany et al. 2007), the ODFW recovery plan concluded that chum are extirpated or nearly so in all Oregon Columbia River populations. A few chum are occasionally encountered during surveys or return to hatchery collection facilities, but they are likely either strays from one of the Washington populations or part of a few extremely small and erratic remnant populations.

The LCFRB completed a revision recovery plan in 2010 that includes Washington populations of Columbia River chum. This plan includes an assessment of the current status of CR chum populations. This assessment relied and built upon the viability criteria developed by the WLC-TRT (McElhany et al 2006) and an earlier evaluation of Oregon WLC populations (McElhany et al. 2007). This evaluation assessed the status of populations with regard to the VSP parameters of abundance and productivity, spatial structure, and diversity (McElhany et al. 2000). That analysis indicated that all of the Washington populations, with two exceptions, are in the overall "very-high-risk" category (also described as "extirpated or nearly so"). The Grays river population was considered to be at moderate risk and the Lower Gorge population at low risk. The very-high-risk status assigned to the majority of Washington populations (and all the Oregon populations) reflects the very low abundance observed in these populations (e.g. <10 fish/year).

A recovery plan for the lower Columbia River salmon ESUs and steelhead DPS is in development. NMFS issued a proposed ESA recovery plan for Lower Columbia River Chinook Salmon, Lower Columbia River Coho Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead on May 16, 2012 (77 FR 28855). The plan summarizes (and incorporate as appendices) locally developed recovery plans (ODFW 2010; LCFRB 2010) that address the Oregon portion and most of the Washington portion of the Lower Columbia ESUs and DPS. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For recovery planning and development of recovery criteria, the WLC-TRT developed recommendations at the scale of independent populations, strata, and ESUs. In addition to recommending recovery criteria, the WLC-TRT also recommended methods for evaluating population status, or extinction risk. The information below is based on these analyses and is summarized from Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Northwest (Ford et al. 2010).

Description and Geographic Range. The Columbia River chum salmon ESU consists of 17 historical populations in three strata—Coastal, Cascade, and Gorge (Figure 24). The Upper Gorge population includes the White Salmon subbasin (Myers et al. 2006; McElhany et al. 2003).

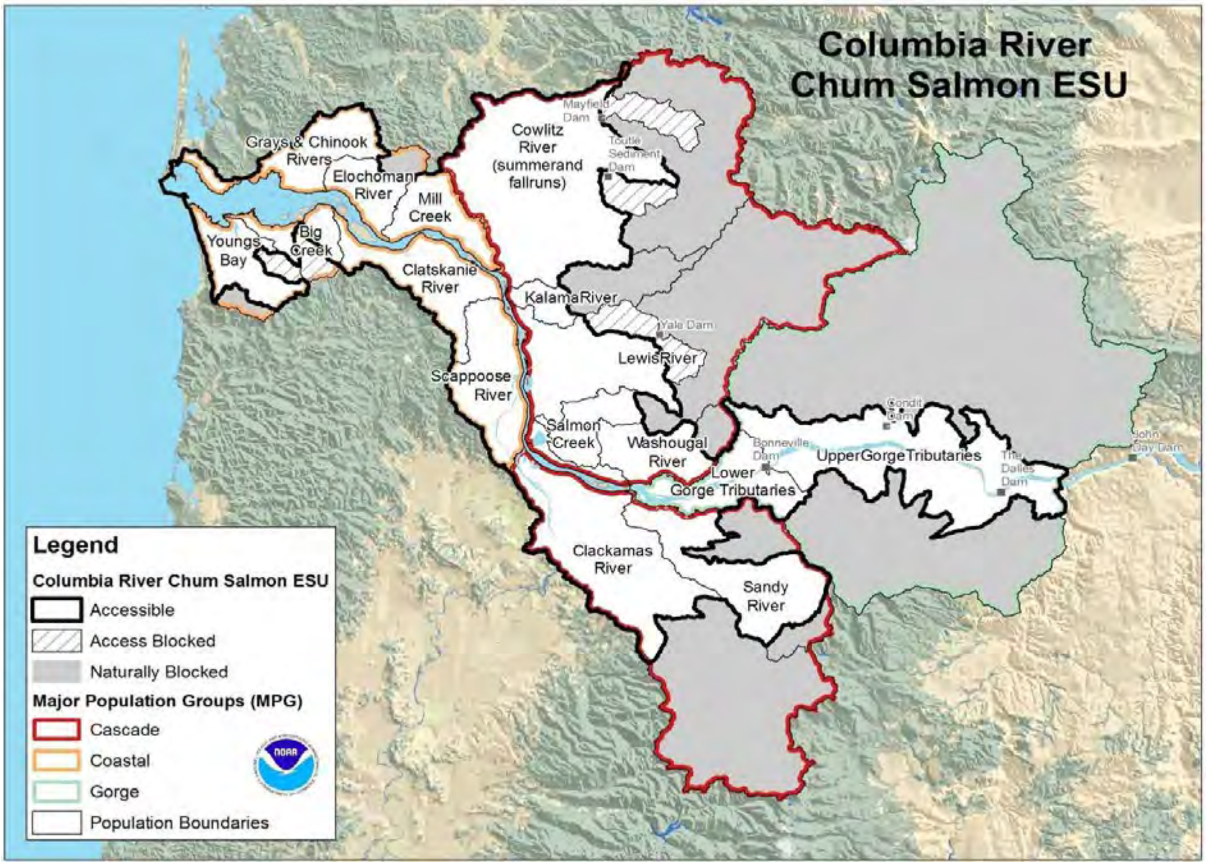

Figure 24. Columbia River Chum Salmon ESU population structure.

Life History. Chapter 11 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

The following brief description is based largely on life-history information and excerpts from the report of the LCFRB (2003) and the WLC-TRT's recent review of historical population structure for this ESU (Myers et al. 2003).

Intensive monitoring of chum spawning escapement is conducted in three Washington tributaries in the lower Columbia Basin. Currently, spawning populations of CR chum salmon are limited to tributaries below Bonneville Dam, with most spawning occurring in two areas on the Washington side of the Columbia River—Grays River, near the mouth of the Columbia River, and Hardy and Hamilton Creeks, approximately 3 miles below Bonneville Dam. Some chum salmon pass Bonneville Dam, but there are no known extant spawning areas in the Bonneville pool. Chum salmon populations exist in other river systems of the lower Columbia, but are not consistently monitored and are assumed to be extremely low in abundance.

Chum salmon returning to the Columbia River are considered a fall run. Adult fall run chum salmon return to the Columbia River from mid-October through November, but apparently do not reach the Grays River until late October-early December. Spawning occurs in the Grays River from early November to late December. Fish returning to Hamilton and Hardy Creeks begin to appear in the tributaries in early November and their spawn timing is more protracted (mid-November to mid-January). Adults typically mature as 4-year-olds, although age-3 and age-5 fish are also common (Fulton 1970).

Chum seldom show persistence in surmounting river blockages and falls, which may be why they usually spawn in lower river reaches. Chum salmon spawn typically dig their redds in the mainstem or in side channels of rivers from just above tidal influence to nearly 60 miles (100 km) from the sea. They spawn in shallower, slower-running streams and side channels more frequently than do other salmonids. In some locations, subgravel flow (upwelled groundwater from seeps and springs) may be important in the choice of redd sites by chum salmon. Many Columbia River chum have been found to select spawning sites in areas of upwelling groundwater. New spawning grounds for chum were recently discovered along the northern Columbia River shoreline near the Interstate-205 Glen Jackson Bridge where groundwater upwelling occurs. A significant number of chum returning to Hamilton Creek spawn in a spring-fed channel, and portions of the Grays River and Hardy Creek populations spawn in the area of springs. Hundreds of chum salmon once returned to spawn within spring-fed areas along Duncan Creek; efforts have been completed to restore passage to these productive areas and protect the springs that feed them.

Chum do not have a clearly defined smolt stage, but are nonetheless capable of adapting to seawater soon after emerging from gravel. Downstream migration may take only a few hours or days in rivers where spawning sites are close to the mouth of the river. Historical information concerning the timing of chum salmon emigration in the lower Columbia River is limited. Recent seining projects conducted in the Grays River and at Ives Island indicate outmigration occurs from March through May and peaks from mid-April to early May (Table 17).

Chum salmon juveniles, like other anadromous salmonids, use estuaries to feed before beginning long-distance oceanic migrations. However, chum and ocean-type Chinook salmon usually have longer residence times in estuaries than do other anadromous salmonids. The period of estuarine residence appears to be the most critical phase in the life history of chum salmon and may play a major role in determining the size of the subsequent adult run back to freshwater. Chum salmon spend more of their life history in marine waters than other Pacific salmonids. Juveniles feed primarily on plankton and epibenthic organisms, while subadults feed on similar items as well as larger prey (including fishes and squid). Most adults mature and spawn as 3-year-old fish.

Table 17. Lower Columbia River chum salmon life-history stages.

Life Stage	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Adult upstream migration												
Spawning												
Egg incubation												
Fry emergence												
Fry migration												

Habitat. Chum salmon prefer particular microhabitats for spawning and do not ascend falls or steep gradients like steelhead and other salmon. Overall, fish have been adversely affected by changes in access, streamflow, water quality, sedimentation, habitat diversity, channel stability, riparian conditions, and floodplain interactions. These large-scale changes have altered habitat conditions and processes important to migratory and resident fish and wildlife (NMFS 2006).

Habitat conditions for anadromous fish have been fundamentally altered throughout the Columbia River Basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control. CR chum salmon are adversely affected by hydrosystem-related flow and water quality effects, obstructed and/or delayed passage, and ecological changes in impoundments. For example, a large portion of the upper gorge chum habitat is believed to have been inundated by Bonneville Dam. Chum are affected to a lesser extent than other salmon and steelhead, but dams in many of the larger subbasins have blocked access to large areas of productive habitat (NMFS 2006).

Abundance. Historically, CR chum salmon supported a large commercial fishery that landed more than 500,000 fish per year, and chum salmon were reported in almost every river in the lower Columbia River Basin. However, most runs had disappeared by the 1950s. There are now no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho and Chinook salmon, and some tributaries support a minor recreational harvest. The estimated minimum run size for the Columbia River has been relatively stable, although at a very low level, since the run collapsed during the mid-1950s. Current abundance is probably less than 1 percent of historical levels, and the species has undoubtedly lost some (perhaps most) of its original genetic diversity.

Currently, the WDFW regularly monitors only a few natural “index” populations in the basin, one in Grays River, two in small streams near Bonneville Dam, and the mainstem area next to those two streams. Average annual natural escapement to the index spawning areas was approximately 1,300 fish from 1990 through 1998. The WDFW surveyed other (nonindex) areas in 1998 and found only small numbers of chum salmon (typically less than 10 fish per stream) in Elochoman, Abernathy, Germany, St. Cloud, and Tanner Creeks and in the North Fork Lewis and the Washougal Rivers. The State of Oregon does not conduct targeted surveys, so the current extent of chum salmon spawning on the Oregon side of the river is unknown. Recent estimates for the lower Columbia Gorge and Grays River chum salmon populations range from 3,000 to 18,500 adults (WDFW 2010b). The average spawner abundance based solely on these two populations is approximately 6,000 naturally produced adult CR chum salmon. The number of hatchery spawners is unknown.

WDFW (2010b) developed planning ranges for abundance of viable CR chum salmon populations (Table 18). ODFW (2010a) has not set abundance goals for historical populations in Oregon. Of the 17 historical populations in the CR chum ESU, all of the populations that occurred in Oregon are considered extirpated or nearly so (McElhany et al. 2007). The range of abundance goals for existing populations is from 900 to 2,000 fish (in the Lower Gorge population). Except for the Grays River, all of the populations are well below abundance targets. In 2008, the number of naturally produced chum salmon spawning in the Grays River was well above the abundance goal.

Table 18. Recovery goals for CR chum salmon populations (WDFW 2010a and 2010b).

Population	Contributing	Current Viability	Viability Goal	Current Abundance	Abundance Goal
Coast					
Grays	Primary	Low+	Very High	2,700	1,600
Elochoman	Primary	Low	High	<200	1,300
Mill Creek	Primary	V. Low	High	<100	1,300
Youngs Bay	Primary	Na	High	--	--
Big Creek	Contributing	Na	Low	--	--
Clatskanie	Contributing	Na	Med	--	--
Scappoose	Contributing	Na	Low	--	--
Cascade					
Cowlitz summer-run	Contributing	V. Low	Med	--	900
Cowlitz fall-run	Contributing	V. Low	Med	<300	900
Kalama	Contributing	V. Low	Low	<100	900
Lewis	Primary	V. Low	High	<100	1,300
Salmon	Stabilizing	V. Low	V. Low	<100	--
Washougal	Primary	Low	High+	<100	1,300
Clackamas	Contributing	Na	Med	--	--
Sandy	Primary	Na	High	--	--
Gorge					
Lower Gorge	Primary	Med+	High+	223	2,000
Upper Gorge	Contributing	V. Low	Med	<50	900

It is difficult to accurately estimate juvenile CR chum abundance. The NW Fisheries Science Center began calculated outmigration estimates for naturally produced juvenile CR chum in 2008. With only 2 years of data, NMFS has chosen not to use an average but instead to use the 2009 estimated outmigration as an indicator of what could be expected in 2010. In 2009, 8,461,800 naturally-produced smolts were estimated to reach Tongue Point in the Columbia River (Ferguson 2009b). Additionally, an average of 349,250 unmarked listed hatchery CR chum smolts reached the same point in the lower Columbia River for the years 2006-2009 (Ferguson 2006, 2007, 2009a, 2009b). In 2010, chum salmon fry were observed outmigrating past Bonneville Dam for the first time (the progeny of adult chum migrating above Bonneville Dam to the Upper Gorge population area) (Ford et al. 2010).

Productivity. Trends and growth rate for CR chum salmon are difficult to determine because 14 of the 16 historical populations are extirpated, or nearly so. The two extant populations are at Grays River and the lower Columbia Gorge. The majority of chum salmon spawning in the Grays River currently occurs in less than 1.1 km of the river. Previous to its destruction in a 1998 flood, approximately 50 percent of the Grays River population spawning occurred in an artificial spawning channel created by the WDFW in 1986. Data from a WDFW analysis conducted in 2000 shows a small upward trend from 1967 to 1998, and a low probability that the population is declining. However, a longer data set indicates that both long- and short-term trends are negative over the period 1950–2000, with a high probability that the trend and growth rate are less than one. Data from the Gorge populations showed a downward trend since the 1950s and a relatively low abundance up to 2000. However, preliminary data indicate that the 2002 abundance showed a substantial increase, estimated to be more than 2,000 chum salmon in Hamilton and Hardy Creeks, plus another 8,000 or more in the mainstem. Overall, due to a limited number of populations and low abundance, CR chum salmon productivity is low (Good et al. 2005).

Spatial Structure and Diversity. The WLC-TRT partitioned CR chum salmon into three strata based on ecological zones. Ecological zones range from areas at the mouth of the Columbia River that are influenced by the ocean to the Columbia River gorge above Bonneville Dam. The WLC-TRT analysis suggests that a viable ESU would need multiple viable populations in each stratum. The strata and associated populations are identified in Table 19 (Good et al. 2005).

Table 19. Historical Population Structure and Abundance of CR Chum Salmon.

Ecological Zone	Population	Status
Coastal	Youngs Bay	Functionally Extirpated
	Grays River	Depressed
	Big Creek	Functionally Extirpated
	Elochoman River	Functionally Extirpated
	Clatskanine River	Functionally Extirpated
	Mill, Abernathy, Germany Creeks	Functionally Extirpated
	Scappoose Creek	Functionally Extirpated
Cascade	Cowlitz River	Functionally Extirpated
	Kalama River	Functionally Extirpated
	Lewis River	Functionally Extirpated
	Salmon Creek	Functionally Extirpated
	Clackamas River	Functionally Extirpated

Ecological Zone	Population	Status
	Sandy River	Functionally Extirpated
	Washougal River	Functionally Extirpated
Columbia Gorge	Lower gorge tributaries	Depressed
	Upper gorge tributaries	Functionally Extirpated

Assessments conducted as part of recovery planning since the last status review indicate that spatial structure within most Washington chum salmon populations is moderate to good (Ford et al. 2010). However, methods for evaluating spatial structure of chum salmon populations may incompletely consider their microhabitat requirements, making the assessments imprecise. Assessments also show that most Washington chum salmon populations are at high risk for diversity. Diversity and spatial structure of Oregon chum salmon populations has not been assessed since the last status review. Genetic studies since the previous review also indicate that a summer-run chum salmon population existed historically in the Cowlitz River, where summer-run chum salmon are occasionally observed. These genetic analyses suggest that Cowlitz summer chum salmon should be considered a historical population in the Columbia River chum ESU. This population is a unique life history in the ESU and represents an important component of ESU diversity (Ford et al. 2010).

Substantial spawning occurs in only two of the 17 historical populations, meaning 88 percent of the historical populations are extirpated, or nearly so. The two extant populations, Grays River and the lower gorge population, appear to contain only a fraction of the wild historic abundance. Both populations have benefited from artificial spawning channels constructed to provide habitat that is lacking in the Columbia River.

A large portion of the upper gorge chum population is believed to have been inundated by Bonneville Dam. The WDFW and ODFW conducted surveys to determine the distribution and abundance of chum salmon in the lower Columbia. Very small numbers were observed in several locations in Washington; one chum salmon was observed in Oregon out of 30 sites surveyed (Good et al. 2005).

The leading factor affecting CR chum salmon diversity is the extirpation (or nearly so) of 14 of the 16 historical populations. The remaining populations are at low abundance, although increases in the early 2000s are encouraging. Chum run-timing is rather fixed, compared to other salmon and steelhead, and thus may not help improve the overall diversity of the ESU.

Hatchery programs are established for CR chum, in the Chinook, Grays, and Washougal Rivers, but it is unknown how they have affected natural CR chum salmon. Chum are released at a small size; thus, are not externally marked before release (though many are otolith marked). CR chum salmon diversity may not be adversely affected by hatchery releases because the releases have been relatively small and intermittent compared to other stocks in the Columbia River (McElhaney et al. 2004).

ESU Summary

None of the Columbia River chum ESU's three strata meet recovery criteria; most (14 out of 17) chum populations remain at very high risk. The Grays River and Lower Gorge populations showed sharp increases in adult abundance in 2002, but have since declined back to relatively low levels, within the range of variation observed over the last several decades. Chinook and coho salmon populations in the Lower Columbia and Willamette rivers showed similar increases in the early 2000s followed by declines to recent levels, suggesting the increase in chum salmon abundance is due to factors common to several species and may be related to ocean conditions. The WDFW surveys the mainstem Columbia component (under the I-205 Bridge) of the Lower Gorge chum salmon population, but recent data were not available in time to analyze for the 2010 status review. NMFS suspects that these spawners follow a pattern similar to the Grays and other components of the Lower Gorge population.

Overall, the new information does not indicate a change in the biological risk category since the time of the 2010 status review (Ford et al. 2010). Although this ESU has made little progress toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly.

4.2.9 Lower Columbia River Chinook Salmon

On June 28, 2005, NMFS listed LCR Chinook salmon—both natural and some artificially propagated fish—as a threatened species (70 FR 37160). The ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River (64 FR 14208). Seventeen artificial propagation programs are considered to be part of the ESU—The Sea Resources Tule Chinook Program, Big Creek Tule Chinook Program, Astoria High School (STEP) Tule Chinook Program, Warrenton High School (STEP) Tule Chinook Program, Elochoman River Tule Chinook Program, Cowlitz Tule Chinook Program, North Fork Toutle Tule Chinook Program, Kalama Tule Chinook Program, Washougal River Tule Chinook Program, Spring Creek NFH Tule Chinook Program, Cowlitz spring Chinook Program in the Upper Cowlitz River and the Cispus River, Friends of the Cowlitz Spring Chinook Program, Kalama River Spring Chinook Program, Lewis River Spring Chinook Program, Fish First Spring Chinook Program, and the Sandy River Hatchery (ODFW stock #11) Chinook Salmon Hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (70 FR 37160).

The Elochoman Hatchery Fall Chinook Salmon Program was terminated in 2009. The last adults from this program will return to the Elochoman River in 2013. There are four new fall Chinook salmon hatchery programs—the Deep River Net-Pen, Klaskanine Hatchery, Bonneville Hatchery, and Little White Salmon National Fish Hatchery tule fall Chinook salmon programs. These programs utilize broodstock from existing hatchery programs that are part of the ESU and warrant consideration for inclusion in the ESU (Jones et al. 2011).

A report on the population structure of Lower Columbia salmon and steelhead populations was published by the WLC-TRT in 2006 (Myers et al. 2006). The Chinook population designations in that report were used in the 2010 status update and were used for status evaluations in recent recovery plans by ODFW and LCFRB. LCR Chinook populations exhibit three different life-history types base on return timing and other features: fall run (a.k.a. "tules"); late fall run (a.k.a. "brights"); and spring run.

In 2010, ODFW completed a recovery plan that included Oregon populations of Lower Columbia Chinook ESU. Also in 2010, the LCFRB completed a revision of its recovery plan that includes Washington populations of LCR Chinook. Both of these recovery plans include an assessment of current status of LCR Chinook populations. These assessments relied and built upon the viability criteria developed by the WLC-TRT (McElhany et al 2006) and an earlier evaluation of Oregon WLC populations (McElhany et al. 2007). These evaluations assessed the status of populations with regard to the VSP parameters of abundance and productivity, spatial structure, and diversity (McElhany et al. 2000). These analyses indicate that all but one of the 21 fall Chinook populations are most likely in the "very high-risk" category (also described as "extirpated or nearly so"). "Very high-risk" is broad category ranging from 100 percent extinction probability (already extirpated) to 60 percent probability of extinction in 100 years. The Clatskanie fall Chinook population was designated most likely in the "high-risk" category, but with substantial possibility of falling in the "very high-risk" category. Of the nine spring Chinook populations, eight are most likely at "very high-risk." The Sandy spring Chinook was considered most likely in the "moderate-" to "high-" risk range. The late fall life history (two populations) was considered the strongest in the ESU with the Lewis late fall population most likely in the "very low-risk" category and the Sandy late fall population most likely in the "low-risk" category.

A recovery plan for the LCR salmon ESUs and steelhead DPS is in development. NMFS issued a proposed ESA recovery plan for Lower Columbia River Chinook Salmon, Lower Columbia River Coho Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead on May 16, 2012 (77 FR 28855). The plan summarizes (and incorporate as appendices) locally developed recovery plans (ODFW 2010; LCFRB 2010) that address the Oregon portion and most of the Washington portion of the Lower Columbia ESUs and DPS. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For recovery planning and development of recovery criteria, the WLC-TRT developed recommendations at the scale of independent populations, strata, and ESUs. In addition to recommending recovery criteria, the WLC-TRT also recommended methods for evaluating population status, or extinction risk. The information below is based on these analyses and is summarized from Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Northwest (Ford et al. 2010).

Description and Geographic Range. The LCR Chinook salmon ESU consists of 32 historical populations in six strata—Coastal fall-run, Cascade spring-run; Cascade fall-run; Cascade late fall-run; Gorge fall-run; and Gorge spring-run (Figure 25).

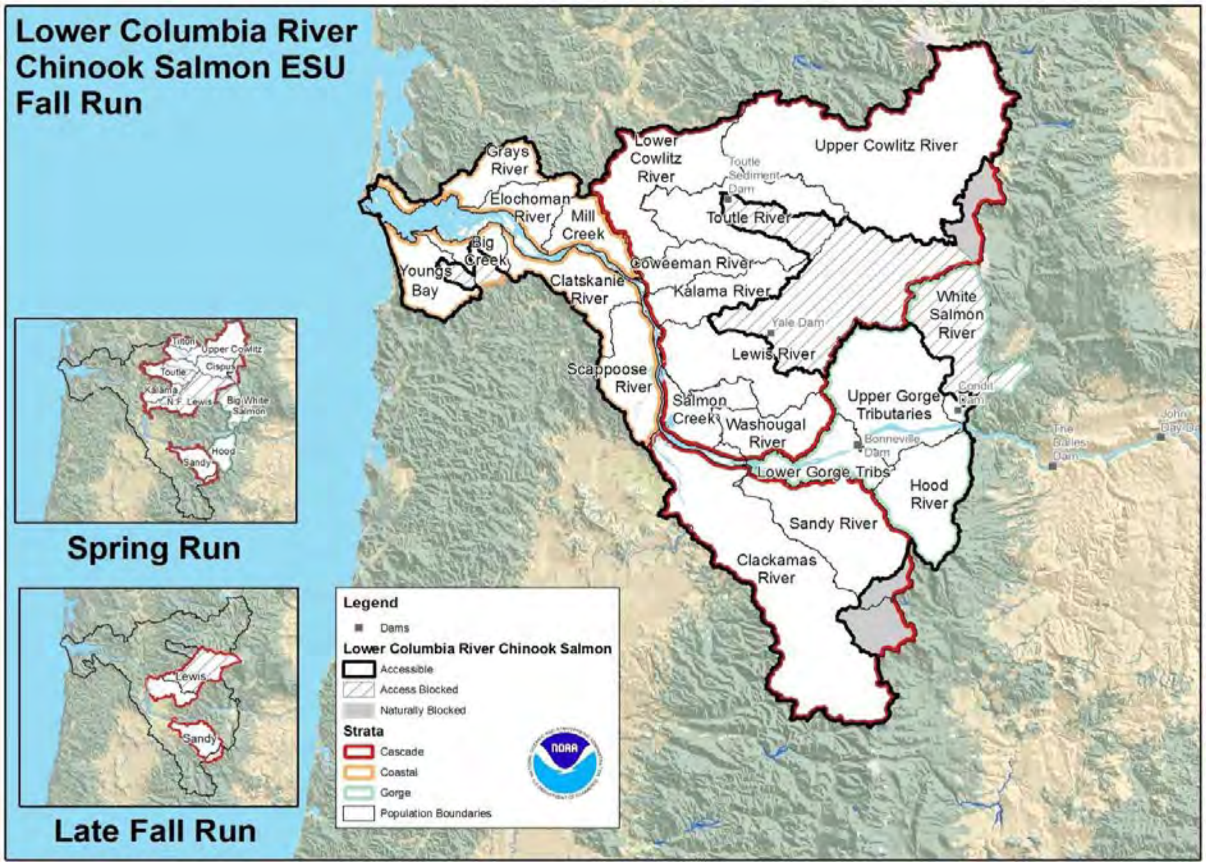

Figure 25. Lower Columbia River Chinook salmon ESU population structure.

Life History. Chapter 12 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Of the Pacific salmon, Chinook salmon exhibit the most diverse and complex life-history strategies. Chinook salmon follow one of two general freshwater cycles: stream- or ocean-type. After emerging from the gravel, stream-type Chinook salmon reside in freshwater for a year or more before migrating to the ocean as yearling fish. Ocean-type Chinook salmon migrate to the ocean within their first year as subyearlings. These two types of Chinook salmon have different life-history traits, geographic distribution, and genetic characteristics. Chinook in the lower Columbia River generally follow an ocean-type life-history cycle.

Runs are designated on the basis of when adults enter freshwater; however, distinct runs may also differ in the degree of maturation at river entry and time of spawning. Early, spring-run (stream-maturing) Chinook salmon tend to enter freshwater as immature or bright fish, migrate upriver (holding in suitable thermal refuges for several months), and finally spawn in late summer and early autumn. Late, fall-run (ocean maturing) Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry. Fall Chinook dominate Chinook salmon runs in this ESU. Today, the once abundant natural runs of fall and spring Chinook have been largely replaced by hatchery production. Large Chinook runs continue to return to many of their natal streams, but there are few sustained native, naturally reproducing populations.

Adult spring Chinook return to the Columbia River at 4 to 5 years of age. They enter the Columbia River in March and April and generally enter natal basins from March through June, well in advance of spawning in August and September. Spring Chinook typically spawn in headwater areas where higher gradient habitat exists. Successful spawning depends on sufficient clean gravel of the right size, in addition to the constant need of adequate flows and water quality. Fall Chinook return to the Columbia River at 3 to 4 years of age, although 5-year-olds are common in some populations. They enter freshwater from August to September and spawning generally occurs from late September to November, with peak spawning activity in mid-October. Bright fall Chinook adults enter the Columbia River August to October; dominant age class varies by population and brood year, but is typically age 4. Spawning occurs in November to January, with peak spawning in mid-November.

Chinook salmon eggs incubate throughout the autumn and winter months. As with other salmonids, water temperature controls incubation time and affects survival. During incubation, clean, well-oxygenated water flow is critical. Floods/scouring, dewatering, and sedimentation can result in high egg mortality. In the lower Columbia River, spring Chinook fry emerge from the gravel from November through March; peak emergence time is likely December and January. Fall Chinook fry generally emerge from the gravel in April, depending on the time of egg deposition and incubation water temperature. The emerging fry quickly migrate to quiet waters and offstream areas where they can find food and protection from predators.

After emerging from the gravel in the spring, most fall Chinook fry rear in the freshwater habitat for 1-4 months before emigrating to the ocean as subyearlings. A few fall Chinook remain in freshwater until their second spring and emigrate as yearlings. Conversely, spring Chinook emerge from the gravel earlier than fall Chinook, generally in the late winter/early spring. Normally, spring Chinook spend 1 full year in freshwater and emigrate to sea in their second spring. After emergence, fry generally search for suitable rearing habitat within side sloughs, side channels, spring-fed seep areas and along the outer edges of the stream. These quiet-water side margin and offchannel slough areas are vital for early juvenile habitat. The presence of woody debris and overhead cover aid in food and nutrient inputs, and provide protection from predators during early freshwater residence.

Juvenile Chinook salmon in freshwater feed on a variety of terrestrial and aquatic insects and crustaceans, while subadults feed on similar items as well as larger prey, including fishes, shrimp, and squid (Scott and Crossman, 1973). One study noted that adults in marine waters forage on a large array of fish species, especially herring and sand lance (Pritchard and Tester 1944 as cited in Scott and Crossman 1973).

Habitat. As noted above, LCR Chinook salmon inhabit the Columbia River and its tributaries from its mouth upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River. Habitat for LCR Chinook has been adversely affected by changes in access, streamflow, water quality, sedimentation, habitat diversity, channel stability, riparian conditions, channel alternations, and floodplain interactions. These large-scale changes have altered habitat conditions and processes important to migratory and resident fish and wildlife. Additionally, habitat conditions have been fundamentally altered throughout the Columbia River Basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control. Lower Columbia salmon are adversely affected by hydrosystem-related flow and water quality effects, obstructed and/or delayed passage, and ecological changes in impoundments. Dams in many of the larger subbasins have blocked anadromous fishes' access to large areas of productive habitat.

Abundance. Historical records of Chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run Chinook salmon are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays. Furthermore, spring-run populations have been severely depleted throughout the species' range and extirpated from several rivers. In 1998, NMFS reassessed the status of this species. Updated abundance information indicated that smaller tributary streams in the range of the species support naturally spawning Chinook salmon runs numbering in the hundreds of fish. Larger tributaries (e.g., Cowlitz River basin) contain natural runs of Chinook salmon ranging in size from 100 to almost 1,000 fish. NMFS calculated adult abundance using the geometric mean of natural-origin spawners in the 5 years previous to 2003. In 2005, NMFS estimated the LCR Chinook salmon abundance at approximately 14,130 fish (Good et al. 2005). More recent data places the abundance of naturally produced LCR Chinook salmon at approximately 13,847 spawners (Table 20).

The 2005 status review included abundance data for most LCR Chinook salmon populations up to the year 2001. For the most current review, Ford et al. (2010) compiled data through 2008 or 2009 for most populations, although for the Clatskanie fall and Sandy late fall Chinook salmon populations, data were available only through 2006. Abundance of all LCR Chinook salmon populations increased during the early 2000s but has since declined back to levels close to those in 2000 for all but one population. Abundance of the Sandy spring Chinook salmon population has declined from levels in the early 2000s but remains higher than its 2000 level. In general, abundance of LCR Chinook salmon populations has not changed considerably since the previous status review (Ford et al. 2010).

Table 20. Abundance Statistics and Recovery Goals for LCR Chinook salmon Populations (Streamnet 2010; WDFW 2010a; WDFW 2010b; ODFW 2010).

Life history/ Ecological zone	Population	Abundance Goal	Hatchery-origin spawners (average)	Natural-origin spawners (average)	Years for Abundance
Fall Run					
Coastal	Youngs Bay	1,502	656	73	2003-2007
	Grays	1,000	68	137	2004-2008
	Big	1,458	1,695	188	2003-2007
	Elochoman	1,500	663	490	2004-2008
	Clatskanie	1,441	1,683	187	2003-2007
	Mill,	900	410	700	2004-2008
	Scappoose	1,456	na	na	
Cascade	Coweeman	900	0	591	2004-2008
	Lower Cowlitz	3,000	2,314	489	2004-2008
	Upper Cowlitz	1,000	na	na	
	Toutle	4,000	2,153	455	2004-2008
	Kalama	500	4,758	1,385	2004-2008
	Salmon Creek	1,500	0	1,060	2004-2008
	Clackamas	2,174	792	488	2009
	Washougal	1,200	1,296	1,956	2004-2008
	Sandy	1,480	1,185	368	2003-2007
Columbia Gorge	Lower gorge	1,466	Unknown	146	2003-2007
	Upper gorge	1,445	Unknown	345	2004-2008
	Hood	1,507	na	na	
	Big White	500	Unknown	1,524	2004-2008
Late Fall (bright)					
Cascade	Sandy	2,153	na	na	
	North Fork	7,300	107	563	2004-2008
Spring run					
Cascade	Upper Cowlitz	1,800	0	451	2004-2008
	Cispus	1,800	na	na	
	Tilton		na	na	
	Toutle	1,100	na	na	

Life history/ Ecological zone	Population	Abundance Goal	Hatchery-origin spawners (average)	Natural-origin spawners (average)	Years for Abundance
	Kalama	300	0	499	2004-2008
	Lewis	1,500	0	322	2004-2008
	Sandy	1,464	182	1,429	2002-2005
Columbia Gorge	Big White	500	na	na	
	Hood	1,472	na	na	
Total			17,961	13,847	

The Oregon and Washington LCR draft recovery plans (WDFW 2010a, ODFW 2010) recommend targets for abundance of natural-origin spawners in LCR Chinook salmon populations (Table 20). Abundance objectives are reached when populations consistently exceed target numbers in most years. The range of abundance recommended for recovery is from 500 (Kalama and Big White Salmon) to 7,300 (North Fork Lewis). Current abundance estimates from WDFW, ODFW, and Streamnet suggest that only five of the populations are at or have exceeded abundance goals. However, it is unknown as to what portion of the fish spawning in the Big White Salmon are of hatchery origin.

Juvenile abundance estimates are published each spring in the annual memorandum estimating percentages of listed Pacific salmon and steelhead smolts arriving at various locations in the Columbia River Basin. Numbers for 2010 are not available at this time; however, the average outmigration for the years 2006-2009 is shown in Table 21 (Ferguson 2006, 2007, 2009a, 2009b).

Table 21. Average estimated outmigration for listed LCR Chinook salmon (2006-2009).

Origin	Outmigration
Natural	24,886,644
Listed hatchery intact adipose	741,333
Listed hatchery adipose clipped	35,542,725

The number of natural fish should be viewed with caution, however, as it only addresses one of several juvenile life stages. Moreover, deriving any juvenile abundance estimate is complicated by a host of variables, including the facts that: (1) spawner counts and associated sex ratios and fecundity estimates can vary widely between years; (2) multiple juvenile age classes (fry, parr, smolt) are present, yet comparable data sets may not exist for all of them; and (3) survival rates between life stages are poorly understood and subject to a multitude of natural and human induced variables (e.g., predation, floods, harvest, etc.). Listed hatchery fish outmigration numbers are also affected by some of these factors; however, releases from hatcheries are generally easier to quantify than is natural production.

Productivity. Summary statistics on population trends and growth rates are available in the status review update completed in 2005 (Good et al. 2005) with further updates in 2010 (Ford et al. 2010). Growth rate estimates were calculated in two ways—one assuming that hatchery-origin spawners would have zero reproductive success; the other assuming that hatchery-origin spawners would have a reproductive success equal to that of natural-origin spawners. Because growth rate was only calculated for time series for which the fraction of hatchery-origin spawners was known, most of the long-term trend estimates used data dating from 1980, even though the abundance time series of total spawners may have extended earlier than 1980. Using both calculations, the majority of populations have a long-term trend of less than 1, indicating the population is in decline.

In general, there is a great deal of uncertainty about the growth rate. This uncertainty is generally higher for Chinook salmon than for other LCR anadromous salmonids because of the high variability observed in the time series. Assuming that hatchery-origin fish have a reproductive success equal to natural-origin fish, analysis indicates a negative long-term growth rate for all of the populations except the Coweeman River fall run. Potential reasons for these declines were cataloged in previous status reviews; they include habitat degradation, overharvest, deleterious hatchery practices, and climate-driven changes in marine survival (Good et al. 2005).

Spatial Structure and Diversity. Myers et al. (2006) identified 32 historical demographically independent populations in three geographic/ecological subregions for the LCR Chinook salmon ESU. The subregions range from basins with strong coastal influences to ecological zones in the Columbia River gorge above Bonneville Dam. Within the LCR Chinook salmon ESU, run timing was the predominant life-history criteria used in identifying populations. Three distinct run times, spring, fall, and late fall, were identified. The distribution of populations with distinct run times varied among the three ecological subregions. Fall Chinook salmon historically were found throughout the LCR Chinook Salmon ESU, while spring Chinook salmon historically were only found in the upper portions of basins with snowmelt-driven flow regimes (western Cascade Crest and Columbia Gorge tributaries). Late fall Chinook salmon were identified in only two basins in the western Cascade Crest tributaries. In general, late fall Chinook salmon also matured at an older average age than either lower Columbia River spring or fall Chinook salmon, and had a more northerly oceanic migration route.

The WLC-TRT estimated that 8-10 historic populations have been extirpated, most of them spring-run populations (NMFS 2005a). The near loss of that important life-history type remains an important concern. In addition, some of the populations have been blocked for many years by dams on the Cowlitz and Lewis rivers. Trap-and-haul operations on the Cowlitz have recently reintroduced Chinook salmon to many miles of suitable spawning and rearing habitat. Thus, the LCR Chinook salmon current spatial structure is less diverse than its historical structure, but management actions are underway to improve the situation.

Diversity in Chinook salmon populations can range in scale from genetic differences within and among populations to complex life-history traits. One of the leading factors affecting the diversity of LCR Chinook is the loss of habitat due to impassable barriers such as dams. As described above, several major river systems in the lower Columbia are blocked. Trap-and-haul operations and artificial propagation have mitigated some of the effects, but many negative effects continue unabated.

In general, the fraction of hatchery origin spawners in LCR Chinook salmon populations has not changed dramatically since the last status review (Ford et al. 2010). Assessments conducted as part of recovery planning since that status review indicate that most LCR tule fall Chinook salmon populations are at high-to-moderate risk for issues related to diversity and at relatively low risk for issues related to spatial structure (Ford et al. 2010). These assessments also indicate that the two LCR late fall Chinook salmon populations are at moderate-to-low risk for issues related to diversity and spatial structure. LCR spring Chinook salmon populations range from very high-to-moderate risk because of diversity, and most are at very high risk due to spatial structure concerns (Ford et al. 2010).

Artificial propagation has also been identified as a major factor affecting diversity among LCR Chinook salmon. It is unknown how many populations in this ESU are being sustained, at least in part, by artificial propagation. Some of the populations contain substantial numbers of hatchery-origin spawners (first-generation hatchery fish). The development and implementation of stock transfer policies in Oregon and Washington have reduced artificial production's effects on natural fish.

NMFS recognizes that artificial propagation can be used to help recover ESA-listed species, but it does not consider hatcheries to be a substitute for conserving the species in its natural habitat. Potential benefits of artificial propagation for natural populations include reducing the short-term risk of extinction, helping to maintain a population until the factors limiting recovery can be addressed, reseeding vacant habitat, and helping speed recovery. Artificial propagation could have negative effects on population diversity by altering life-history characteristics such as smolt age and migration, and spawn timing.

ESU Summary

Three evaluations of LCR Chinook salmon status, all based on WLC-TRT criteria, have been conducted as part of the recovery planning process since the last status review (McElhany et al. 2007; ODFW 2010; LCFRB 2010). All three evaluations concluded that none of the ESU's six strata meet recovery criteria. Of the 32 historical populations in the ESU, 28 are considered at very high risk (and some may be extirpated or nearly so) and only two populations are considered viable.

Based on the recovery plan analyses, all of the tule (fall) Chinook salmon populations are considered very high risk except one that is considered at high risk. Additional modeling conducted in association with tule harvest management suggests that three populations (the Coweeman, Lewis, and Washougal) are at a somewhat lower risk. However, even these more optimistic evaluations suggest that the remaining 18 tule (fall) Chinook salmon populations are at substantial risk because of very low natural-origin spawner abundance (<100/population), high hatchery fraction, habitat degradation, and harvest impacts. The spatial structure of this component of the ESU remains relatively good.

Nearly all spring Chinook salmon populations are cut off from access to essential spawning habitat by tributary hydroelectric dams. Under Federal Energy and Regulatory Commission (FERC) relicensing settlement agreements, programs to allow access have been developed in the Cowlitz and Lewis systems. The effort in the Cowlitz is underway, but adult transport above the dams in the Lewis basin will not begin until at least 2012; thus, these programs are not yet producing self-sustaining populations. The Sandy spring Chinook salmon population, which is not affected by a tributary dam, is considered at moderate risk. All other spring Chinook salmon populations are considered at very high risk or extirpated or nearly so. The historical spring Chinook salmon population in the Hood River is extirpated, and fish are being reintroduced using an out-of-ESU hatchery stock. The historical spring Chinook salmon population in the White Salmon River is also considered extirpated; the goal is to reestablish this population after Condit Dam removal which occurred in early 2012.

The two late-fall Chinook salmon populations, the Lewis and the Sandy, are the only populations in this ESU considered to be at low or very low risk. Both populations have relatively few hatchery-origin spawners, and both (especially the Lewis) have maintained high spawner abundances since the last status review in 2005.

Overall, the new information does not indicate a change in the biological risk category since the last status review. Although this ESU has made little progress toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly since the last status review.

4.2.10 Lower Columbia River Coho Salmon

On June 28, 2005, NMFS listed LCR coho salmon—both natural and some artificially propagated fish—as a threatened species (70 FR 37160). Originally part of a proposed species with a larger geographic range (Lower Columbia River/Southwest Washington), LCR coho salmon were identified as a separate threatened species on June 28, 2005 (70 FR 37160). The listing includes all naturally spawned populations of coho salmon in streams and their tributaries to the Columbia River in Washington and Oregon, from the mouth of the Columbia River at the Pacific Ocean up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon. Twenty-five artificial propagation programs are part of the ESU and are also listed as follows:

- Grays River
- Sea Resources Hatchery
- Peterson Coho Project
- Big Creek Hatchery
- Astoria High School (STEP) Coho Program
- Warrenton High School (STEP) Coho Program

- Elochoman Type-S Coho Program
- Elochoman Type-N Coho Program
- Cathlamet High School FFA Type-N Coho Program
- Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers
- Cowlitz Game and Anglers Coho Program
- Friends of the Cowlitz Coho Program
- North Fork Toutle River Hatchery
- Kalama River Type-N Coho Program
- Kalama River Type-S Coho Program
- Washougal Hatchery Type-N Coho Program
- Lewis River Type-N Coho Program
- Lewis River Type-S Coho Program
- Fish First Wild Coho Program
- Fish First Type-N Coho Program
- Syverson Project Type-N Coho Program
- Eagle Creek National Fish Hatchery
- Sandy Hatchery
- Bonneville/Cascade/Oxbow Complex Coho Hatchery Programs

The Elochoman Hatchery Type-S and Type-N coho salmon programs were eliminated in 2008. The last adults from these two programs returned to the Elochoman in 2010 (Jones et al. 2011). NMFS found that these programs should be removed from the ESU.

Under the final listing in 2005, the Section 4(d) protections, and limits on them, apply to natural and hatchery threatened salmon with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed. This document evaluates impacts on both listed natural and listed hatchery fish.

A recovery plan for the LCR salmon ESUs and steelhead DPS is in development. NMFS issued a proposed ESA recovery plan for LCR Chinook Salmon, LCR Coho Salmon, CR Chum Salmon, and LCR Steelhead on May 16, 2012 (77 FR 28855). The plan summarizes (and incorporate as appendices) locally developed recovery plans (ODFW 2010; LCFRB 2010) that address the Oregon portion and most of the Washington portion of the Lower Columbia ESUs and DPS. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For recovery planning and development of recovery criteria, the WLC-TRT developed recommendations at the scale of independent populations, strata, and ESUs. In addition to recommending recovery criteria, the WLC-TRT also recommended methods for evaluating population status, or extinction risk. The information below is based on these analyses and is summarized from Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Northwest (Ford et al. 2010).

Description and Geographic Range. The LCR coho salmon ESU consists of 24 historical populations in three strata—Coastal, Cascade, and Gorge (Figure 26).

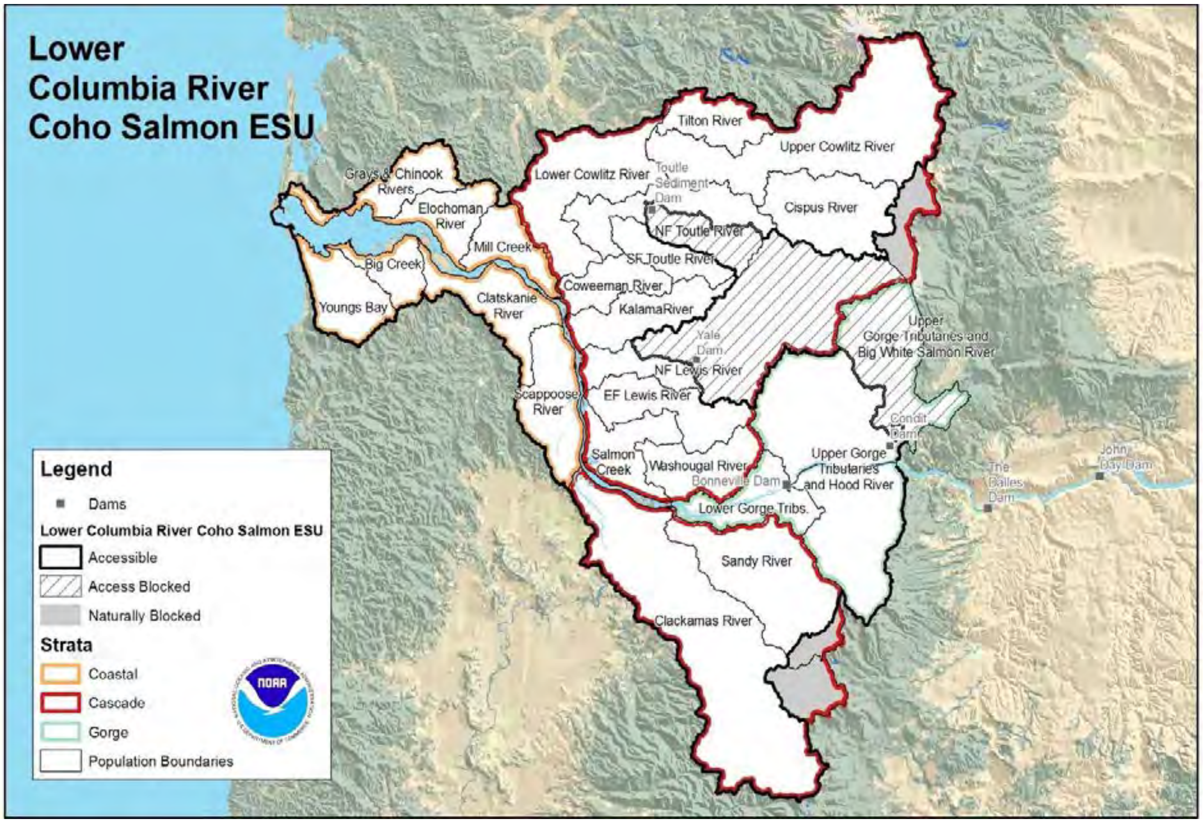

Figure 26. Lower Columbia River coho salmon ESU population structure

NMFS reviewed the status of the LCR coho salmon ESU in 1996 (NMFS 1996), 2001 (NMFS 2001) again in 2005 (Good et al. 2005), and most recently in 2010 (Ford et al. 2010). In the 2001 review, the BRT was very concerned that the vast majority (over 90 percent) of historical populations in the LCR coho salmon ESU appeared to be either extirpated or nearly so. The two populations with any significant production (Sandy and Clackamas rivers) were at appreciable risk because of low abundance, declining trends, and failure to respond after a dramatic reduction in harvest. The large number of hatchery coho salmon in the ESU was also considered an important risk factor. The majority of the 2001 BRT votes were for “at risk of extinction” with a substantial minority “likely to become endangered.” An updated status evaluation was conducted in 2005, also with a majority of BRT votes for “at risk of extinction” and a substantial minority for “likely to become endangered.”

A report on the population structure of Lower Columbia salmon and steelhead populations was published by the WLC-TRT in 2006 (Myers et al. 2006). The coho population designations in that report are used in the 2010 status update and were also used for status evaluations in recent recovery plans by ODFW and LCFRB.

In 2010, ODFW completed a recovery plan that included Oregon populations of Lower Columbia coho ESU. Also in 2010, the LCFRB completed a revision of its recovery plan that includes Washington populations of Lower Columbia coho. Both of these recovery plans include an assessment of current status of LCR coho populations. These assessments relied and built upon the viability criteria developed by the WLC-TRT (McElhany et al 2006) and an earlier evaluation of Oregon WLC populations (McElhany et al. 2007). These evaluations assessed the status of populations with regard to the VSP parameters of abundance and productivity, spatial structure and diversity (McElhany et al. 2000).

These analyses indicate that all of the Washington populations and all but two of the Oregon populations are in the overall "very high-risk" category (also described as "extirpated or nearly so"). Two populations in Oregon, the Scappoose and Clackamas, were considered by ODFW to most likely be in the moderate risk category. These results differ somewhat from the McElhany et al. (2007) analysis, which found Scappoose and Sandy at high risk, Clackamas barely in the low-risk category and all other Oregon populations considered very high risk. The results from Oregon and Washington are largely driven by the very low abundance and productivity of naturally produced LCR coho.

Life History. Chapter 13 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Coho salmon is a widespread species of Pacific salmon, occurring in most major river basins around the Pacific Rim from Monterey Bay, California, north to Point Hope, Alaska, through the Aleutians, and from the Anadyr River south to Korea and northern Hokkaido, Japan. From central British Columbia south, the vast majority of coho salmon adults are 3-year-olds, having spent approximately 18 months in freshwater and 18 months in salt water. The primary exceptions to this pattern are "jacks," sexually mature males that return to freshwater to spawn after only 5 to 7 months in the ocean. West Coast coho salmon smolts typically leave freshwater in the spring (April to June) and reenter freshwater when sexually mature from September to November, and spawn from November to December and occasionally into January. Stocks from British Columbia, Washington, and the Columbia River often have very early (entering rivers in July or August) or late (spawning into March) runs in addition to "normally" timed runs.

Habitat. Estuary and lower Columbia mainstem habitats play an important but poorly understood role in the anadromous fish life cycle. Fish have been adversely affected by changes in access, streamflow, water quality, sedimentation, habitat diversity, channel stability, riparian conditions, channel characteristics, and floodplain interactions. These large-scale changes have altered habitat conditions and processes important to migratory and resident fish and wildlife (NMFS 2006).

The following counties lie partially or wholly within the habitat areas occupied by the LCR coho salmon ESU (or contain migration habitat for the species): Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Wasco, and Washington counties in Oregon; and Clark, Cowlitz, Klickitat, Lewis, Pierce, Pacific, Skamania, and Wahkiakum counties in Washington. Critical habitat has not been designated for LCR coho salmon at this time. However, the habitat upon which LCR coho depends overlaps with designated critical habitat for other listed salmon and steelhead.

Abundance. The majority of the natural production of LCR coho comes from the Clackamas and Sandy River populations. Although adult returns in 2000 and 2001 for the Clackamas and Sandy River populations exhibited moderate increases when compared with returns from the late 1990s, the 5-year mean of natural-origin spawners for both populations (reported in 2004) was less than 1,500 adults. During the 1980s and 1990s, natural spawners were not observed at all in the lower Columbia River tributaries. Coincident with the 2000–2001 abundance increases in the Sandy and Clackamas populations, a small number of coho salmon spawners of unknown origin were surveyed in some lower tributaries. In any case, short- and long-term trends in productivity are below replacement. The ODFW estimated that 5,488 naturally produced LCR coho spawned in Oregon in 2004, down from over 6,000 spawners in 2003, but up from very low numbers in 1998 and 1999 (ODFW 2005a). The WDFW estimated that 5,787 natural-origin LCR coho spawned in Washington tributaries in 2004-05, down from over 12,000 in previous years (2002-04) (WDFW 2005). Table 22 displays the most recent returns of naturally produced and hatchery LCR coho salmon. Based on the best available data and using a 3-year geometric mean, the estimated run size of LCR coho salmon for 2010 is 20,765 naturally produced fish and 394,540 hatchery fish.

Table 22. Estimated abundance of adult LCR coho (ODFW and WDFW 2007b, 2008b, 2009b; FPC 2010; Yakima/Klickitat Fisheries Project 2010).

Year	Total	Natural	Hatchery
2003	626,629	31,331	595,298
2004	399,890	19,995	379,895
2005	313,031	15,652	297,379
2006	348,186	17,409	330,777
2007	278,303	13,915	264,388
2008	422,970	21,149	401,821
2009	608,517	30,426	578,091
Average	415,305	20,765	394,540

Juvenile abundance estimates are published each spring in the annual memorandum estimating percentages of listed Pacific salmon and steelhead smolts arriving at various locations in the Columbia River Basin. Numbers for 2010 were not available at the time of the 2010 status review; however the average outmigration for the years 2006-2009 is shown in Table 23 (Ferguson 2006, 2007, 2009a, 2009b).

Table 23. Average Estimated Outmigration for Listed LCR Coho Salmon (2007-2009).

Origin	Outmigration
Natural	1,199,449
Listed hatchery intact adipose	1,835,000
Listed hatchery adipose clipped	9,469,600

The number of natural fish should be viewed with caution, however, as it only addresses one of several juvenile life stages. Moreover, deriving any juvenile abundance estimate is complicated by a host of variables, including the facts that: (1) spawner counts and associated sex ratios and fecundity estimates can vary widely between years; (2) multiple juvenile age classes (fry, parr, smolt) are present yet comparable data sets may not exist for all of them; and (3) survival rates between life stages are poorly understood and subject to a multitude of natural and human-induced variables (e.g., predation, floods, harvest, etc.). Listed hatchery fish outmigration numbers are also affected by some of these factors, but releases from hatcheries are generally easier to quantify than is natural production.

Productivity. Long- and short-term trends and growth rate are not available for the majority of populations of LCR coho salmon. The Clackamas River population above North Fork Dam and the Sandy River population above Marmot Dam are the only two populations in the ESU for which natural production trends can be estimated. The long-term trends and growth rate estimates over the time series 1957 to 2002 for the total count at North Fork Dam and the early run portion have been slightly positive and short-term trends and growth rate have been slightly negative. The late-run portion of the North Fork Dam count (hypothesized to be the remains of the historical Clackamas River coho population) shows negative trends and growth rates over both the long and short term. The long- and short-term trends for the counts of coho in the Sandy River above Marmot Dam are both negative. However, the confidence intervals on trend and growth rate for both populations are large, so there is a great deal of uncertainty. There is very limited information on the other populations in the ESU; most are considered extirpated, or nearly so (Good et al. 2005).

Spatial Structure and Diversity. The LCR coho salmon ESU includes 25 populations that historically existed in the Columbia River Basin from the Hood River downstream (McElhany et al. 2007). Historically, coho were present in all lower Columbia River tributaries. Because Willamette Falls was a natural barrier to fall migrating salmonids, LCR coho were not historically found above the falls. In 2005, the WLC-TRT stated that very few wild coho salmon were spawning in lower Columbia River subbasins and a number of local populations have become extinct. The WLC-TRT described 18 populations as extant, all heavily influenced by extensive hatchery releases (NMFS 2005a). The majority of extinct populations (or those at very high risk) are in Washington State and range from the Grays River population near the mouth of the Columbia River to the Big White Salmon population in the upper gorge.

Some of the populations have been blocked for many years by dams on the Cowlitz and Lewis rivers. Trap-and-haul operations on the Cowlitz have recently reintroduced coho salmon to many miles of suitable spawning and rearing habitat. Thus, the LCR coho salmon current spatial structure is less diverse than its historical structure, but management actions are underway to improve the situation.

Diversity in coho salmon is limited by their fairly simple life history. Some early- and late-run stocks are identified but they are relatively similar to each other compared to the complex life-history traits of Chinook salmon. Both early- and late-run stocks were present historically and still persist in the lower Columbia River. Type S is an early type that enters the river from mid-August to September, spawns in mid-October to early November, and generally spawns in higher tributaries. Ocean migration for these fish is coastal Washington, Oregon, and Northern California. Type N is a late type that enters the river from late September to December, spawns in November to January, and generally spawns in lower tributaries. Ocean migration for these fish is coastal British Columbia, Washington, and Oregon.

One of the leading factors affecting the diversity of the ESU is loss of natural spawners. No natural spawners were observed in lower Columbia River tributaries during the 1980s and 1990s. The 1995 Status Review (Weitkamp et al. 1995) determined that the extant natural populations could not be identified, except possibly in the Clackamas River. A lack of natural spawners adversely affects the genetic diversity of this ESU.

Assessments conducted as part of recovery planning since the last status review indicate that Oregon LCR coho salmon populations are at moderate-to-low risk as a result of spatial structure and at high-to-moderate risk from issues related to diversity (Ford et al. 2010). Similar assessments for Washington LCR coho salmon populations also indicate moderate-to-low risk from spatial structure and, in general, high risk from issues related to diversity (Ford et al. 2010). Hatchery releases have remained relatively steady since the previous review. Overall hatchery production remains relatively high, and most populations in the ESU likely contain a substantial fraction of hatchery-origin spawners (although data are limited, particularly for Washington populations). Efforts to shift hatchery production to certain areas (e.g., Youngs Bay and Big Creek) to reduce hatchery-origin spawners in other populations (e.g., the Scappoose and Clatskanie) are relatively recent, and their success is unknown (Ford et al. 2010).

Artificial propagation has been identified as another major factor affecting diversity of LCR coho salmon. For many basins, the number of stocks planted, the size and frequency of annual releases, and the percentage of smolts released changed quite a lot between the time periods before and after 1985. At present, fewer stocks are used, fewer hatchery fish are released, and a higher percentage of the fish that are released are ready to quickly migrate to the ocean. This change came about in response to the development of wild fish policies in Oregon and Washington. In Washington, the development and implementation (in 1991) of a new stock transfer policy (WDF 1991) designed to foster local brood stocks substantially reduced the transfer of eggs and juveniles between watersheds. The policy mandates that hatchery programs use local brood stocks in rivers with extant indigenous stocks.

NMFS recognizes that artificial propagation can be used to help recover ESA-listed species, but it does not consider hatcheries to be a substitute for conserving the species in its natural habitat. However, NMFS also recognizes that for the LCR coho salmon, hatchery fish may be the only way to reseed vacant habitat.

ESU Summary

Three evaluations of LCR coho salmon status, all based on WLC-TRT criteria, have been conducted since the last status review as part of the recovery planning process (McElhany et al. 2007; ODFW 2010; LCFRB 2010). All three evaluations concluded that none of the ESU's three strata meet recovery criteria. Of the 24 historical populations in the ESU, 21 are considered at very high risk. The remaining three (Sandy, Clackamas, and Scappoose) are considered at high-to-moderate risk. All of the Washington populations are considered at very high risk because the limited studies available suggest most of the populations have returns that are greater than 90 percent hatchery fish. However, uncertainty about population status is high because of a lack of regular, comprehensive adult spawner surveys. As was noted in the last status review, smolt traps indicate some natural production in Washington populations, though, given the high fraction of hatchery-origin spawners suspected to occur in these populations, it is not clear that any are self-sustaining.

Overall, the new information considered does not indicate a change in the biological risk category since the time of the 2010 status review. Although this ESU has made little progress toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly.

4.2.11 Lower Columbia River Steelhead

On January 5, 2006, NMFS listed LCR steelhead—both natural and some artificially-propagated fish—as a threatened species (71 FR 834). The listing included all naturally-spawned populations of steelhead in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive) and the Willamette and Hood Rivers, Oregon (inclusive). Steelhead in the upper Willamette River basin above Willamette Falls and steelhead from the Little and Big White Salmon Rivers in Washington are excluded. Ten artificial propagation programs are part of the listed species and are also listed. Hatchery programs included in the DPS are:

- Cowlitz Trout Hatchery (in the Cispus, Upper Cowlitz, Lower Cowlitz, and Tilton Rivers),
- Kalama River Wild (winter- and summer-run),
- Clackamas Hatchery,
- Sandy Hatchery, and
- Hood River (winter- and summer-run) Steelhead Hatchery Programs.

Excluded are O. mykiss populations in the upper Willamette River basin above Willamette Falls, Oregon, and from the Little and Big White Salmon Rivers, Washington.

Releases of Cowlitz Hatchery late-run winter steelhead into the Upper Cowlitz and Cispus rivers were terminated in 2010, with the last returns expected in 2012. The release of Cowlitz Hatchery late-run winter steelhead into the Tilton River was terminated in 2007, and the last returns were in 2009. Releases from the Hood River Summer Steelhead Program ended in 2009, with the last returns expected in 2011 (Jones et al. 2011). NMFS concluded that these programs should be removed from the DPS.

Broodstock collection for the new Lewis River Late-Run Winter Steelhead Program began in 2009. This program uses natural-origin late-run winter steelhead that are genetically representative of the North Fork Lewis River natural-origin winter steelhead population for broodstock and warrants consideration for inclusion in the DPS (Jones et al. 2011).

Under the final listing in 2006, the Section 4(d) protections, and limits on them, apply to natural and hatchery threatened steelhead with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed.

A recovery plan for the LCR salmon ESUs and steelhead DPS is in development. NMFS issued a proposed ESA recovery plan for LCR Chinook salmon, LCR coho salmon, CR chum salmon, and LCR steelhead on May 16, 2012 (77 FR 28855). The plan summarizes (and incorporate as appendices) locally developed recovery plans (ODFW 2010; LCFRB 2010) that address the Oregon portion and most of the Washington portion of the Lower Columbia ESUs and DPS. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For recovery planning and development of recovery criteria, the WLC-TRT developed recommendations at the scale of independent populations, strata, and ESUs. In addition to recommending recovery criteria, the WLC-TRT also recommended methods for evaluating population status, or extinction risk. The information below is based on these analyses and is summarized from Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Northwest (Ford et al. 2010).

Description and Geographic Range. The LCR steelhead DPS consists of 23 historical populations in four strata—Cascade winter-run, Cascade summer-run, Gorge winter-run, and Gorge summer-run (Figure 27).

Life History. Chapter 14 of the *Comprehensive Analysis* (Action Agencies 2007b) contains information about life history and population status of the LCR steelhead DPS and is incorporated here by reference.

In the lower Columbia Basin, migrating adult steelhead can occur in the Columbia River year-round, but peaks in migratory activity and differences in reproductive ecotype lend themselves to classifying steelhead into two races: summer and winter steelhead. Summer steelhead return to freshwater from May to October, and enter the Columbia in a sexually immature condition, requiring several months in freshwater to reach sexual maturity and spawn. Winter steelhead enter freshwater from November to April, and return as sexually mature individuals that spawn shortly thereafter.

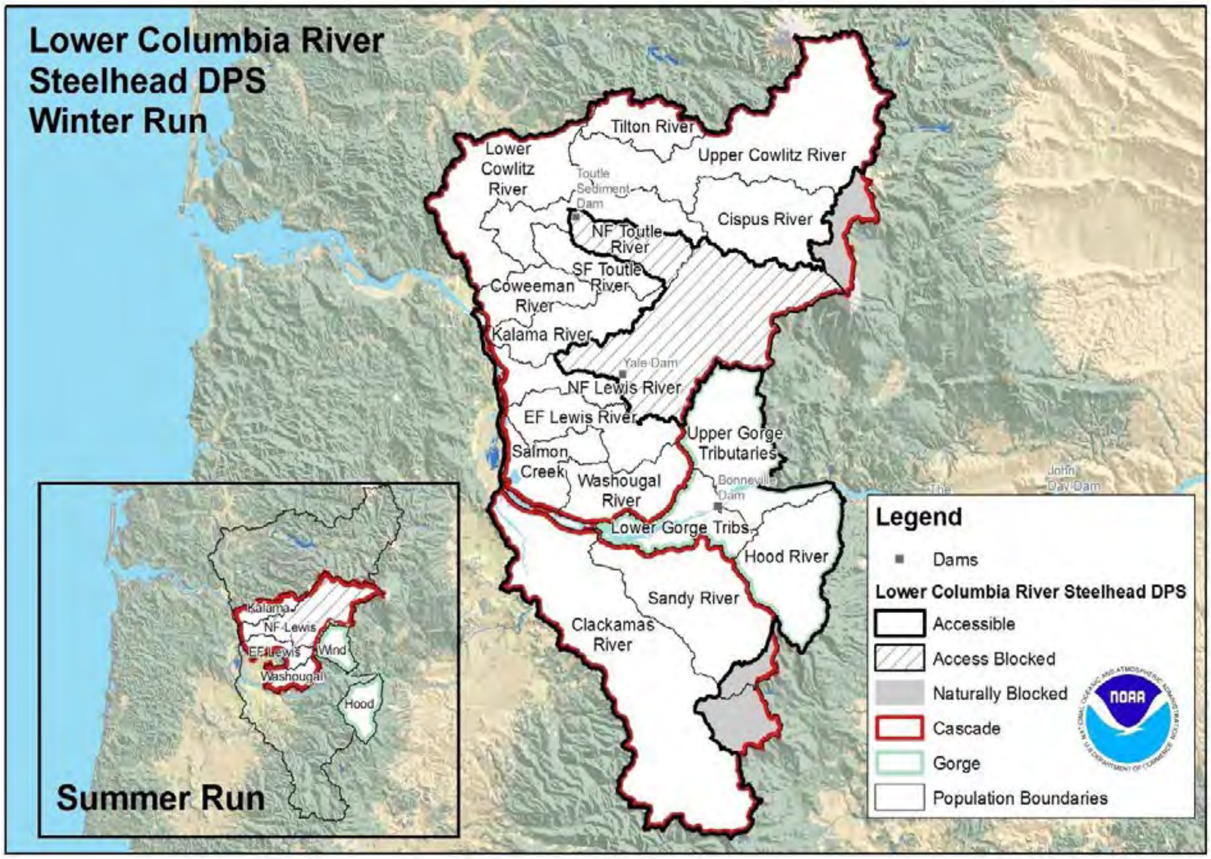

Figure 27. Lower Columbia River steelhead population structure

Some rivers have both summer and winter steelhead, while others have only one race. LCR steelhead have both winter and summer runs, and several river basins have both (e.g., Kalama River, Sandy River, Clackamas River, and Hood River). Where both runs occur in the same stream, summer steelhead tend to spawn higher in the watershed than do winter forms, perhaps suggesting that summer steelhead tend to exist where winter runs do not fully utilize available habitat. In rivers where both winter and summer forms occur, they are often separated by a seasonal hydrologic barrier, such as a waterfall. Coastal streams are predominantly winter steelhead, whereas interior subbasins are dominated by summer steelhead. Historically, winter steelhead may have been excluded from interior Columbia River subbasins by Celilo Falls. A nonanadromous form of *O. mykiss* co-occurs with the anadromous form and juvenile life stages of the two forms can be very difficult to differentiate.

Steelhead spawn in clear, cool, well-oxygenated streams with suitable gravel and water velocity. Adult fish waiting to spawn or in the process of spawning are vulnerable to disturbance and predation in areas without suitable cover. Cover types include overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, deep water, and turbulence. Spawning occurs earlier in areas of lower elevation and where water temperature is warmer than in areas of higher elevation and cooler water temperature. Spawning occurs from January through May, and precise spawn timing is related to stream temperature. Adult steelhead, unlike salmon, do not necessarily die after spawning but return to the ocean. Unlike Pacific salmon, steelhead are iteroparous—capable of spawning more than once before death. However, it is rare for steelhead to spawn more than once before dying, and almost all that do so are females (Nickelson et al. 1992). Repeat spawning is not common among steelhead migrating several hundred miles or more upstream from the ocean.

Steelhead eggs hatch in 35–50 days depending on water temperature. Following hatching, alevins remain in the gravel 2 to 3 weeks until the yolk-sac is absorbed. Steelhead are spring spawners, so they spawn at a time when temperatures are typically cold, but increasing. Their spawning time must optimize avoidance of competing risks from gravel-bed scour during high flow and increasing water temperatures that can become lethal to eggs as the warm season arrives.

Fry emergence is principally determined by the time of egg deposition and the water temperature during the incubation period. Fry emergence may occur from May through August; however, emergence timing differs slightly between steelhead races and among subbasins. The different emergence times between races may be a function of spawning location within the watershed (and, hence, water temperature) or a result of genetic differences of the races. Generally, emergence occurs from March into July, with peak emergence time generally in April and May.

Following emergence, fry usually move into shallow and slow-moving margins of the stream. Fry tend to occupy shallow riffle habitats and as they grow, they inhabit areas with deeper water, a wider range of velocities, and larger substrate.

Steelhead exhibit a great deal of variability in smolt age and ocean age. Most steelhead in the Lower Columbia River smolt at 2 years and spend 2 years in salt water before reentering freshwater, where they may remain up to a year before spawning. The dominant age class of outmigrating steelhead smolts in the lower Columbia River is age 2. In the lower Columbia River, outmigration of steelhead smolts generally occurs from March to June, with peak migration usually in April or May.

Habitat. Estuary and lower Columbia mainstem habitats play an important but poorly understood role in the anadromous fish life cycle. Fish have been adversely affected by changes in access, streamflow, water quality, sedimentation, habitat diversity, channel stability, riparian conditions, channel alternations, and floodplain interactions. These large-scale changes have altered habitat conditions and processes important to migratory and resident fish and wildlife (NMFS 2006).

Abundance. In the early 2000s, runs in the larger rivers (Cowlitz, Kalama, and Sandy River populations), were in the range of 1,000 to 2,000 fish; historical counts, however, indicate these runs were ten times higher. In general, all steelhead runs in the lower Columbia River have declined over the past 20 years, and sharp declines were seen in from the late 1990s to early 2000s (though it is difficult to accurately estimate the number of returning adult steelhead to the lower Columbia River). Escapement estimates compiled by various agencies indicate that approximately 11,900 adult steelhead may have returned in 2004 (Kostow 2004; LeFleur and Melcher 2004). In 2005, NMFS estimated the LCR steelhead abundance at approximately 10,700 fish (Good et al. 2005).

The previous status review in2005 included abundance data for most LCR steelhead populations up to the year 2001. For the 2010 status evaluation, data through 2008 were available for most populations. Since the 2005 status evaluation, all populations increased in abundance during the early 2000s, generally peaking in 2004. Abundance of most populations has since declined back to levels close to the long-term mean. Exceptions are the Washougal summer and North Fork Toutle winter populations, for which abundance is higher than the long-term average, and the Sandy, for which abundance is below the long-term average. The North Fork Toutle winter steelhead population appears to be experiencing an increasing trend dating back to 1990, which is likely partially the result of recovery of habitat since the eruption of Mt. St. Helens in 1980. In general, the LCR steelhead populations do not show any sustained, dramatic changes in abundance since the previous status review (Ford et al. 2010).

The LCFRB 2004 developed planning ranges for abundance of viable LCR steelhead populations. Some abundance goals were not set; the range of abundance is from 61 in the North Fork Lewis to 1,895 fish in the Kalama. The LCFRB identified most of the populations as currently at high risk of extinction. The Wind River summer steelhead and the Kalama River, South Toutle River, and Lower Gorge tributaries' winter steelhead populations are at moderate risk. The North Fork Lewis River summer run and Tilton River winter run were described as either extinct or at very high risk. Some of the populations are approaching the abundance targets, and one (the E.F. Lewis) exceeded it. As of 2009, the total estimated hatchery-origin spawners in the DPS were 17,377 while the estimated natural-origin spawners totaled 11,483 fish (ODFW and WDFW 2009a, WDFW 2006b).

Juvenile abundance estimates are published each spring in the annual memorandum estimating percentages of listed Pacific salmon and steelhead smolts arriving at various locations in the Columbia River Basin. Numbers for 2010 were not available at the time of the 2010 status review; however, the average outmigration for the years 2006-2009 is shown in Table 24 (Ferguson 2006, 2007, 2009a, 2009b).

Table 24. Average estimated outmigration for listed LCR steelhead (2006-2009)

Origin	Outmigration
Natural	579,698
Listed hatchery intact adipose	200,000
Listed hatchery adipose clipped	890,055

The natural abundance number should be viewed with caution, however, as it only addresses one of several juvenile life stages. Moreover, deriving any juvenile abundance estimate is complicated by a host of variables, including the facts that: (1) spawner counts and associated sex ratios and fecundity estimates can vary widely between years; (2) multiple juvenile age classes (fry, parr, smolt) are present, yet comparable datasets may not exist for all of them; (3) it is very difficult to distinguish between nonlisted juvenile rainbow trout and listed juvenile steelhead; and (4) survival rates between life stages are poorly understood and subject to a multitude of natural and human-induced variables (e.g., predation, floods, harvest, etc.).

Productivity. Good et al. (2005) described the long-term trends for a majority of the populations of LCR steelhead at less than 1, indicating that the populations are in decline. When growth rates were estimated under the assumption that hatchery-origin spawners had a reproductive success equal to that of natural-origin spawners, all the populations had a negative growth rate except the North Fork Toutle River winter-run, which has very few hatchery-origin spawners. The North Fork Toutle population is still recovering from the 1980 eruption of Mount St. Helens and average abundance is still low (recent mean of 196 spawners). Potential reasons for overall declines in growth rate for the entire DPS are habitat degradation, deleterious hatchery practices, and climate-driven changes in marine survival.

Spatial Structure and Diversity. The WLC-TRT identified 23 historical populations in this DPS. The 23 populations fall into four strata (NMFS 2005a). In 2003, a TRT analysis suggested that a viable DPS would need (in addition to other factors) multiple viable populations in each stratum.

Although most of the species' historic range is still available to LCR steelhead, the Bull Run dams (1929) in the Sandy River basin, Merwin Dam (1931) in the Lewis River basin, and Mayfield Dam (1963) in the Cowlitz basin either eliminate historical habitat or impede upstream passage or juvenile outmigration. Trap-and-haul operations on the Cowlitz have recently reintroduced steelhead to many miles of suitable spawning and rearing habitat. Thus, the LCR steelhead current spatial structure is less diverse than its historical structure, but management actions are underway to improve the situation.

Diversity in steelhead populations can range in scale from genetic differences within and among populations to complex life-history disparities. One of the leading factors affecting the diversity of this DPS is the loss of habitat associated with construction of dams. As described above, many of the historical populations were affected by dams built 60-90 years ago in upper tributaries.

Total releases of hatchery steelhead in the LCR steelhead DPS have increased from about 2 million to around 3 million fish per year since the 2005 status review. Some populations (e.g., the Hood River and the Kalama) have relatively high fractions of hatchery-origin spawners, whereas others (e.g., the Wind) have relatively few hatchery-origin spawners (Ford et al. 2010). Assessments since the last status review indicate that Oregon LCR steelhead populations are generally at moderate risk because of diversity issues and low risk because of spatial structure (Ford et al. 2010). Similar assessments for Washington LCR steelhead populations also indicate moderate risk because of diversity issues, in general, and moderate-to-low risk because of spatial structure (Ford et al. 2010).

Artificial propagation has been identified as another major factor affecting diversity of LCR steelhead. For many basins, the number of stocks planted, the size and frequency of annual releases, and the percentage of smolts released changed a great deal between the time periods before and after 1985. At present, fewer stocks are used, fewer hatchery fish are released, and a higher percentage of the fish that are released are ready to quickly migrate to the ocean. This change came about in response to the development of wild fish policies in Oregon and Washington. In Washington, the development and implementation (in 1991) of a new stock transfer policy (WDFW 1991) designed to foster local broodstocks resulted in a substantial reduction in the transfer of eggs and juveniles between watersheds. The policy mandates that hatchery programs use local broodstocks in rivers with extant indigenous stocks.

NMFS recognizes that artificial propagation can be used to help recover ESA-listed species, but it does not consider hatcheries to be a substitute for conserving the species in its natural habitat. Potential benefits of artificial propagation for natural populations include reducing the short-term risk of extinction, helping to maintain a population until the factors limiting recovery can be addressed, reseeding vacant habitat, and helping speed recovery. Artificial propagation could have negative effects on population diversity by altering life-history characteristics such as smolt age and migration, and spawn timing.

DPS Summary

Three evaluations of LCR steelhead status, all based on WLC-TRT criteria, have been conducted as part of recovery planning since the 2005 status review (McElhany et al. 2007; ODFW 2010; LCFRB 2010). All three evaluations concluded that none of the DPS' four strata meet recovery criteria. Of the 23 historical populations in the DPS, 16 are considered at high or very high risk. Populations in the upper Lewis, Cowlitz, and White Salmon watersheds are cut off from access to essential spawning habitat by tributary hydroelectric dams. As part of FERC relicensing settlement agreements, programs to allow access have been initiated in the Cowlitz and Lewis systems. The effort in the Cowlitz is underway, but adult transport above the dams in the Lewis basin will not begin until at least 2012; thus, these programs have not yet produced self-sustaining populations. The populations generally remain at relatively low abundance with relatively low productivity.

Overall, the new information considered does not indicate a change in the biological risk category since the time of the last status review. Although this DPS has made little progress toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly.

4.2.12 Upper Willamette River Chinook Salmon

NMFS listed the Upper Willamette River Chinook salmon ESU as threatened on March 24, 1999. This ESU includes all naturally spawned spring-run Chinook salmon populations in the Clackamas River and in the Willamette River and its tributaries above Willamette Falls, Oregon (64 FR 14208). On June 28, 2005, NMFS reaffirmed the Upper

Willamette River (UWR) Chinook salmon as a threatened species (70 FR 37160). Seven artificial propagation programs are considered to be part of the ESU: The McKenzie River Hatchery (ODFW stock #241), Marion Forks/North Fork Santiam River (ODFW stock #21), South Santiam Hatchery (ODFW stock #23) in the South Fork Santiam River, South Santiam Hatchery (ODFW stock #23) in the Calapooia River, South Santiam Hatchery (ODFW stock #23) in the Mollala River, Willamette Hatchery (ODFW #22), and Clackamas Hatchery (ODFW #19) spring-run Chinook salmon hatchery programs. NMFS has determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (70 FR 37160; June 28, 2005).

Under the final listing in 2005, the Section 4(d) protections, and limits on them, apply to natural and hatchery threatened salmon with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed. This BA evaluates impacts on both listed natural and listed hatchery fish.

Description and Geographic Range. Based on geography, migration rates, genetic attributes, life-history patterns, phenotypic characteristics, population dynamics, environmental and habitat characteristics, and with guidance found in McElhany et al. 2000, the WLC-TRT identified seven demographically independent populations within the ESU (Figure 28). These include the Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and the Middle Fork Willamette (Myers et al. 2006).

The updated information provided in Good et al. (2005), the information contained in previous UWR Chinook salmon status reviews, and the WLC-TRT's analysis indicate that most spring-run populations are likely extirpated, or nearly so. The only population considered potentially self-sustaining is the McKenzie River population, but its abundance has been relatively low, with a substantial number of its fish being of hatchery origin. In addition to recommending recovery criteria, the WLC-TRT also assessed the current status of each population within each Upper Willamette River ESU/DPS. Each population was rated against the biological criteria identified in the proposed recovery plan and assigned a current viability rating. Information provided in this status review is summarized from Ford et al. 2010—Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Northwest.

Life History. Chapter 15 of the *Comprehensive Analysis* (Action Agencies 2007b) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

There are two races of Chinook salmon found in Oregon streams—spring Chinook salmon and fall Chinook salmon. Spring-run Chinook salmon generally enter the Upper Willamette River from March through mid-August, while fall Chinook salmon entry peaks in September. Variations in freshwater entry and run timing exist in local populations and occur in response to the local temperature and water flow regimes (Myers et al. 1998). For example, Upper Willamette River spring Chinook salmon exhibit an early entry into freshwater compared to other Columbia River stocks. Upper

Willamette River spring Chinook salmon are unique among other Columbia River stocks based on genetic differences and distinct life-history patterns.

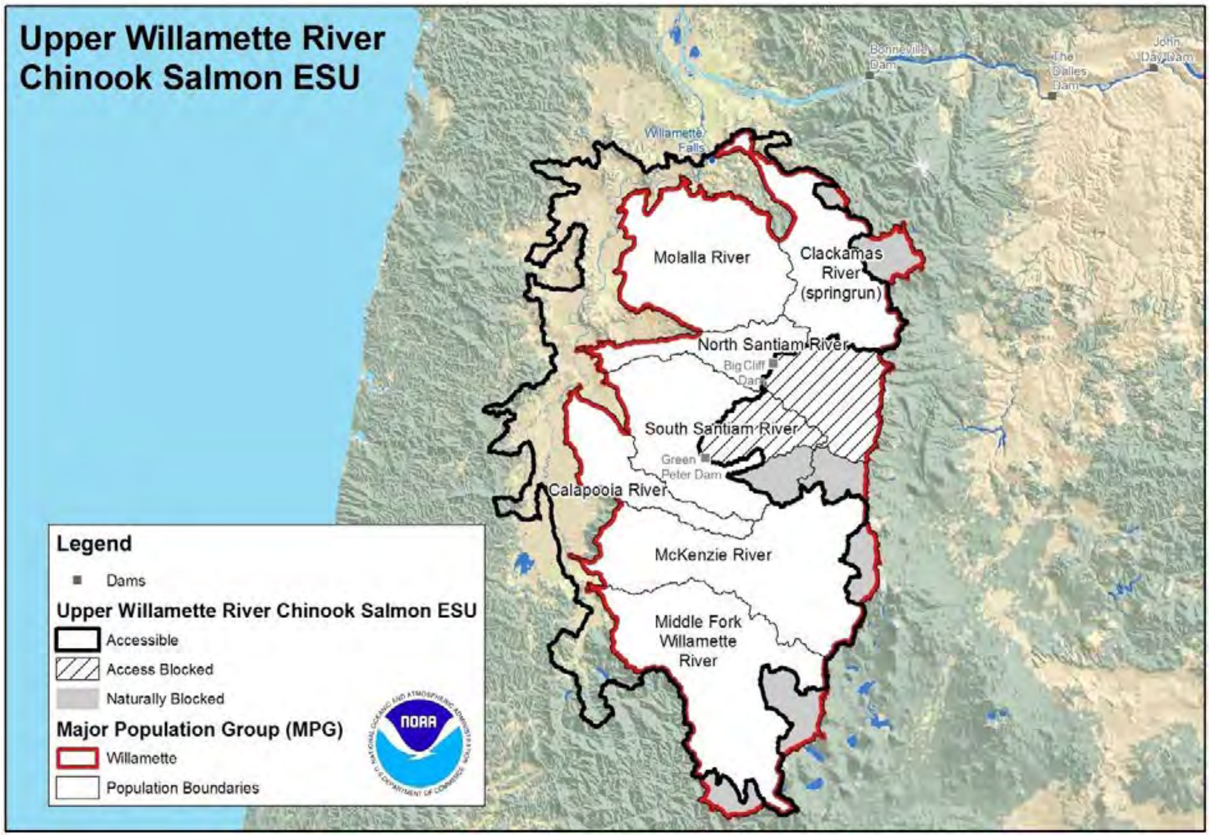

Figure 28. UWR Chinook salmon ESU population structure.

Chinook salmon mature and begin their spawning migration at ages 3 to 6 years, with most spawning adults at ages 4 or 5 (WRI 2004). Spring Chinook salmon spawn primarily from September through November, and fall Chinook salmon spawn predominantly during October and December. Females may deposit somewhere between 3,000 and 6,000 eggs depending on age and body size (WRI 2004).

Similar to all salmon, Chinook salmon egg incubation varies with temperature. Chinook salmon eggs hatch in about 160 days at 3°C, and in 32 days at 16°C (WRI 2004). Prior to emerging, the young remain in the gravel for 2-3 weeks after hatching (WRI 2004). Juvenile life stages (i.e., eggs, alevins, fry, and parr) inhabit freshwater/riverine areas throughout the range of the listed species. Parr usually undergo a smolt transformation in the spring at which time they migrate to the ocean. Subadults and adults forage in coastal and offshore waters of the North Pacific Ocean before returning to spawn in their natal streams. Many variations in juvenile life-history stage are possible. Some juvenile fish may move into the ocean quickly, while others depend on extended rearing in the streams or estuaries (WRI 2004). In the Willamette River basin, most Chinook salmon exhibit a yearling strategy where juveniles will rear in natal streams for a full year before migrating downstream to estuarine habitats (WRI 2004). Although some fish may move throughout the year, juvenile Chinook salmon in the Willamette River exhibit a peak in their downstream migration in the fall with the onset of the fall rains in October and November and again in the late winter and spring with freshets.

Habitat. Stream habitat in the upper Willamette basin has become substantially simplified since the 1800s by removal of large woody debris to increase the river's navigability, reduction in riparian vegetation, and channel modifications for a variety of reasons. Habitat conditions for anadromous fish have been fundamentally altered throughout the Columbia River Basin by the construction and operation of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control. In 1999, NMFS found that the loss of access to historical spawning grounds because of dams was a major risk factor to UWR Chinook salmon (Good et al. 2005). The overall reduction in available spawning and rearing habitat, combined with altered water flow and temperature regimes, have affected the UWR Chinook.

Abundance. Based on egg collections at salmon hatcheries, the estimated spring Chinook salmon run in the 1920s may have been five times the run size of 55,000 fish in 1947, or 275,000 fish. The spring run has been counted at Willamette Falls since 1946, but "jacks," sexually mature males that return to freshwater to spawn after only a few months in the ocean, were not differentiated from the total count until 1952. The geometric mean of the estimated run size from 1946 through 1950 was 43,300 fish, compared to an estimate of 25,500 for 1994 through 1998. In 1994, only 3,900 natural spawners were estimated to reach the Upper Willamette basin; approximately 1,300 of these were naturally-produced. The number of naturally spawning fish has increased gradually in recent years, but many are considered to be first-generation hatchery fish. The McKenzie and Clackamas rivers support the only remaining naturally reproducing populations of spring Chinook salmon in the basin (Table 25). Abundance of naturally produced spawners in other populations is at a very high risk of extinction.

Table 25. Draft abundance targets for Upper Willamette Chinook populations (ODFW 2007).

Population	Current Extinction Risk	Current Abundance	Low Risk Abundance Target
Clackamas	Low	2,800	2,900
Molalla	Very High	< 50	1,000 – 1,400
N. Santiam	Very High	< 50	1,400 – 2,000
S. Santiam	Very High	< 50	2,000 – 2,600
Calapooia	Very High	< 50	1,000 – 1,400
McKenzie	Moderate	2,200	3,100
Middle Fork	Very High	< 50	1,400 – 2,000

Recent data on returning adults are summarized in Table 26 (ODFW and WDFW 2005a, 2006a, 2007a, 2008a, 2009a). Abundance of adult UWR spring Chinook has declined since the highs witnessed around the turn of this century. The 5-year average return for UWR spring Chinook salmon is 9,568 naturally produced adults and 66,071 hatchery adults (2005-2009). Escapement numbers for 2010 are not yet available, but the average for the years 2005-2009 was a combined total of 53,781 hatchery- and naturally-produced adult Chinook.

The WLC-TRT considers the Clackamas and McKenzie populations to be at moderate-to-low risk of extinction for abundance and productivity; the remaining five are in the very high-risk category. Clackamas population returns at the North Fork Dam in 2004 peaked at over 12,000 hatchery and natural fish, but dropped to approximately 2,000 in 2009 and 2010 (Ford et al. 2010). The geometric mean number of natural-origin spawners for the last 5 years is 850 fish per year. The McKenzie population returns increased in abundance, peaking in 2004, but dropped to previous levels of a little more than 1,000 unmarked fish crossing Leaburg Dam. The McKenzie population abundance remained flat in 2010. NMFS is concerned that this may signal a failure of the natural population to respond to increased ocean survivals, but there are multiple factors at play that have yet to be completely evaluated. The Willamette Falls count averaged about 40,000 fish (hatchery and natural origin) and the estimated number of unmarked (mostly natural origin) spawners above Leaburg Dam has recently averaged about 2,000 fish.

Table 26. Return of adult Upper Willamette River spring Chinook entering the Columbia River and escapement to the Clackamas River and Willamette Falls Fish Ladder.

Year	Return		Natural and Hatchery Escapement[1]
	Hatchery	*Natural*	
2005	54,900	5,600	43,219
2006	53,133	6,567	39,719
2007	29,957	9,986	25,416
2008	19,722	7,294	18,117
2009	30,346	9,064	30,583
Average[2]	*66,071*	*9,568*	*53,781*

[1] Escapement is the combined total of hatchery and naturally produced Chinook that escaped the fishery and may have spawned.

[2] Average is reported as the 5-year geometric mean.

Juvenile abundance estimates are published each spring in the annual memorandum estimating percentages of listed Pacific salmon and steelhead smolts arriving at various locations in the Columbia River Basin. Numbers for 2010 were not available at the time of the 2010 status review; however, the average outmigration for the years 2006-2009 is shown in Table 27 (Ferguson 2006, 2007, 2009a, 2009b).

Table 27. Average estimated outmigration for listed UWR Chinook salmon (2006-2009).

Origin	Outmigration
Natural	3,847,700
Listed hatchery intact adipose	108,250
Listed hatchery adipose clipped	5,737,217

Productivity. Previous status reviews described the long-term trends in UWR Chinook escapement as mixed—ranging from slightly upward to moderately downward. Short-term trends in abundance are all strongly downward. Although NMFS found that abundance was relatively stable over the longer term, there was evidence that natural populations were not replacing themselves in the short term (NMFS 1998a). NMFS' first assessment of risk to this ESU (Nehlsen et al. 1991) noted vulnerability to minor disturbances, insufficient information on population trends, and the potential loss of unique run-timing characteristics as causes for concern.

Good et al. (2005) did not address UWR Chinook salmon productivity trends specifically, but did indicate that most natural-origin spring-run Chinook populations are likely extirpated, or nearly so. The only population considered potentially self-sustaining is the McKenzie River population. However, its abundance has been relatively low (low thousands), with a substantial number of these fish being of hatchery origin. The McKenzie River population has shown a considerable increase in the last couple years, hypothesized to be a result of increased ocean survival. What ocean survival will be in the future is unknown, and the long-term sustainability of the McKenzie River population is uncertain.

Spatial Structure and Diversity. The WLC-TRT identified seven historical populations. All seven populations are in one stratum, the Cascade spring run stratum (NMFS 2005a). The WLC-TRT analysis suggests that a viable ESU would need multiple viable populations in this stratum. The North Fork Dam on the Clackamas River, Big Cliff and Detroit dams on the North Santiam River, Foster and Green Peter dams on the South Santiam River, Blue River and Cougar dams on the McKenzie River, Fall Creek and Dexter dams on the middle fork Willamette, and numerous blockages on smaller tributaries of the Molalla and Calapooia Rivers either eliminate historical habitat or impede upstream passage or juvenile outmigration. Good et al. (2005) estimated that perhaps a third of the historical habitat used by fish in this ESU is currently inaccessible behind dams.

Between 1941 and 1968, the U.S. Army Corps of Engineers constructed, and now operates, a system of 13 dams and reservoirs for flood control in the Willamette River basin. Most of the dams do not include fish passage, and those that do are not very effective at passing fish. On July 11, 2008, NMFS issued a biological opinion on the Willamette Project (NMFS 2008a). The biological opinion includes a schedule for completion of improvements to some of the dams so that juvenile fish can pass them safely and improving water temperatures downstream from the dams to a more natural seasonal pattern. Efforts to make the dams more fish-friendly and to improve river water temperatures should improve the spatial structure of the species.

The lack of access to historical habitat above dams continues to be a key limiting factor for the spatial structure metric. The Clackamas population is at very low risk of extinction for spatial structure, the Molalla and McKenzie populations are at low-to-moderate risk, while the remaining four populations are at very high risk. The majority of natural production in the Clackamas occurs upstream of the North Fork Dam in historically accessible habitat, although there is some spawning, primarily by hatchery-origin fish, downstream of the dam. The majority of natural-origin spawning in the McKenzie population occurs above Leaburg Dam.

The Clackamas and McKenzie Rivers contain the only two populations in the ESU that have substantial natural production; both are at moderate risk of extinction for the diversity metric. The other five populations are at moderate-to-high risk for diversity. The 2005 ESA status analysis reported that nearly all the Molalla, North Santiam, South Santiam, Calapooia, and Middle Fork Willamette spawning populations were of hatchery origin. The analysis of hatchery fraction data collected since the last review support the view that these populations continue to be hatchery dominated and are likely not self-sustaining (McElhany et al. 2007; Schroeder et al. 2007; ODFW 2010). In addition, these populations appear to be experiencing significant risks from pre-spawning mortality of adults (Schroeder et al. 2005; McElhany et al. 2007; Schroeder et al. 2007).

Diversity in Chinook salmon populations can range in scale from genetic differences within and among populations to complex life-history disparities. Willamette Falls, a natural barrier before it was laddered, prevented fall-run Chinook salmon from occupying the upper Willamette River. Thus, the UWR Chinook salmon were historically composed of only the spring run. The ladder allows other life-history traits to occupy areas in the upper Willamette River; however, none are considered part of the historical populations or the ESU.

The diversity of UWR Chinook salmon has been affected by loss of habitat above dams and hatchery production. As described above, dams and other habitat alterations have reduced or eliminated tributary and mainstem areas. Introduction of fall Chinook and laddering the falls have increased the potential for genetic introgression between wild spring and hatchery fall Chinook. There is no direct evidence of hybridization between the two runs.

Artificial propagation has been identified as a major factor affecting the variation in diversity traits of UWR Chinook salmon. Large numbers of fish from the upper Willamette River (Santiam, McKenzie, and Middle Fork Willamette rivers) have been introduced since the 1960s. Changes in spawning timing have been observed over the last 100 years. Regardless of origin, the existing spring run has maintained a low-to-moderate level of natural production (and local adaptation) for a number of generations (NMFS 2004). The development and implementation of fish hatchery management and native fish conservation policies by the ODFW should help reduce the effects of hatchery programs on native stocks.

NMFS recognizes that artificial propagation can be used to help recover ESA-listed species, but it does not consider hatcheries to be a substitute for conserving the species in its natural habitat. Potential benefits of artificial propagation for natural populations include reducing the short-term risk of extinction, helping to maintain a population until the factors limiting recovery can be addressed, reseeding vacant habitat, and helping speed recovery. Artificial propagation could have negative effects on population diversity by altering life-history characteristics such as smolt age and migration, and spawn timing.

Updated ESU Risk Summary

Two related status evaluations of UWR Chinook salmon have been conducted since the 2005 status update (McElhany et al. 2007; ODFW 2010). Both evaluations concluded that the ESU is substantially below the viability criteria recommended by the WLC-TRT. Of the seven historical populations in the ESU, five are considered at very high risk. The remaining two (Clackamas and McKenzie) are considered at moderate- to-low risk. New data collected since the last report verified the high fraction of hatchery-origin fish (in some cases, >90 percent of total returns). The new data also highlight the substantial risks associated with pre-spawning mortality of adults. Although recovery plans are targeting key limiting factors for future actions, there have been no significant on-the-ground actions to resolve the lack of access to historical habitat above dams since the last review; nor have there been substantial actions removing hatchery fish from the spawning grounds. Overall, new information considered does not indicate a change in the biological risk category since the time of the previous status review in 2005.

4.2.13 Upper Willamette River Steelhead

NMFS listed the Upper Willamette River steelhead ESU as threatened on March 25, 1999, and reaffirmed this listing on January 5, 2006 (71 FR 834). The listing included all naturally spawned populations of winter-run steelhead in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River, inclusive (64 FR 14517). This DPS does not include any artificially propagated steelhead stocks that reside within the historical geographic range of the DPS. Hatchery summer-run steelhead occur in the Willamette basin but are an out-of-basin stock that is not included as part of the DPS (71 FR 834; January 5, 2006).

Description and Geographic Range. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 4,872 square miles in the Willamette River basin. For recovery planning and development of recovery criteria, the WLC-TRT identified four historical demographically independent populations for Upper Willamette River winter steelhead based on geography, migration rates, genetic attributes, life-history patterns, phenotypic characteristics, population dynamics, and environmental and habitat characteristics with guidance found in McElhany et al. 2000 (Figure 29). These include the Molalla, North Santiam, South Santiam and Calapooia (Myers et al. 2006).

There is intermittent spawning and rearing in westside Willamette River tributaries but these areas do not constitute an independent population (Ford et al. 2010).

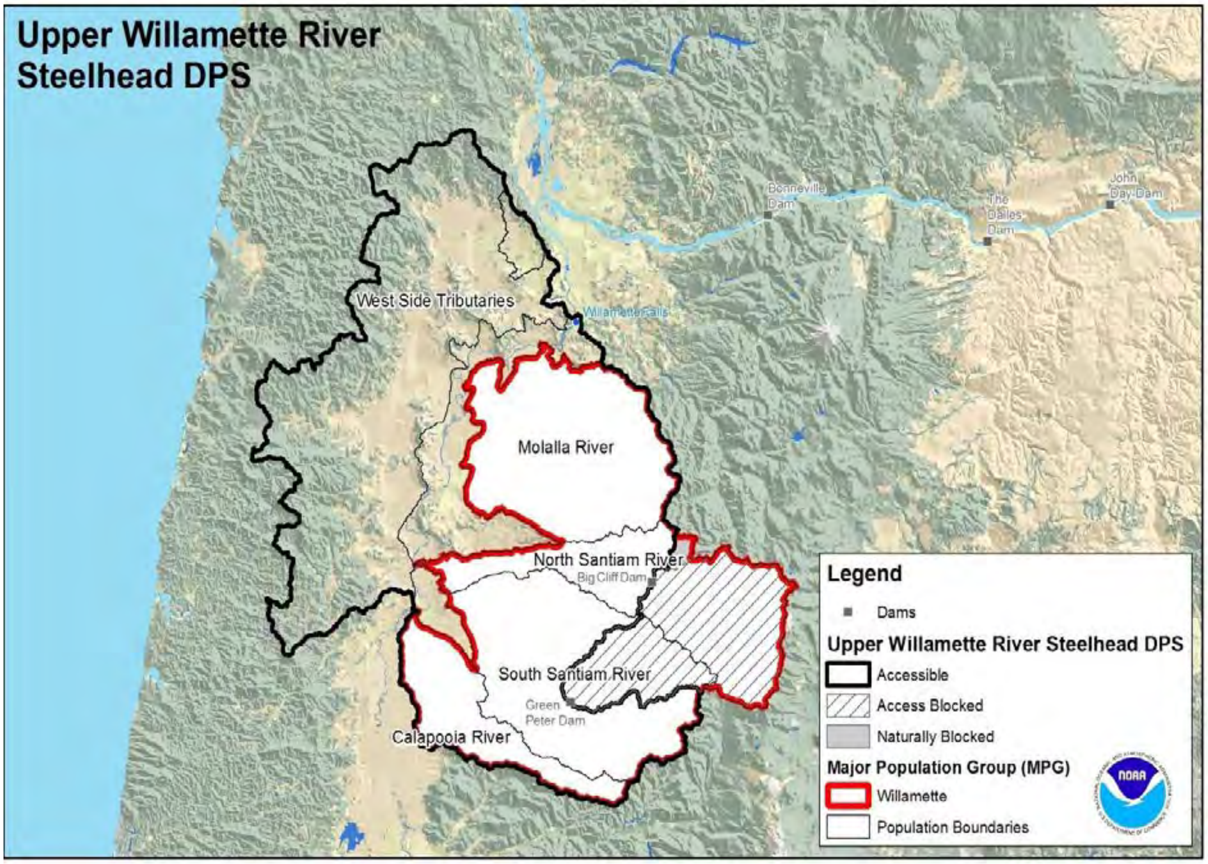

Figure 29. UWR steelhead population structure

In addition to recommending recovery criteria, the WLC-TRT also assessed the current status of each population within each Upper Willamette River ESU/DPS. Each population was rated against the biological criteria identified in the proposed recovery plan and assigned a current viability rating. Information provided in this status review is summarized from Ford et al. 2010—Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Northwest.

Life history. Chapter 16 of the *Comprehensive Analysis* (Action Agencies 2007b) and Busby et al. (1996) contains additional information about the life history and population status of this ESU and is incorporated here by reference.

Listed UWR steelhead are late-migrating winter steelhead, entering freshwater primarily in March and April. This atypical run timing appears to be an adaptation for ascending Willamette Falls, which functioned as an isolating mechanism for the Upper Willamette basin before the falls were laddered. Reproductive isolation resulting from passing above the falls may explain the genetic distinction between steelhead from the upper Willamette River and those in the lower river.

The UWR late-migrating steelhead are ocean-maturing fish. Most return at age 4, although a small proportion return as 5-year-old fish. Juvenile life stages (i.e., eggs, alevins, fry, and parr) inhabit freshwater/riverine areas throughout the range of the listed species. Parr usually undergo a smolt transformation as 2-year-olds, at which time they migrate to the ocean. Subadults and adults forage in coastal and offshore waters of the North Pacific Ocean before returning to spawn in their natal streams. Unlike Pacific salmon, steelhead are iteroparous—capable of spawning more than once before death. However, it is rare for steelhead to spawn more than once before dying, and almost all that do so are females (Nickelson et al. 1992). A nonanadromous form of *O. mykiss* co-occurs with the anadromous form and juvenile life stages of the two forms can be very difficult to differentiate.

Most species of *Oncorhynchus* die after spawning, whereas *O. mykiss* may spawn more than once. Busby et al. (1996) reviewed data on North American populations, and first-time (maiden) spawners comprised 94 percent of adults in the Columbia River. The majority of repeat spawners are female, presumably due to the extended time and energy males spend on the spawning ground competing for and guarding females and nests.

Habitat. Stream habitat in the upper Willamette basin has become substantially simplified since the 1800s—removal of large woody debris to increase the river's navigability, reduction in riparian vegetation, and channel modifications for a variety of reasons. Habitat conditions for anadromous fish have been fundamentally altered throughout the Columbia River Basin by the construction and operation of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control. In 1999, NMFS found that the loss of access to historical spawning grounds because of dams was a major risk factor to UWR steelhead. Less than 70 percent of the DPS' historical habitat is currently available to UWR steelhead (Good et al. 2005).

Abundance. Overall, numbers of native winter steelhead in the Upper Willamette basin declined in the early 1970s, exhibited large fluctuations in abundance from the late 1970s through late 1980s, declined to very low numbers in the 1990s, and rebounded to moderate levels in the early 2000s. Good et al. (2005), using data from the early 2000s, estimated the mean abundance of the entire listed species at less than 6,000 fish. (No artificially propagated steelhead stocks are considered part of the listed species.)

All four UWR steelhead populations are at relatively low abundance. Although hatchery production has been reduced or eliminated, effects on natural spawning remain high. No single population has been identified as naturally self-sustaining.

Population estimates show declines in recent years. All steelhead in the UWR steelhead DPS pass Willamette Falls. In the previous status review, data were only available to the year 2002 when population abundance peaked. However, since then, population abundance has returned to the relatively low levels of the 1990s—with the total abundance of winter steelhead at Willamette Falls in 2008 reaching 4,915 (distributed throughout the entire upper basin, minus basin mortality, including the four populations). Because wild winter steelhead also return outside of the DPS boundaries (ending at the

Calapooia River), Willamette Falls counts best estimate the actual DPS abundance. In 2009, the late-returning abundance for the entire DPS was 2,110 fish.

Adult winter-run steelhead are counted at the Willamette Falls fishway ladder (ODFW 2010b). Fish counts for the most recent years are displayed in Table 28. The fish counts for winter-run steelhead begin in November and end in May of the following year. The number of winter-run steelhead passing over Willamette Falls during the winter of 2008-2009 was only 2,813 and the most recent 5-year average is only slightly higher at 4,676. The 2009 counts were the lowest since the 1990s and the short-term trend is a downward trend.

Table 28. Upper Willamette winter-run steelhead abundance.

ESU/DPS	Winter Run	Natural-origin Spawners	5-year geometric mean
UWR Steelhead	2008-2009	2,813	4,676
	2007-2008	4,830	5,642
	2006-2007	5,494	7,060
	2005-2006	6,404	8,008
	2004-2005	5,963	
	2003-2004	11,842	
	2002-2003	9,092	

It is difficult to accurately estimate juvenile UWR steelhead abundance during the coming years. However, the average outmigration (2006-2009) of naturally produced smolts estimated to reach Tongue Point in the Columbia River is 226,535 (Ferguson 2006, 2007, 2009a, 2009b). As with other species, it is reasonable to assume that this figure could be substantially higher when other juvenile life stages are included. In addition, nonlisted juvenile rainbow trout and unlisted juvenile steelhead occur in the same areas as the listed UWR steelhead and it is very difficult to distinguish between them.

Productivity. Good et al. (2005) described the populations of UWR steelhead as in decline, with no single self-sustaining natural population. All populations are relatively small, and are affected to an unknown degree by hatchery production. On a positive note, the counts of all populations indicated an increase in abundance in 2001 compared to low numbers in the 1990s. The Molalla, North Santiam, and Calapooia river populations showed a declining trend from 1980 to 2000 or 2001. Counts of winter-run steelhead in the South Santiam are confounded by a hatchery program that was initiated in the 1980s. No spawner abundance counts are available for the west side tributaries population; however, there is assumed to be little, if any, natural production of steelhead in these tributaries. It is unknown whether the recent low productivity will continue or if the populations will return to the higher number from the early 2000s. Ford et al. 2010 considers all four populations to be in the moderate-risk-of-extinction category for abundance and productivity.

Spatial Structure and Diversity. The WLC-TRT identified four historical populations (Molalla, North Santiam, South Santiam, and Calapooia) and one "population sink" area (the west side tributaries) for this DPS. All of the populations (plus the sink) are in one stratum. The WLC-TRT determined that the west side tributaries were unlikely, individually or collectively, to have constituted a demographically independent population. The WLC-TRT included the west side tributaries as a population sink to recognize that winter steelhead may intermittently utilize some of these tributaries for spawning or rearing. This underscores the influence of these tributaries on water conditions in the mainstem Willamette River (NMFS 2005a). None of the four historical populations are extinct, thus the species' current spatial structure appears to be relatively intact. However, access to entire basins has been affected by changes to the habitat—especially by dams on the North and South Santiam. Historically, the areas above the dams on the North and South Santiam were primary production areas for UWR steelhead (Good et al. 2005).

Between 1941 and 1968, the U.S. Army Corps of Engineers constructed, and now operates, a system of 13 dams and reservoirs for flood control in the Willamette River basin. Most of the dams do not include fish passage, and those that do are not very effective at passing fish. On July 11, 2008, NMFS issued a biological opinion on the Willamette Project (NMFS 2008a). The biological opinion includes a schedule for completion of improvements to some of the dams so that juvenile fish can pass them safely, and improving water temperatures downstream from the dams to a more natural seasonal pattern. Efforts to make the dams more fish-friendly and to improve river water temperatures should improve the spatial structure of the species.

Diversity in steelhead populations can range in scale from genetic differences within and among populations to complex life-history disparities. One of the leading factors affecting the diversity of this DPS is the loss of habitat associated with construction of dams. As described above, the UWR steelhead have been affected by dams.

Steelhead from the Upper Willamette River are genetically distinct from those in the lower river (Busby et al. 1996). Reproductive isolation from lower river populations may have been facilitated by Willamette Falls, which is known to be a migration barrier to some anadromous salmonids. For example, winter steelhead and spring Chinook salmon occurred historically above the falls, but summer steelhead, fall Chinook salmon, and coho salmon did not (PGE 1994). Fish ladders were constructed at Willamette Falls in the late 1800s to aid the passage of anadromous fish. The ladders have been modified and rebuilt as fish passage technology has improved, most recently in 1971 (Bennett 1988; PGE 1994).

Winter steelhead hatchery releases in the Upper Willamette River ceased in 1999. However, there is still a substantial hatchery program for nonnative summer steelhead. In recent years, returning nonnative summer steelhead outnumber the native winter-run steelhead, which raises genetic (diversity) and ecological concerns. All four Upper

Willamette River populations are considered to be in the moderate-risk category for diversity. With regard to spatial structure, the previous status report considered loss of access to historical spawning grounds because of dams to be a major risk factor. During the 2010 status review, the WLC-TRT considered the Molalla population to be in the low-risk category for spatial structure, and the other three populations to be in the moderate-to-high risk categories for spatial structure, because dams block access to the upper watersheds in the North and South Santiam watersheds, and, other water quality problems exist in the Calapooia River. South Santiam steelhead access to the upper watershed is dependent upon trap-and-haul of fish at Foster Dam.

Updated DPS Risk Summary

Overall, the new information considered does not indicate a change in the biological risk category since the time of the 2005 status review. Although direct biological performance measures for this DPS indicate a little realized progress to date toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly. UWR steelhead initially increased in abundance, but subsequently declined. Current abundance is at the levels observed in the mid-1990s when NMFS first listed the DPS. The DPS continues to demonstrate the overall low abundance pattern that was of concern during the last status review. The elimination of winter run hatchery release in the basin reduces hatchery threats, but nonnative summer steelhead hatchery releases are still a concern. Human population growth within the Willamette basin continues to be a significant risk factor for the UWR steelhead populations. New information considered during the 2010 status review confirms that this DPS remains at a moderate risk of extinction.

4.3 Designated Critical Habitat for Columbia Basin Salmon and Steelhead

The ESA requires NMFS to designate critical habitat, to the maximum extent prudent and determinable, for species it lists under the ESA. Critical habitat is defined as:
(1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time of listing if the agency determines that the area itself is essential for conservation.

NMFS has designated critical habitat for 12 of the 13 salmon and steelhead species that may be affected by the Proposed Action. Critical habitat includes the stream channels within the designated stream reaches, and extends laterally to the ordinary high-water line. In areas where ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. In estuarine and nearshore marine areas, critical habitat includes areas contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 meters relative to mean lower low water. Within these areas, the primary constituent elements (PCEs) essential for the conservation of the listed species are those sites and habitat components that support one or more life stages.

Critical habitat was designated for Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, and Snake River sockeye salmon in December 1993 (58 FR 68543) and revised for Snake River spring/summer Chinook salmon in October 1999 (64 FR 57399) (see Table 29).

Table 29. Types of sites and essential physical and biological features of designated critical habitat PCEs identified for SR Sockeye, spring/summer Chinook, and fall Chinook salmon.

Habitat Component	Sockeye	Spring/Summer Chinook	Fall Chinook
1) spawning juvenile rearing areas	1) spawning gravel 2) water quality 3) water quantity 4) water temp. 5) food 6) riparian veg. 7) access	1) spawning gravel 2) water quality 3) water quantity 4) cover/shelter 5) food 6) riparian veg. 7) space	Same as Spring/Summer Chinook
2) juvenile migration corridors	1) substrate 2) water quality 3) water quantity 4) water temp. 5) water velocity 6) cover/shelter 7) food 8) riparian veg. 9) space 10) safe passage	Same as sockeye	Same as sockeye
3) areas for growth development to adulthood	Ocean areas – not identified	Same as sockeye	Same as sockeye
4) adult migration corridors	1) substrate 2) water quality 3) water quantity 4) water temp. 5) water velocity 6) cover/shelter 7) riparian veg. 8) space 9) safe passage	Same as sockeye	Same as sockeye

4.3.1 Snake River Spring/Summer Chinook, Fall Chinook, and Sockeye Salmon

Critical habitat designations for Snake River basin ESUs (SR spring/summer Chinook, SR fall Chinook, and SR sockeye) were defined in 58 FR 68543 for all SR mainstem and tributary subbasins occupied by these respective species. Critical habitat was also designed for the Columbia River mainstem migration corridor for each of these ESUs as follows: “The Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake River . . ..” Because the Odessa Proposed Action will have no effect to critical habitat areas in the Snake River basin outside of the Columbia River migration corridor, this BA will not list those critical habitat areas or discuss them further. The effects analysis performed in Section 5.4 below will analyze the effects on the Columbia River migration corridor critical habitat only for the Snake River basin ESUs.

Critical habitat was designated for the Snake River basin steelhead DPS and all other listed upper Columbia River, middle Columbia River, lower Columbia River (except coho salmon), and Willamette River anadromous salmonid ESUs and DPSs in September 2005 (70 FR 52630). Designation of critical habitat for the Lower Columbia River coho salmon ESU is currently under development by NMFS.

As part of the designation process, NMFS convened Critical Habitat Analytical Teams (CHARTs) to evaluate the current status of the ESU’s habitat and identify threats to habitat health. The Lower and Upper Columbia River CHART’s assessment reports are available at NMFS’ website at http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/2005-Biological-Teams-Report.cfm. In determining which areas should be critical habitat, the CHARTs identified the primary constituent elements (PCEs) that are essential for the conservation of the species. PCEs for these ESUs and DPSs are those sites and habitat components that support one or more life stages, including (1) freshwater spawning sites, (2) freshwater rearing sites, and (3) freshwater migration corridors. The ESUs addressed in the final critical habitat rule (70 FR 52630) and CHART reports share many of the same rivers and estuaries and have similar life-history characteristics and, therefore, many of the same PCEs. These PCEs include sites essential to support one or more life stages of the ESU (sites for spawning, rearing, migration and foraging). These sites, in turn, contain physical or biological features essential to the conservation of the ESU (for example, spawning gravels, water quality and quantity, side channels, forage species).

NMFS (NMFS 2005b) has identified the following PCEs for the nine ESUs and DPSs of Columbia Basin salmonids that were designated in 2005 (70 FR 52630):

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. These features are essential to conservation because without them, the species cannot successfully spawn and produce offspring.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them, juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (e.g., predator avoidance, competition) that help ensure their survival.

3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them, juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a nonfeeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.

4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. These features are essential to conservation because without them, juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to the conservation of adults because they provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to freshwater, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas.

5. A fifth category in NMFS (NMFS 2005b), "nearshore marine areas," refers to areas designated in Puget Sound (i.e., is not applicable to Columbia Basin salmonids).

The CHART identified habitat-related human activities that affect PCE quantity and/or quality. The primary categories of habitat-related activities identified by the CHART are (1) forestry, (2) agriculture, (3) channel modifications/diking, (4) road building/ maintenance, (5) urbanization, (6), dams, (7) irrigation impoundments and withdrawals, and (8) wetland loss/removal. All of these activities have PCE-related impacts because they have altered one or more of the following: stream hydrology, flow and water-level modifications, fish passage, geomorphology and sediment transport, temperature, dissolved oxygen, vegetation, soils, nutrients and chemicals, physical habitat structure, and stream/estuarine/marine biota and forage (NMFS CHART 2005).

At the time of the critical habitat designations that became final in September 2005, NMFS' CHARTs rated 525 occupied watersheds in the Columbia River Basin. The CHARTs gave each of these occupied watersheds a high, medium, or low rating. High-value watersheds are those with a high likelihood of promoting conservation, while low value watersheds are expected to contribute relatively little. Of the 525 watersheds evaluated, 382 were assigned a high rating, 93 a medium rating, and 50 a low rating. Many of the high value watersheds encompassed the mainstem Columbia River migration corridor due to its importance to both juvenile and adult salmon and steelhead populations. The CHART reports all noted that, "After reviewing the best available scientific data for all of the areas within the freshwater and estuarine range of Columbia River Basin salmon and steelhead, the CHART concluded that the Columbia River corridor was of high conservation value to the respective ESUs and DPSs. The CHART reports noted that this corridor connects every watershed and population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a particularly important area for salmon and steelhead as both juveniles and adults make the critical physiological transition between life in freshwater and marine habitats" (ISAB 2000, Marriott et al. 2002).

The action area is a migration and rearing corridor for adults and juveniles of all the listed salmon and steelhead species considered in this BA and has been designated as critical habitat from Chief Joseph Dam to the mouth of the Columbia River. The essential features of freshwater rearing areas are water quality, water temperature, cover/shelter, riparian vegetation and food. The essential features of freshwater migration corridors potentially affected by the Proposed Action are substrate, water quality, water velocity, temperature, riparian vegetation, food, and cover/shelter.

Similar to the Snake River basin discussed above, the Odessa Proposed Action will not have adverse affects to critical habitat areas in tributary subbasins of the Columbia River because these are outside of the hydrologic influence of the Proposed Action. As a result, this BA will not list those critical habitat areas or discuss them further. The effects analysis performed in Section 5.4 below will analyze the effects to critical habitat for the Columbia River migration corridor, including the estuarine habitat in the lower Columbia River, only. The following section briefly defines the boundaries and stream lengths for the Columbia River migration corridor that are likely to be affected by the Proposed Action for each salmon ESU and DPS with designated critical habitat. The habitat area definitions and designated stream lengths were taken from the 2005 NMFS CHART report (NMFS CHART 2005). The CHART ratings do not address SR spring/summer Chinook salmon, SR fall Chinook salmon, or SR sockeye salmon, because critical habitat was designated for these ESUs in 1993 under a separate rulemaking process. Ratings for the LCR coho salmon ESU are currently under development.

4.3.2 Upper Columbia River Spring Chinook

The Columbia River rearing and migration corridor consists of that segment from Rock Island Dam downstream to the Pacific Ocean (Figure 30). Rock Island Dam is located near the downstream border of the Entiat River, which was the furthest downstream HUC5 with spawning or tributary PCEs identified in the range of this ESU. Fish distribution and habitat use data from WDFW identify approximately 448 miles of occupied riverine and estuarine habitat in this corridor (WDFW 2003). This corridor overlaps with the following counties: Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Sherman, Umatilla, and Wasco counties in Oregon; and Benton, Chelan, Clark, Cowlitz, Douglas, Franklin, Grant, Kittitas, Klickitat, Skamania, Wahkiakum, Walla Walla, and Yakima counties in Washington.

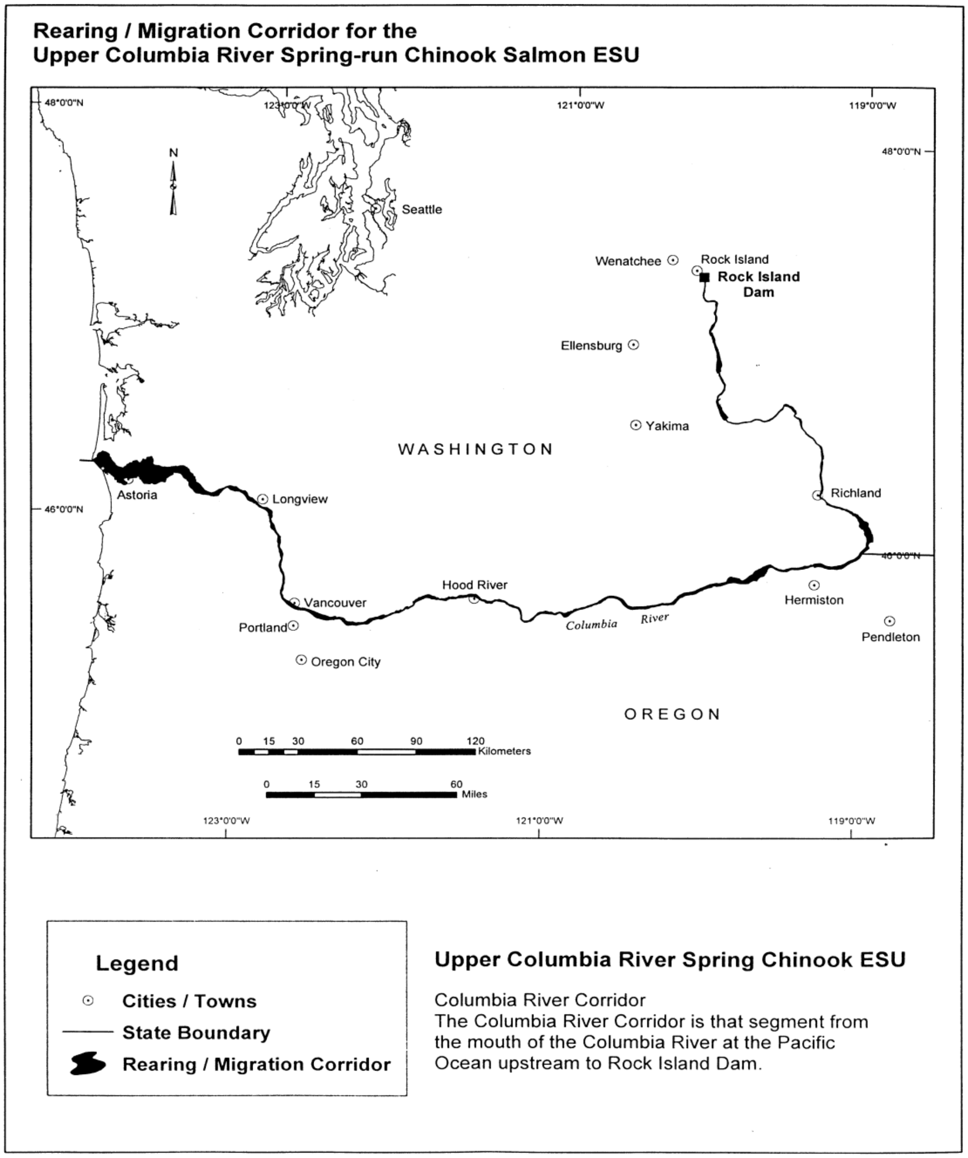

Figure 30. Map of designated critical habitat for Columbia River rearing/migration corridor for the UCR spring-run Chinook salmon ESU (map source: 70 FR 52630).

4.3.3 Upper Columbia River Steelhead

The Columbia River rearing and migration corridor consists of that segment from the confluence of the Yakima and Columbia rivers downstream to the Pacific Ocean. This confluence is located in the Columbia River/Zintel Canyon HUC5, which was the furthest downstream HUC5 with spawning or tributary PCEs identified in the range of this ESU. Fish distribution and habitat use data from WDFW identify approximately 331 miles of occupied riverine and estuarine habitat in this corridor (WDFW 2003). This corridor overlaps with the following counties: Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Sherman, Umatilla, and Wasco counties in Oregon; and Benton, Clark, Cowlitz, Franklin, Klickitat, Skamania, Wahkiakum, and Walla Walla counties in Washington.

4.3.4 Middle Columbia River Basin steelhead

The Columbia River rearing and migration corridor consists of that segment from the confluence of the Wind and Columbia rivers downstream to the Pacific Ocean. This confluence is located at the downstream boundary of the Middle Columbia/Grays Creek HUC5 which was the furthest downstream HUC5 with spawning or tributary PCEs identified in the range of this ESU. Fish distribution and habitat use data from ODFW and WDFW identify approximately 151 miles of occupied riverine and estuarine habitat in this corridor (ODFW 2003a; ODFW 2003b; WDFW 2003). This corridor overlaps with the following counties: Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Sherman, Umatilla, and Wasco counties in Oregon; and Benton, Clark, Cowlitz, Franklin, Klickitat, Skamania, Wahkiakum, and Walla Walla counties in Washington.

4.3.5 Snake River basin Steelhead

The lower Snake/Columbia River rearing and migration corridor begins in southeast Washington immediately downstream of the confluence of the Snake River with the Palouse River (Figure 31). The corridor includes approximately 58 miles of the Lower Snake River and 320 miles of the Columbia River. Watersheds between the Palouse River to the Columbia/Snake River confluence are outside of the spawning range of this ESU and likely used in a limited way as juvenile rearing habitat for this ESU.

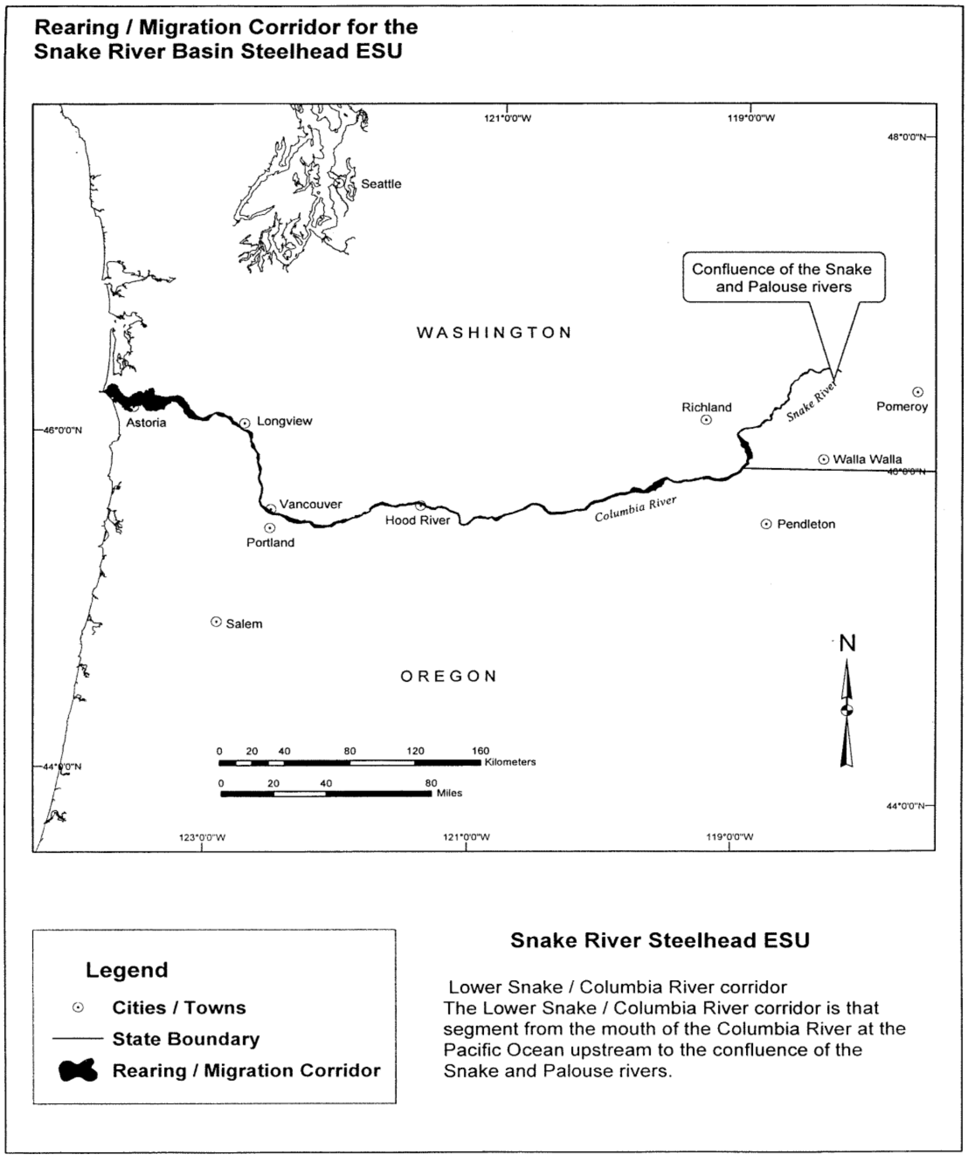

Figure 31. Map of 58 miles of Snake River and 320 miles of designated critical habitat for Columbia River rearing/migration corridor for the SR steelhead DPS (map source: 70 FR 52630).

4.3.6 Columbia River Chum Salmon

The lower Columbia River rearing and migration corridor consists of that segment from the mouth of the Columbia River at the Pacific Ocean upstream to an imaginary line connecting the confluences of the Sandy River (Oregon) and Washougal River (Washington) (Figure 32). This corridor overlaps with the following counties: Clatsop, Columbia, and Multnomah counties in Oregon; and Clark, Cowlitz, Pacific, and Wahkiakum counties in Washington. Fish distribution and habitat use data from WDFW identify approximately 118 miles of occupied riverine and estuarine habitat in this corridor (WDFW 2003).

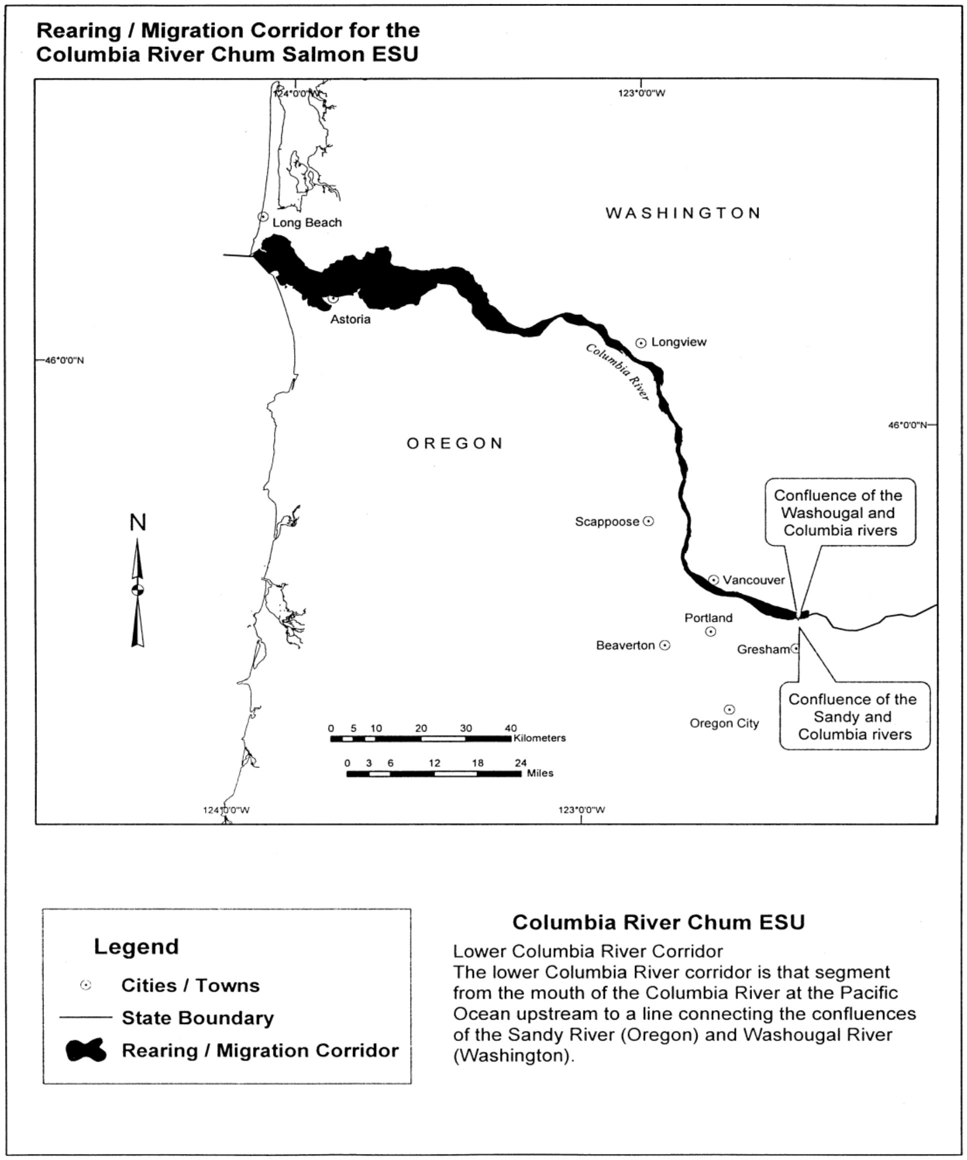

Figure 32. Map of 118 miles of designated critical habitat for Columbia River rearing/migration corridor for the Columbia River chum ESU (map source: 70 FR 52630).

4.3.7 LCR Chinook Salmon

The lower Columbia River rearing and migration corridor consists of that segment of the Columbia River from the confluences of the Sandy River (Oregon) and Washougal River (Washington) to the Pacific Ocean (see Figure 32 for chum salmon ESU above). This corridor overlaps with the following counties: Clatsop, Columbia, and Multnomah counties in Oregon; and Clark, Cowlitz, Pacific, and Wahkiakum counties in Washington. Fish distribution and habitat use data from ODFW and WDFW identify approximately 118 miles of occupied riverine and estuarine habitat in this corridor (ODFW 2003a; ODFW 2003b; WDFW 2003).

4.3.8 LCR coho salmon

Critical habitat has not been designated for LCR coho salmon at this time. However, the habitat upon which LCR coho depend overlaps with designated critical habitat for other listed salmon and steelhead.

4.3.9 LCR Steelhead

The lower Columbia River rearing and migration corridor consists of that segment from the mouth of the Columbia River at the Pacific Ocean upstream to an imaginary line connecting the confluences of the Sandy River (Oregon) and Washougal River (Washington) (see Figure 32 for chum salmon ESU above). This corridor overlaps with the following counties: Clatsop, Columbia, and Multnomah counties in Oregon; and Clark, Cowlitz, Pacific, and Wahkiakum counties in Washington. Fish distribution and habitat use data from ODFW and WDFW identify approximately 118 miles of occupied riverine and estuarine habitat in this corridor (ODFW 2003a; ODFW 2003b; WDFW 2003).

4.3.10 Upper Willamette Chinook Salmon

The lower Willamette/Columbia River rearing and migration corridor consists of that segment from the confluence of the Willamette and Clackamas rivers to the Pacific Ocean. This corridor also includes the Multnomah Channel portion of the Lower Willamette River. Watersheds downstream of the Clackamas River subbasin (Johnson Creek and Columbia Slough/Willamette River HUC5s) are outside the spawning range of this ESU and likely used in a limited way as juvenile rearing habitat for this ESU. Fish distribution and habitat use data from ODFW identify approximately 137 miles of occupied riverine and estuarine habitat in this corridor (ODFW 2003a; ODFW 2003b). The following counties contain designated critical habitat for UWR Chinook salmon: Benton, Clackamas, Clatsop, Columbia, Lane, Linn, Marion, Multnomah, Polk, and Yamhill counties in Oregon; and Clark, Cowlitz, Pacific, and Wahkiakum counties in Washington (70 FR 52630).

4.3.11 Upper Willamette River Steelhead

The lower Willamette/Columbia River rearing and migration corridor consists of that segment from the confluence of the Willamette and Clackamas rivers to the Pacific Ocean. This corridor also includes the Multnomah Channel portion of the Lower Willamette River. Watersheds downstream of the Clackamas River subbasin (Johnson Creek and Columbia Slough/Willamette River HUC5s) are outside the spawning range of this ESU and likely used in a limited way as juvenile rearing habitat for this ESU. Fish distribution and habitat use data from ODFW identify approximately 138 miles of occupied riverine and estuarine habitat in this corridor (ODFW 2003a; ODFW 2003b). The following counties contain designated critical habitat for UWR steelhead: Benton, Clackamas, Clatsop, Columbia, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill counties in Oregon; and Clark, Cowlitz, Pacific, and Wahkiakum counties in Washington (70 FR 52630).

4.4 Southern DPS of Pacific Eulachon (*Thaleichthys pacificus*)

4.4.1 Current Rangewide Status of Southern DPS of Pacific Eulachon

Pacific eulachon, or smelt, are a small, anadromous forage fish inhabiting the northeastern Pacific Ocean, ranging from northern California northward to south-central Alaska and into the southeastern Bering Sea. Upon completion of a status review, NMFS determined that populations of Pacific eulachon spawning from the Skeena River in British Columbia, Canada south to the Mad River in northern California comprised a southern DPS and was evaluated for listing under the ESA (74 FR 10857). The southern DPS of Pacific eulachon was listed as threatened under the ESA by NMFS on March 18, 2010 (75 FR 13012).

Description and Geographic Range. Eulachon are endemic to the northeastern Pacific Ocean, ranging from northern California to southwest and south-central Alaska and into the southeastern Bering Sea. In the portion of the species’ range that lies south of the U.S.–Canada border, most eulachon production originates in the Columbia River Basin. Within the Columbia River Basin, the major and most consistent spawning runs return to the mainstem of the Columbia River and the Cowlitz River. Periodic spawning also occurs in the Grays, Elochoman, Kalama, Lewis, and Sandy rivers. Adult eulachon have been recorded at several locations on the Washington and Oregon coasts, and they were previously common in Oregon’s Umpqua River and the Klamath River in northern California. Runs occasionally occur in many other rivers and streams, although these tend to be erratic, appearing in some years but not others, and appearing only rarely in some river systems (Hay and McCarter 2000; Willson et al. 2006; NMFS 2010). Adult eulachon are known to migrate up coastal rivers, including the Columbia River, spawning in the mainstem and select tributaries (Figure 33), with larval forms outmigrating through the estuary and with juvenile forms rearing in marine waters extending out along the continental shelf (NMFS 2008d).

Figure 33. Distribution of eulachon in the lower Columbia River and tributaries.

Biological Requirements. The biological requirements of southern DPS eulachon are not completely understood, but we do know that eulachon require adequate spatial structure and diversity, habitat, abundance, and productivity to ensure their survival and recovery in the wild (NMFS 2010).

Eulachon generally spawn in rivers fed by either glaciers or snowpack and that experience spring freshets. It has been suggested that because these freshets rapidly move eulachon eggs and larvae to estuaries, it is likely that eulachon imprint and home to an estuary into which several rivers drain rather than to individual spawning rivers (Hay and McCarter 2000).

Adult eulachon return to freshwater to spawn at 2 to 5 years of age. Eulachon typically enter the Columbia River system from December to May with peak entry and spawning during February and March (NMFS 2010) (Table 30). Peak tributary abundance is usually in February, with variable abundance through March and an occasional showing in April (ODFW and WDFW 2009). Spawning in the lower Columbia River can occur soon after freshwater entry (ODFW and WDFW 2009). Eulachon spawn in the mainstem Columbia River and usually spawn every year in the Cowlitz River, with inconsistent runs and spawning events occurring in the Gray's, Elochoman, Lewis, Kalama, and Sandy rivers (ODFW and WDFW 2009). Though eulachon have been observed migrating up the Columbia River, spawning has not been documented in the mainstem above RM 80 (Romano et al. 2002).

Table 30. Eulachon presence in the lower Columbia River and tributaries.

Life Stage	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Adult												
Egg												
Larvae												

Several aspects of eulachon biology indicate that large aggregations of adult eulachon are necessary to maintaining the species normal reproductive output. Eulachon are a short-lived, high-fecundity, high-mortality forage fish, and such species typically have extremely large population sizes. Eulachon are broadcast spawners and typically prefer spawning areas with coarse-sandy substrate. Most adults die after spawning. Estimates of fecundity range from 7,000 to 60,000 eggs per female and survival from egg to larva may be less than 1 percent (NMFS 2010). After fertilization, the eggs settle to the bottom and adhere to river substrates, typically pea-sized gravel and coarse sand (Hart and McHugh 1944). Incubation occurs for about 30 to 40 days, depending on water temperature (ODFW and WDFW 2009).

Young eulachon larvae are about 0.2 to 0.3 inches in length and are rapidly flushed to the ocean, often within days of hatching, subsisting on their yolk sac during this downstream dispersal (ODFW and WDFW 2009). After the yolk sac is depleted, eulachon feed on pelagic plankton. Larvae rear in the pelagic zone and experience high mortality rates during their transition to the juvenile phase. Among such marine species, conditions of high fecundity and high mortality may lead to random “sweepstake recruitment” events where only a small minority of spawning individuals contribute to subsequent generations (Hedgecock 1994). It is thought that large population sizes are necessary for viability because: (1) there is a critical threshold density of adult eulachon that must be present for successful reproduction; (2) there must be enough offspring to counteract high inriver egg and larval mortality and larval mortality in the ocean; and (3) there must be enough offspring to buffer against variation in local environmental conditions (NMFS 2010).

Eulachon spend the majority of their life in salt water and little is known about their ecology. Information on the distribution and ecology of juvenile eulachon is scanty due to these fish being too small to be detected in fisheries surveys and too large to occur in ichthyoplankton surveys (Hay and McCarter 2000). It is likely that juvenile eulachon rear in nearshore marine areas at a moderate or shallow depth (Barraclough 1964) and feed on pelagic plankton, including euphausiids (krill). As they grow at sea, they tend to utilize waters of greater depths and have been found as deep as 2,050 feet (Allen and Smith 1988).

Adult eulachon range in size from 5 to 12 inches and are planktivorous in the ocean, but stop feeding when returning to freshwater to spawn (McHugh 1939, Hart and McHugh

1944). The homing instinct of eulachon (returning to birth streams) is not clear, but it is postulated that larvae may spend weeks to months in nearby estuarine environments where they grow significantly in size and may develop the capacity to imprint on large estuaries and eventually home to these areas as adults (McCarter and Hay 1999, Hay and McCarter 2000).

Abundance and Productivity. Quality data on current population sizes for eulachon is lacking; however, NMFS determined that although eulachon are a relatively poorly monitored species, the weight of the available information indicated that an abrupt decline in the abundance of the southern DPS throughout its range had occurred (NMFS 2010b). Historically, the largest returns of any spawning population throughout the species' range occurred in the Columbia River. Prior to the construction of Bonneville Dam, occasional reports were received of smelt occurring upstream as far as Hood River, Oregon, and possibly farther (Smith and Saalfeld 1955). In times of great abundance (e.g., 1945, 1953), eulachon have been known to migrate as far upstream as Bonneville Dam at RM 146.1 (Smith and Saalfeld 1955, Howell et al. 2001), and are suspected of passing through the ship locks, having reached the Klickitat River (Smith and Saalfeld 1955). Historically, commercial harvest of eulachon occurred in the lower Columbia River mainstem and tributaries such as the Grays, Cowlitz, Kalama, Lewis, and Sandy rivers.

Monitoring of the annual eulachon run size has not occurred, although commercial harvest on the Columbia River and some tributaries has been documented since the late 1800s and represents the best available long-term data on Columbia River eulachon returns. Although commercial landings are not applicable for developing annual population estimates because they are influenced by commercial demand, season structure, and environmental conditions, they do provide a useful measure of the relative run strength (NMFS 2010c). Annual returns, based on commercial landings, vary among years, but were relatively stable until the mid-1990s when a sharp decline occurred (Figure 34).

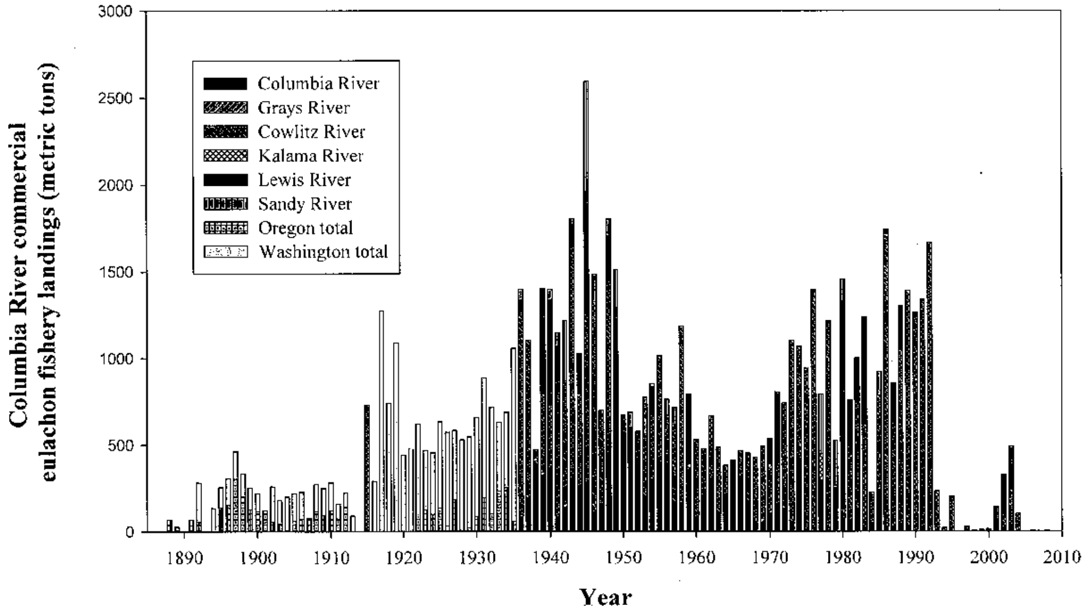

Figure 34. Commercial eulachon fishery landings in the Columbia River and tributaries from 1888 to 2008 (NMFS 2010c).

There are few direct estimates of eulachon abundance. In some areas of the southern DPS where escapement counts or estimates of spawning stock biomass are unavailable, catch statistics are used to estimate relative abundance. However, inferring population status or even trends from yearly changes in catch statistics requires assumptions that are seldom met, including similar fishing effort and efficiency, assumptions about the relationship of the harvested portion to the total portion of the stock, and statistical assumptions, such as random sampling. None of these assumptions can be verified. There are few fishery-independent sources of abundance data available for eulachon, and there is an absence of monitoring programs for them (in the United States). However, the combination of catch records and anecdotal information indicate that eulachon were present in large annual runs in the past and that significant declines in abundance have occurred. Eulachon numbers are at, or near, historically low levels throughout the range of the southern DPS.

The Columbia River and its tributaries support the largest known eulachon run. Although direct estimates of adult spawning stock abundance are unavailable, records of commercial fishery landings begin in 1888 and continue as a nearly uninterrupted data set to the present time (NMFS 2010). Historic commercial catch levels were typically more than 500 metric tons, and occasionally exceeded 1,000 metric tons, for three quarters of a century from about 1915 to 1992. In 1993, the catch level began to decline and has averaged less than 5 metric tons through the last 4 years of record (2005- 2008). Some of this pattern is due to fishery restrictions which were put in place in response to the sharp decline in abundance. Persistent low returns and landings of eulachon in the Columbia River from 1993 to 2000 prompted the States of Oregon and Washington to adopt a Joint

State Eulachon Management Plan (WDFW and ODFW 2001). The eulachon management plan includes harvest restrictions when run strength, juvenile production, and ocean productivity indicate a poor return.

Similar declines in abundance have occurred in the Fraser and other coastal British Columbia rivers (Hay and McCarter 2000; Moody 2008). Over a three-generation time of 10 years (1999-2009), the overall biomass of the Fraser River eulachon population has declined by nearly 97 percent (NMFS 2010). The biomass was estimated to be 418 metric tons in 1999 and by 2009 had dropped to just 14 metric tons. Abundance information is lacking for many of the coastal British Columbia subpopulations but, in general, NFMS (2010) found that eulachon were present in larger annual runs in the past. Furthermore, four out of seven of the coastal British Columbia subpopulations may be at risk from small population concerns such as allele effects and random genetic and demographic effects.

There has been no long-term monitoring program for eulachon in Northern California, but large spawning aggregations of eulachon were reported to have once regularly occurred in the Klamath River (Fry 1979; Moyle et al. 1995; Larson and Belchik 1998; Moyle 2002; Hamilton et al. 2005). Although NMFS is reasonably confident that eulachon have declined substantially in the Klamath River, it is also clear that they have not been totally absent from this area in recent years. In particular, recent reports from Yurok Tribal fisheries biologists of a few eulachon being caught incidentally in other fisheries on the Klamath in 2007 indicates eulachon still enter the Klamath River in low numbers.

Spatial Structure and Diversity. There are no distinct differences among eulachon throughout the range of the southern DPS. However, the BRT did separate the DPS into four subpopulations in order to rank threats they face. These are the Klamath River (including the Mad River and Redwood Creek), the Columbia River (including all of its tributaries), the Fraser River, and the BC coastal rivers north of the Fraser River up to, and including, the Skeena River. No detailed analysis has been conducted yet to determine southern DPS eulachon population structure below the DPS level.

Habitat. As noted above, the southern DPS of eulachon inhabits rivers in British Columbia, Washington, Oregon, and northern California. The rivers in this region are influenced by medium-to-high rainfall and generally drain in mountainous terrain with steep canyons. Between the ocean and the mountains lies a narrow coastal plain composed of sand, silt, and gravel. Average annual river flows for most rivers in this region are among the highest found on the West Coast when adjusted for watershed area. Peak flows occur during winter rainstorms common in December and January. Snowmelt adds to the surface runoff in the spring, providing a second flow peak (spring freshet), and there are long periods when the river flows are maintained at a level of at least 50 percent of peak flow.

Primary Limiting Factors. As discussed in the *Federal Register* listing notice (75 FR 13012), the primary factors resulting in the decline of the southern DPS of eulachon are the destruction, modification, or curtailment of habitat and an inadequacy of existing regulatory mechanisms. NMFS also identified climate-induced changes in ocean conditions as the most significant threat and climate-induced changes to freshwater habitat as a moderate threat to eulachon throughout the range of the DPS (75 FR 13012). Other factors identified as low-to-moderate threats included dams and water diversion projects, dredging, commercial and recreational fisheries, predation or disease, and bycatch of eulachon in other commercial fisheries, depending on when and/or where they occur (75 FR 13012).

4.4.2 Critical Habitat for Pacific Eulachon

On October 20, 2011, NMFS published a rule designating critical habitat for Pacific eulachon (76 FR 65324). Within the action area, the lower Columbia River from the mouth upstream to Bonneville Dam is designated as critical habitat, and, along with its tributaries, is noted to support the largest known spawning run of eulachon.

Essential Features

In developing critical habitat, NMFS developed a list of physical or biological features essential for conservation of Pacific eulachon, including:

- Freshwater spawning and incubation sites with water flow, quality, and temperature conditions and substrate supporting spawning and incubations,
- Freshwater and estuarine migration corridors free of obstruction and with water flow, quality, and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted, and
- Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival (juveniles: phytoplankton, copepod eggs, copepods, and other small zooplanktons; adults: euphausiids and copepods).

Of these, the mainstem of the lower Columbia in the action area provides: 1) spawning and incubation sites, and 2) a large migratory corridor to spawning areas in the tributaries (NMFS 2010c). Effects of the Odessa Proposed Action on the components of these two essential features are analyzed in Section 5.5.5 to consult on the designated critical habitat for Pacific eulachon.

4.5 Southern DPS of Green Sturgeon (*Acipenser medirostris*)

4.5.1 Current Rangewide Status of Southern DPS of Green Sturgeon

Upon completion of a status review, NMFS determined that green sturgeon comprise two DPSs that qualify as species under ESA: 1) a northern DPS, consisting of populations in coastal systems from the Eel River, California northward, that was determined to not warrant listing; and 2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River (Adams et al. 2002). On April 7, 2006, NMFS listed the southern DPS of North American green sturgeon (hereafter referred to as "green sturgeon") as a threatened species (71 FR 17757).

Description and Geographic Range. The southern DPS consists of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. Information on their oceanic distribution and behavior indicates that green sturgeon make generally northern migrations—even occurring in numbers off Vancouver Island (NMFS 2005b). A mixed stock assessment assigned about 70-90 percent of the green sturgeon present in the Columbia River estuary and Willapa Bay to the southern DPS. The stock composition in Grays Harbor is about 40 percent southern DPS (Israel et al. 2009).

Biological Requirements. Green sturgeon—like all sturgeon—are a long-lived, slow-growing species. Adult green sturgeon typically migrate into freshwater beginning in late February and spawn from March to July. Green sturgeon females produce 60,000-140,000 eggs. Green sturgeon larvae are different from all other sturgeon because they lack a distinct swim-up or post-hatching stage and are distinguished from white sturgeon by their larger size, light pigmentation, and size and shape of the yolk sac. First feeding occurs 10 days after they hatch, and metamorphosis to juveniles is complete at 45 days. The larvae grow fast, reaching a length of 66 mm and a weight of 1.8 grams in three weeks of exogenous feeding. Larvae hatched in the laboratory are photonegative and exhibit hiding behaviors after the onset of exogenous feeding. The larvae and juveniles are nocturnal. Juveniles appear to spend 1-3 years in freshwater before they enter the ocean (NMFS 2005b).

Green sturgeon are the most marine-oriented of the North American sturgeon species. Juveniles of this species are able to enter estuarine waters after only 1 year in freshwater. During this time, they are believed to feed on benthic invertebrates, although little is known about rearing habitats and feeding requirements. Green sturgeon are known to range in nearshore marine waters from Mexico to the Bering Sea, and are commonly observed in bays and estuaries along the west coast of North America, including the Columbia River (NMFS 2008m). McLain (2006) noted that southern DPS green sturgeon were first determined to occur in Oregon and Washington waters in the late 1950s when tagged San Pablo Bay green sturgeon were recovered in the Columbia River estuary. The proportion of the southern relative to Northern DPS is high (~67-82 percent, or 121 fish, of 155 fish sampled) (Israel and May 2007). Aggregations of adults occupy the lower Columbia River and estuary, up to the Bonneville Dam, primarily during summer months (WDFW and ODFW 2002, Moser and Lindley 2007). Beamis and Kynard (1997) suggested that green sturgeon move into estuaries of nonnatal rivers to feed. Information from fisheries-dependent sampling suggests that green sturgeon only occupy large estuaries during the summer and early fall in the northwestern United States. Green sturgeon are known to enter Washington estuaries during summer (Moser and Lindley 2007). There is no evidence of spawning in the Lower Columbia. Green sturgeon in the lower Columbia River are most likely feeding, but, to date, all stomachs examined (n>50) have been empty (Rien as cited in Grimaldo and Zeug 2001).

Green sturgeon disperse widely in the ocean between their freshwater life stages. Tagged fish from the Sacramento River have been captured primarily to the north in coastal and estuarine waters. While there is some bias associated with this information (which was retrieved primarily from commercial fishing), a northern migration is also supported by the large concentrations of green sturgeon entering the Columbia River estuary, Willapa Bay, and Grays Harbor. These fish tend to be immature; however, some mature fish and at least one ripe fish have been found in the lower Columbia River (Adams et al. 2002).

The southern DPS' status and biological requirements are described in two status reviews (Adams et al. 2002; NMFS 2005b). The southern DPS was listed as threatened because NMFS found that they are not presently in danger of extinction, but are likely to become so. The southern DPS of green sturgeon requires adequate spatial structure, habitat, abundance, productivity, and diversity to ensure their survival and recovery in the wild.

Abundance and Productivity. Juvenile entrainment data from the Sacramento-San Joaquin Delta pumping facilities of the Central Valley Project and State Water Project provide an indication of how green sturgeon abundance has changed since 1968. The estimated average number of green sturgeon entrained and killed each year at John Skinner Fish Facility prior to 1986 was 732; from 1986 on, the average number decreased to 47. At the Tracy Fish Collection Facility, the average prior to 1986 was 889; from 1986 on the number decreased to 32 (70 FR 17386). A substantial decrease in entrainment of green sturgeon was thus seen at both facilities. Furthermore, the decrease in numbers of green sturgeon entrained in these facilities occurred while water export levels at both facilities have increased substantially, i.e., more water was pumped but fewer green sturgeon were entrained.

The only nonharvest population estimate for adult green sturgeon in the southern DPS comes from the California Department of Fish and Game (CDFG) (2002) white sturgeon monitoring project. Tagging experiments for white sturgeon in San Pablo Bay have captured a total of 498 green sturgeon and tagged 233 of them. A population estimate for green sturgeon was derived by multiplying the ratio of legal-size green sturgeon to legal-size white sturgeon (legal-size sturgeon are ≥102 cm) caught in the tagging program by the legal-size white sturgeon population estimate. Even though the last estimate (2001) is four times greater than the next highest, trend analysis of green sturgeon abundance and productivity indicates that the population is neither decreasing nor increasing (NMFS 2005b).

There are a number of problems with the adult abundance estimate, the most important being the assumption that both species are equally vulnerable to the gear. Green sturgeon also tend to concentrate in estuaries only during summer, as opposed to white sturgeon which remain in estuaries year around. Furthermore, the portion of these captures consisting of southern DPS green sturgeon is unknown, as the fish were primarily captured in San Pablo Bay which is known to consist of a mixture of northern and southern DPS green sturgeon. However, declines in abundance are evident due to habitat loss and degradation, overharvest, and entrainment.

Quality data on current population sizes and trends for green sturgeon is nonexistent. Lacking any empirical abundance information, Beamesderfer et al. (2007) recently attempted to characterize the relative size of the Sacramento-San Joaquin green sturgeon population (Southern DPS) by comparison with the Klamath River population (Northern DPS). Using Klamath River Tribal fishery harvest rate data and assuming adults represent 10 percent of the population at equilibrium, they roughly estimate the Klamath population at 19,000 fish with an annual recruitment of 1,800 age-1 fish. Given the relative abundance of the two stocks in the Columbia River estuary based on genetic samples, they speculate abundance of the Sacramento population may equal, or exceed, the Klamath population estimate. Collectively, Beamesderfer et al. (2007) estimate abundances of the various green sturgeon populations may be larger than previously thought due to seasonal high abundances in the Columbia River, Willapa Bay, and Grays River estuaries and other coastal tributaries, historical high harvest in different areas at different times, and a significant portion of each population likely remains in the ocean at any given time.

Spatial Structure and Diversity. The only known spawning population of green sturgeon in the southern DPS is found in the Sacramento River. Based upon observations incidental to winter-run Chinook monitoring at the Red Bluff Diversion Dam, Tehama County, green sturgeon adults and juveniles occur throughout the upper Sacramento River. Adult green sturgeon have been observed in the Feather River (Beamesderfer et al. 2004) and are thought to also enter the Bear River, a tributary of the lower Feather River (USFWS 1995). However, there are no confirmed reports of green sturgeon reproduction in the Feather River. The CDFG (2002) reported that Oroville Dam limits access to potential spawning habitat, and warm water releases from the Thermalito Afterbay reservoir may increase temperatures to levels that are unsuitable for spawning and incubation in the Feather River. Adult green sturgeon have also been captured in the San Joaquin River Delta (Adams et al. 2002). Moyle et al. (1992) suggested the presence of green sturgeon in the delta is evidence that green sturgeon are spawning in the San Joaquin River. But there are no documented observations of green sturgeon in the San Joaquin River upstream of the delta.

Diversity in green sturgeon populations can range in scale from genetic differences within and among populations to complex life-history traits. One of the leading factors affecting the diversity of the southern DPS of green sturgeon is the loss of habitat due to impassable barriers such as dams. As described above, several tributaries to the Sacramento River have been blocked and have therefore almost certainly reduced the DPS' diversity. Although this DPS migrates over long distances, its spawning locations are small and have been greatly affected by human activities.

Habitat. Recent habitat evaluations conducted in the upper Sacramento, Feather, and San Joaquin Rivers suggest that large amounts of potential green sturgeon spawning habitat were made inaccessible or altered by dams (NMFS 2005b). An American Fisheries Society assessment concluded that the green sturgeon's range has declined by 88 percent

(Musick et al. 2000). Logging practices, land use practices, railroad construction, and building and operating dams have all destroyed green sturgeon habitat (Adams et al. 2002). There has been a substantial loss of spawning habitat behind Keswick and Shasta dams—both impassable barriers to green sturgeon. Water temperatures in the current spawning areas are lower than they were historically due to water releases from Shasta Dam. Before dam construction, green sturgeon would have had to migrate farther up the mainstem than they do now in order to encounter water temperatures cool enough to trigger spawning. Additional habitat behind Shasta Dam—in the Pit, McCord, and Little Sacramento River systems—would have supported separate populations or at least a single, larger Sacramento River population less vulnerable to catastrophes than one confined to a single mainstem location (70 FR 17386).

Limiting Factors for Green Sturgeon. The principal factor in the decline of the southern DPS is the reduction of the spawning habitat to a limited section of the Sacramento River (NMFS 2006d). The potential for catastrophic events to affect such a limited spawning area increases the risk of the green sturgeon's extirpation. Insufficient freshwater flow rates in spawning areas, contaminants (e.g., pesticides), bycatch of green sturgeon in fisheries, potential poaching (e.g., for caviar), entrainment of juveniles by water projects, influence of exotic species, small population size, impassable migration barriers, and elevated water temperatures in the spawning and rearing habitat likely also pose threats to this species (NMFS 2006d).

Conclusion

The southern DPS of N. American green sturgeon remains vulnerable due to having only one small spawning population, potential growth-limiting and lethal temperatures, harvest concerns, loss of spawning habitat, and entrainment by water projects. There will have to be substantial changes in this species' status before it can recover.

4.5.2 Critical Habitat for Green Sturgeon

Critical habitat was designated for the southern DPS of green sturgeon on October 9, 2009 (74 FR 52300). It includes approximately 320 miles of freshwater river habitat, 897 square miles of estuarine habitat, 11,421 square miles of marine habitat, 487 miles of habitat in the Sacramento-San Joaquin Delta, and 135 square miles of habitat within the Yolo and Sutter bypasses (Sacramento River, California). The critical habitat designation includes the Columbia River estuary below RM 46, the maximum extent of saltwater intrusion, and coastal waters within the 60-fathom depth, including the Columbia River plume.

Primary Constituent Elements for Green Sturgeon Critical Habitat in the Columbia River Estuary and Plume

As part of the designation process, NMFS convened CHARTs to identify habitat features essential to the conservation of the species and provide a biological assessment of these features within the range of the species. The CHART recognized that the different systems occupied by green sturgeon at specific stages of their life cycle serve distinct purposes and thus may contain different PCEs. Based on the best available scientific information, the CHART identified the following PCEs for freshwater riverine systems, estuarine areas, and coastal marine waters:

- For freshwater riverine systems: (1) abundant food resources; (2) substrate of proper type or size; (3) water flows; (4) water quality; (5) migration corridors; (6) habitat depth; and (7) sediment quality.
- For estuarine habitats: (1) food resources; (2) water flow; (3) water quality; (4) migration corridors; (5) habitat depth; and (6) sediment quality.
- For nearshore coastal marine habitats: (1) migration corridors; (2) water quality; and (3) food resources.

Based on discussions with the CHART and consideration of the economic analysis, several activities were identified that may threaten the PCEs to the extent that special management considerations or protection may be required. Major categories of habitat-related activities are: (1) dams; (2) water diversions; (3) dredging and disposal of dredged material (including activities associated with wetland loss and removal); (4) in-water construction or alterations (including channel modifications/diking, sand and gravel mining, gravel augmentation, road building and maintenance, forestry, grazing, agriculture, urbanization, and other activities); (5) National Pollution Discharge Elimination System permit activities and activities resulting in nonpoint source pollution; (6) powerplants; (7) commercial shipping (including concerns related to exotic/invasive species introductions or spread); (8) aquaculture; (9) desalination plants; (10) proposed alternative energy hydrokinetic projects (e.g., tidal energy and wave energy projects); (11) liquefied natural gas projects; (12) bottom trawling; and (13) habitat restoration activities for other species. All of these activities may have an effect on one or more PCEs by altering one or more of the following: stream hydrology, water level and flow, water temperature, dissolved oxygen levels, erosion and sediment input/transport, physical habitat structure, vegetation, soils, nutrients and chemicals, fish passage, and stream/estuarine/marine benthic biota and prey resources.

As previously stated, green sturgeon critical habitat in the Columbia River Basin extends from approximately RM 46 of the Columbia River downstream to the confluence of the Columbia River with the Pacific Ocean. This area is best represented by the estuarine critical habitat type and possesses those PCEs listed above for estuarine habitat areas. The green sturgeon critical habitat in the Columbia River was not designated in upstream riverine critical habitat areas, nor will the Proposed Action have a measureable effect to the nearshore marine habitat areas in the Columbia River plume or Pacific Ocean. As a result, the only green sturgeon critical habitat area that Reclamation can affect is estuarine critical habitat.

Of the estuarine habitat area PCEs that are potentially affected by the Proposed Action, the mainstem of the lower Columbia in the action area provides water flow and a migratory corridor (NMFS 2010c). Effects of the Odessa Proposed Action on the components of these two essential features are analyzed in Section 5.6.1 to consult on the designated critical habitat for green sturgeon eulachon.

4.6 Southern Resident Killer Whales (*Orcinus orca*)

4.6.1 Current Rangewide Status for Southern Resident Killer Whale DPS

The Southern Resident killer whale DPS was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). The final rule included information on the population decline in the 1990s and identified several potential factors that may have caused the decline or may be limiting recovery, such as quantity and quality of prey, toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. The rule also identified oil spills as a potential risk factor for this species. Southern Residents are designated as “depleted” and “strategic” under the Marine Mammal Protection Act (MMPA) (NMFS 2003e). A final recovery plan for Southern Residents was issued in January 2008 (NMFS 2008j). For more detailed information about this population, please refer to the Final Recovery Plan for Southern Resident Killer Whales, which can be found on the internet at www.nwr.noaa.gov.

Description and Geographic Range. Killer whales are the world’s largest dolphins and the listed Southern Resident DPS overlaps in range in the northeastern Pacific Ocean with other whale populations classified as transient, resident, and offshore populations. The Southern Resident killer whale DPS consists of three pods, identified as J, K, and L pods. Southern Residents are found throughout the coastal waters off Washington, Oregon, and Vancouver Island, and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia. Southern Residents are highly mobile and can travel up to 86 miles (160 km) in a single day (Erickson 1978, Baird 2000). To date, there is no evidence that Southern Residents travel further than 50 km offshore (Ford et al. 2005).

Southern Residents spend the majority of their time from late spring to early autumn in inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound) (Bigg 1982, Ford et al. 2000, Krahn et al. 2002). Typically, J, K and L pods arrive in May or June and spend most of their time in the core area of Georgia Basin and Puget Sound until departing in October. Although the entire Southern Resident DPS has potential to occur in the coastal waters at any time during the year, occurrence is more likely during November to May when Southern Residents are only occasionally found in the inland waters of Washington State. K and L pods also make frequent trips to the outer coasts of Washington and southern Vancouver Island during this time, which generally last a few days (Ford et al. 2000). There have been four sightings of Southern Resident killer whales within the Columbia River plume (NMFS 2007). The information on the rangewide status of the species is generally representative of the status of the species in coastal waters.

Biological Requirements. Southern Resident killer whales are a long-lived species, with late onset of sexual maturity (review in NMFS 2008j). Females produce a low number of surviving calves over the course of their reproductive lifespan (5.4 surviving calves over 25 years) (Olesiuk et al. 1990, Bain 1990). Mothers and offspring maintain highly stable social bonds throughout their lives, which is the basis for the matrilineal social structure in the Southern Resident population (Bigg et al. 1990, Baird 2000, Ford et al. 2000). Groups of related matrilines form pods. Three pods – J, K, and L, make up the Southern Resident community. Clans are composed of pods with similar vocal dialects and all three pods of the Southern Residents are part of J clan.

Southern Resident killer whales are known to consume 22 species of fish and one species of squid (Scheffer and Slipp 1948, Ford et al. 1998, 2000, Ford and Ellis 2006, Saulitis et al. 2000). A long-term study of Southern Resident killer whale diet identified salmon as their preferred prey (97 percent of prey consumed during spring, summer and fall) (Ford and Ellis 2006). Feeding records for Southern Residents suggest that diet resembles that of the Northern Residents, with a strong preference for Chinook salmon (78 percent of identified prey) during late spring to fall (Hanson et al. 2005, Ford and Ellis 2006). Chum salmon (11 percent) are also taken in significant amounts, especially in autumn. Other species eaten include coho (5 percent), steelhead (*O. mykiss*, 2 percent), sockeye (*O. nerka*, 1 percent), and non-salmonids (e.g., Pacific herring and quillback rockfish [*Sebastes maliger*], 3 percent combined). Chinook were preferred despite the much lower abundance of Chinook in the Study Area in comparison to other salmonids (such as sockeye), presumably because of the species' large size, high fat and energy content, and year-round occurrence in the area. Killer whales also captured older (i.e., larger) than average Chinook (Ford and Ellis 2006).

Abundance. In general, little information is available regarding the historical abundance of Southern Resident killer whales. Some evidence suggests that, until the mid- to late-1800s, the Southern Resident killer whale population may have numbered more than 200 animals (Krahn et al. 2002). Two methods have been used to estimate a historical population size of 140 to 200 individuals. The minimum estimate (~140) is the number of whales killed or removed for public display in the 1960s and 1970s, added to the remaining population at the time of the captures. The maximum estimate (~200) is based on a recent genetic analysis of microsatellite DNA (NMFS 2003e) which found that the genetic diversity of the Southern Resident population resembles that of the Northern Residents (Barrett-Lennard 2000, Barrett-Lennard and Ellis, 2001), and concluded that the two populations were once similar in size.

Recent efforts to assess the killer whale population during the past century have been hindered by an absence of empirical information prior to 1974 (NMFS 2006). For example, a report by Scheffer and Slipp (1948) is the only pre-1974 account of Southern Resident abundance in the area, and it merely noted that the species was "frequently seen" during the 1940s in the Strait of Juan de Fuca, northern Puget Sound, and off the coast of the Olympic Peninsula, with smaller numbers along Washington's outer coast. Olesiuk et al. (1990) estimated the Southern Resident population size in 1967 to be 96 animals. At about this time, marine mammals became popular attractions in zoos and marine parks, which increased the demand for interesting and exotic display animals. Between 1967 and 1973, it is estimated that 47 killer whales, mostly immature, were taken from the Southern Resident population for public display. The rapid removal of individual whales caused an immediate decline in numbers (Ford et al. 2000). By 1971, the level of removal decreased the population by about 30 percent, to approximately 67 whales (Olesiuk et al. 1990). In 1993, two decades after the live capture of killer whales ended, the three Southern Resident pods–J, K, and L–totaled 96 animals (Ford et al. 2000).

At present, the Southern Resident population has declined to essentially the same size that was estimated during the early 1960s, when it was considered as likely depleted (Olesiuk et al. 1990). The population appeared to experience a period of recovery by increasing to 99 whales in 1995, but then declined by 20 percent to 79 whales in 2001 (-3.3 percent per year) before another slight increase to 83 whales in 2003 (Ford et al. 2000; Carretta et al. 2004). There have been recent increases in the population from 2002-2006 indicating that L pod's decline may have ended; however, such a conclusion may be premature. The 2006 census counted 90 Southern Resident killer whales—24 in J pod, 22 in K pod, and 44 in L pod (Center for Whale Research 2006). Despite the recent increase in population abundance, the decline in the 1990s, unstable population status, and population structure (e.g. few reproductive-age males and noncalving adult females) continue to be causes for concern. Moreover, it is unclear whether the recent increasing trend will continue, because these observations may represent an anomaly in the general pattern of survival or a longer-term shift in the survival pattern. Several individuals disappeared in the fall of 2006 and one new calf has been identified since the 2006 population estimate (NMFS 2007).

4.6.2 Critical Habitat for the Southern Resident DPS of Killer Whales

Critical habitat for the Southern Resident killer whale DPS was published November 29, 2006 (71 FR 69054). Critical habitat includes approximately 2,560 square miles of inland waters in three specific areas: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Based on the natural history of the Southern Residents and their habitat needs, NMFS identified the following physical or biological features (i.e., PCEs) essential to conservation: (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging.

Southern Resident critical habitat does not occur in the coastal waters near the Columbia River. As such, designated critical habitat does not overlap with the area considered for this consultation, nor are there any discernable changes to the physical environment that occur in this area that could be correlated to the operation of the Odessa Proposed Action. The Proposed Action will not affect critical habitat for the killer whale and will not be considered further in this consultation.

5.0 EFFECTS OF THE ACTION

"Effects of the action" refers to those direct and indirect effects of an action on the species or designated critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline (50 CFR 402.2). Direct effects are considered immediate effects of the action on the species or designated critical habitat. Indirect effects are those caused by the Proposed Action and are later in time, but are still reasonably likely certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. In accordance with the provisions of the ESA implementing regulations and the Service's Section 7 Handbook, Reclamation uses the following definitions to make its effects determinations for each listed species:

> **May Affect - Likely to adversely affect (MA/LAA)**: Any adverse effect to ESA-listed species or their critical habitat may occur as a direct or indirect result of the Proposed Actions or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the Proposed Action is beneficial to the listed species, but is also likely to cause some adverse effects, then the Proposed Action is likely to adversely affect the listed species. If incidental take is anticipated to occur as a result of the Proposed Action, a likely to adversely affect determination should be made.
>
> **May Affect - Not likely to adversely affect (MA/NLAA)**: Effects on ESA-listed species or their critical habitat are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not be able to meaningfully measure, detect, or evaluate insignificant effects; or expect discountable effects to occur.
>
> **No Effect (NE)**: When the action agency determines its Proposed Action will not affect listed species or critical habitat.

One or more life stages of each species considered in this analysis occurs within the action area and could potentially be affected by the Proposed Action. Those species with geographic distributions in the farthest upstream reaches of the upper Columbia River upstream from Bonneville Dam or FCRPS dams located farther upstream (Upper Columbia River Chinook and steelhead and Snake River basin species) are affected in more direct ways than those which spawn downstream from Bonneville Dam (e.g. Columbia River chum, UWR spring Chinook) due to their proximity to reaches with greater proportional hydrologic changes. Similarly, those species which must navigate through eight or more dams are more directly affected by dams and reservoirs than those which pass only one or two.

Because of the potential importance of hydrologic changes in Columbia River flows to salmon and steelhead species, and because hydrologic changes in the mainstem Columbia River are the only potential mechanism by which the Proposed Action may affect listed species, hydrologic changes to mainstem Columbia River flows resulting from the Proposed Action are discussed first. All subsequent effects to listed salmon ESUs and steelhead and marine species DPSs in the action area are discussed relative to the magnitude and timing of hydrologic changes that could occur from implementing the Proposed Action.

5.1 Effects to Hydrology

Hydrologic modeling and spreadsheet analyses were used to estimate the effects of the Proposed Action on the hydrology of the CBP, Banks Lake, and the Columbia River system. The environmental baseline of the Columbia River system was modeled with BPA's HYDSIM model and the environmental baseline and Proposed Action on the CBP was modeled with a RiverWare (RW) model. A spreadsheet analysis was used to integrate the Columbia River system from HYDSIM and the CBP and Proposed Action from RiverWare. Differences in diversions between the environmental baseline and Proposed Action were computed to estimate the effects of the Proposed Action on Banks Lake storage and Columbia River flows.

The models apply historic hydrologic data to the current level of development and operating plans to evaluate likely future hydrologic and system operation patterns. The use of this data assumes that future hydrologic conditions would be similar to those observed in the past. The 1929-to-1998 70-year period of record used in the modeling for the Columbia Basin includes periods of years that were the driest on record and years that were the wettest on record in the Columbia Basin. Since this period covers a variety of hydrologic conditions, it is reasonable to use this information to make future predictions. Model runs evaluated the impacts that would occur during four water-year types:

- **Wet year:** approximately 10 percent of the years would be this wet or wetter (within the hydrologic record, 1982 was selected as being representative of these conditions)
- **Average year:** approximately 50 percent of years would be wetter and 50 percent drier (1995 was selected as the representative year)
- **Dry year:** approximately 15 percent of years would be this dry or drier (1988 was selected as the representative year)
- **Drought year:** approximately 5 percent of years would be this dry or drier (1931 was selected as the representative year)

The frequency of occurrence or category of these water-year types (which are based on rankings of annual water volumes at The Dalles Dam) in this analysis varies somewhat from those used in the FCRPS Consultation. However, for the purposes of this BA, the four water-year types are considered similar enough to the categories used in FCRPS consultation to be directly comparable.

5.1.1 Banks Lake Hydrology

The effect of the Proposed Action on Banks Lake was calculated using a spreadsheet analysis. The difference in modeled water delivery requirements on the CBP and additional diversions from the Columbia River for the Proposed Action was compared to the environmental baseline. This modeled difference was used to determine the effects of the Proposed Action on the storage and water surface elevation of Banks Lake.

Implementation of the Proposed Action would result in additional drawdown of Banks Lake during the summer since Banks Lake storage would be used to supply the additional irrigation water to the Study Area during the spring and summer. Long-term effects from these anticipated drawdown levels would be a reduction in water surface elevations in the Banks Lake in April through September for all water-year types, as shown in Table 31. In the environmental baseline, the maximum drawdown of 5.0 feet at Banks Lake occurs at the end of August when flow augmentation water is supplied to the Columbia River. The Proposed Action would result in an additional August drawdown of 6.0 feet in 1982 and 1995 (representative wet and average years) and 5.9 feet in 1988 and 1931 (representative dry and drought years). The maximum total drawdown of Banks Lake at the end of August due to the additional delivery of surface water to the Odessa Subarea under the Proposed Action would be 11.0 feet in 1982 and 1995 and 10.9 feet in 1988 and 1931.

Table 31. Banks Lake Drawdown (feet) resulting from Proposed Action Implementation.

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Environmental Baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0
Water Year 1982 (Wet Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	11.0	6,1
Additional Drawdown Beyond Baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	6.0	6.1
Water Year 1995 (Average Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	11.0	6,1
Additional Drawdown Beyond Baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	2.7	4.4	6.0	6.1
Water Year 1988 (Dry Year)												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	10.9	6.0
Additional Drawdown Beyond Baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	5.9	6.0
Water Year 1931 (Drought Year)												

Condition	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	10.9	6.0
Additional Drawdown Beyond Baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.6	4.3	5.9	6.0

Drawdowns represent end-of-month levels for all months.

5.1.2 Columbia River Hydrology

The effects of the Proposed Action on Columbia River flows were also calculated using a spreadsheet analysis. Changes in operations that would occur with the Proposed Action were compared to the modeled environmental baseline for operation of the CBP and the FCRPS dams on the Columbia River system.

The analysis of Proposed Action impacts on Columbia River hydrology are based on the flow changes that would occur in the river downstream of Grand Coulee Dam. Monthly flow changes that are likely to occur on the Columbia River with implementation of the Proposed Action were computed by modeling the effects of diverting, on average, an additional 164,000 acre-feet of water from the Columbia River to the CBP. The 164,000 acre-feet would be supplied to the CBP through the drawdown of Banks Lake during the irrigation season and refilling Banks Lake from the Columbia River outside the juvenile fish migration season. The monthly Columbia River flow changes with the Proposed Action were compared to the modeled environmental baseline.

Consistent with State water law, it was assumed that no new diversions would occur in July through August in any year with the Proposed Action. In addition, based on comments on the Draft EIS, it was assumed that no new diversions would occur in September. Finally, Reclamation determined that no diversions would be needed during the months of April through September. As a result, the Proposed Action will have no effect to Columbia River flows between the spring and summer months of April through September.

Implementation of the Proposed Action would reduce flow in the Columbia River downstream of Grand Coulee Dam during October in every year. Modeling analyses indicate that Banks Lake can be refilled completely in October by diverting an additional 164,000 acre-feet of water (average of approximately 2,700 cfs during the month) from the Columbia River at Grand Coulee Dam. As a result, the annual operation scenario with the Proposed Action will only require additional diversions from the Columbia River to occur in October. An analysis of pump capacity and historic pump maintenance schedules indicates that, barring any unforeseen circumstances, there will be adequate pump capacity in October in the future to refill Banks Lake. Consequently, under typical conditions, no additional diversions would be required during the months of November through March.

In rare instances, there may be a need to divert additional water from the Columbia River with the Proposed Action during the months of November through March. This would occur if there were unforeseen problems during October preventing adequate diversions to replace water supplied under the Proposed Action. The frequency of this happening would be very low; it did not occur during the 70-year modeled period. If additional diversions were needed in November through March, the amount would be limited to a monthly maximum of 21,000 acre-feet (approximately 350-cfs monthly average flow) when chum salmon elevation targets were being met downstream of Bonneville Dam, and 6,000 acre-feet (approximately 100-cfs monthly average flow) when water management objectives were not being met.

Table 32 presents a summary of the anticipated maximum diversions and the percent change in Columbia River flows that would result from both the typical diversion scenario of October pumping only and with maximum diversions proposed between the months of November and March that would occur on an extremely limited and infrequent basis.

Table 32. Summary of Proposed Action water diversions and the anticipated hydrologic effects to Columbia River streamflows at three locations from implementation of the Proposed Action. Average Columbia River streamflows are based on the 1929-to-1998 period of record for each location. Percent change in average monthly Columbia River flows are estimated for both the typical water diversion scenario of October pumping only which is anticipated to occur every year, and for the worst-case maximum Proposed Action increases in Columbia River diversions between November and March. No additional diversions are proposed for April through September.

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Maximum additional diversion per month under Proposed Action												
Maximum Increase in Diversion rates (cfs)	2,700	350[1]	350[1]	350[1]	350	350[1]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Below Grand Coulee Dam												
Average Monthly Columbia River Flow (cfs)	72,981	89,837	92,109	120,872	96,619	93,697	107,363	147,625	161,725	132,548	104,212	66,741
% change in flows with Maximum Increase in Diversion	3.70%	0.39%	0.38%	0.29%	0.36%	0.37%	N/A	N/A	N/A	N/A	N/A	N/A
At McNary Dam												
Average Monthly Columbia River Flow (cfs)	106,735	122,516	134,280	168,829	158,170	159,512	205,533	281,617	301,102	204,956	143,841	98,799
% change in flows with Maximum Increase in Diversion	2.53%	0.29%	0.26%	0.21%	0.22%	0.22%	N/A	N/A	N/A	N/A	N/A	N/A
At Bonneville Dam												
Average Monthly Columbia River Flow (cfs)	112,493	133,759	149,723	185,967	177,131	178,522	225,764	294,751	311,177	212,271	150,118	105,505
% change in flows with Maximum Increase in Diversion	2.40%	0.26%	0.23%	0.19%	0.20%	0.20%	N/A	N/A	N/A	N/A	N/A	N/A

[1] 350-cfs maximum diversions during November-March are only anticipated to occur in years when the full 2,700 cfs in October cannot be pumped.
[2] No diversions are proposed for the months of April through September. N/A refers to no action.

5.1.3 Hydrologic Effects to Other Water Bodies

No measureable change in the water surface elevation of Lake Roosevelt would be anticipated as a result of the Proposed Action. In addition, Reclamation would generally not alter the current operation of waters downstream of the Odessa Subarea, including Potholes Reservoir and lower Crab Creek, although some minor impacts to Potholes Reservoir may occur as a result of return flow changes to this water body (see Section 5.1.4, "*Return Flows*" for more information on return flow impacts). No adverse impacts on water quality are expected to occur to any of these additional water bodies from hydrologic effects of Columbia River water diversions or return flows (Reclamation 2011). Fish and aquatic resources at Billy Clapp Lake and upper Crab Creek would not be impacted by any of the proposed alternatives. Therefore, there will be no effect to hydrology in any of these water bodies.

5.1.4 Return Flows

A RiverWare hydrologic simulation model of the Columbia Basin Irrigation Project (CBIP), referred to as the CBIP-RW model, was used for predicting the effects of increased water withdrawal and surface water delivery to the Odessa Study Area (Reclamation 2009). The calibrated CBIP-RW model runs at a daily timestep, simulating reservoirs, canal and lateral flows, farm deliveries, return flows, groundwater pumping, and natural flows within the Project. The model was run for a 70-year period of record using inflow data set of available flows from the Columbia River for the period 1929 to 1998 in combination with Crab Creek flows for the Irby and Beverley USGS gage stations.

The CBIP-RW model was used to estimate total water needs for each alternative analyzed in the Odessa FEIS and accounted for the changes in return flows that resulted from altered CBP operations. The hydraulic simulations indicated that the majority of additional return flows were collected in Potholes Reservoir. However, minor added return flows were found in some small drains, while return flows in other small drains were completely unaffected by the proposed changes in water delivery to the Odessa Study Area.

Potholes Reservoir

Potholes Reservoir and the associated Potholes Canal make up a substantial part of the supply for the southern part of the Columbia Basin Project. Because of the high efficiency of water reuse in the southern portion of the CBP, increases in return flows to Potholes Reservoir result in reduce feed and subsequent water delivery needs to supply the southern areas of the CBP. Essentially, increased return flows to Potholes Reservoir decreases the amount of water needed to enhance water storage through other water supply routes. Ultimately, return flows are not increased to the Columbia River because any excess return flows are captured in Potholes Reservoir and subsequently reused for irrigation delivery to the southern portion of the CBP.

The model results for Potholes Reservoir end-of-month elevations for wet, dry, and average water year types are shown in Table 33 for the Odessa Proposed Action (Alternative 4A, Modified Partial-Replacement-Banks). Figure 35 compares the various FEIS Alternatives against the environmental baseline condition for average water year types.

Table 33. Potholes Reservoir end-of-month Elevations resulting from CBIP-RW model runs for the period 1929-1998.

Potholes Reservoir Elevation (feet) - 70 yr Period of Record						
	Baseline Operations			Modified Partial-Replacement-Banks		
	Exceedance					
	10%	50%	90%	10%	50%	90%
Jan	1042.4	1042.0	1041.6	1042.2	1041.8	1041.4
Feb	1044.4	1043.6	1043.1	1044.3	1043.5	1042.9
Mar	1045.3	1043.7	1042.9	1045.1	1043.4	1042.7
Apr	1045.9	1045.3	1044.8	1045.8	1045.1	1044.7
May	1046.4	1046.4	1046.4	1046.4	1046.4	1046.4
Jun	1042.0	1041.9	1041.7	1042.0	1041.9	1041.6
Jul	1035.7	1035.5	1035.0	1035.8	1035.5	1035.0
Aug	1029.2	1028.7	1027.9	1029.4	1029.0	1028.1
Sep	1028.3	1028.1	1027.7	1028.3	1028.1	1027.7
Oct	1030.1	1030.0	1029.8	1029.9	1029.8	1029.7
Nov	1037.0	1036.8	1036.7	1036.8	1036.7	1036.5
Dec	1039.9	1039.7	1039.5	1039.7	1039.5	1039.3

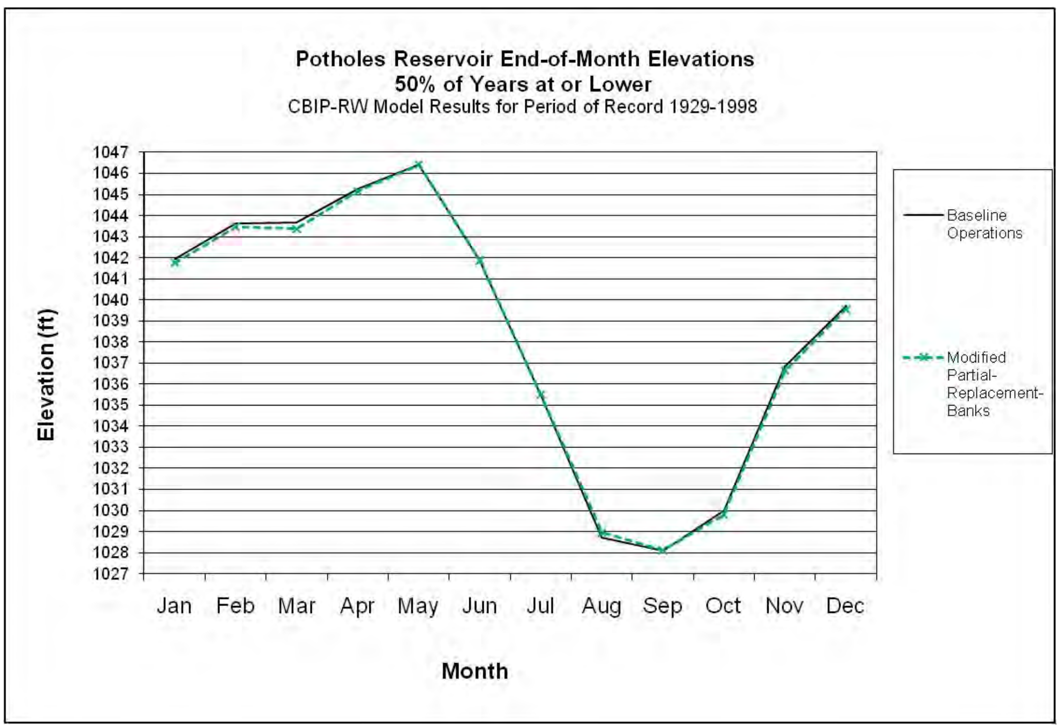

Figure 35. Potholes Reservoir end of month elevations for the Odessa Subarea Special Study Feasibility-Level Investigation options using the Columbia River available flows and Upper Crab Creek inflows for the period 1929-1998.

The CBIP-RW model results indicate that the Proposed Action scenario does not significantly increase the median end-of-month elevations of Potholes Reservoir (See Figure 35). This indicates that very little hydrologic change will occur to Potholes Reservoir from anticipated return-flow levels as a result of proposed action implementation.

Hydrologic modeling that was conducted for the FEIS analysis (Reclamation 2012) indicated that the Odessa Proposed Action had the least effect on Banks Lake of all the delivery alternatives analyzed; the median end-of-August elevation was 1564.9 feet, which coincides with the environmental baseline operating conditions of a 5.0-foot drawdown. For the Partial-Replacement Banks scenario, Banks Lake median elevation at the end-of-August is 1562.7 feet, for a total of 7.3-foot drawdown.

Small Drains

CBIP-RW hydrologic simulations indicated that the canals and wasteways which drain back to the Columbia River had either no increase in return flow, or minor increases. The Columbia River points of interest were Crab Creek at Beverly, Esquatzel Canal at Columbia River, and Potholes East Canal Wasteway at Mile 16.4. The CBIP-RW Model was run with a 77-year dataset for Columbia River available flows and Upper Crab Creek flows for the period 1929-1998. The model results indicated that the return flow changes compared to baseline conditions were either extremely minor or immeasurable for most wasteways analyzed in the FEIS. The effects on return flows to the Columbia River were greatest in the Esquatzel Canal because of the direct drainage of the East Low Canal to this project wasteway. However, development and increased use of the East Low Canal did not significantly impact the return flows to the Columbia River at Esquatzel Canal. CBIP-RW simulation modeling indicated that return flows increased by an average of 12 cfs (or 6 percent of average return flows in this CBP wasteway) as a result of Proposed Action implementation. None of the options analyzed in the FEIS modeling added return flows at Crab Creek at Beverly or Potholes East Canal Wasteway at Mile 16.4.

5.1.5 Water Temperature Impacts

The CEQUAL Model was used to predict water temperature effects to the Columbia River downstream from Grand Coulee Dam that could result from the additional withdrawal of 164,000 acre-feet of water from Lake Roosevelt during the month of October. The calibrated CEQUAL model run used an hourly timestep between Julian days 275 and 305 and simulated water temperature changes that would occur with an additional 2,700-cfs flow reduction at the Keys Pump-Generating Plant below Grand Coulee Dam. Model outputs were analyzed for both midnight and noon outflow temperatures.

Results of the CEQUAL model simulations showed that the outflow temperature difference between the baseline condition and the additional water withdrawal of 164,000 acre-feet in October was positive on average, signifying that original outflow temperatures are greater than the proposed action outflow temperatures below Grand Coulee Dam. This result makes sense, since the Keys Pump-Generating Plant releases would be reduced by 2,700 cfs. Since the Third Powerhouse at the Keys Pump-Generating Plant pulls warmer water from a higher and warmer elevation, the resultant outflow would be colder, on average, than baseline conditions.

Reducing Columbia River flows in the fall would result in a 0.03-degree F cooling effect to the Columbia River, on average, with an expected temperature change range of 0.16º F decrease to 0.05º F increase in temperature as an October monthly average. Day-to-day temperature changes as simulated in the CEQUAL model were simulated to be much greater. It is likely that the model error or even the instrument error is within the range of change the CEQUAL model is predicting. Modeling error was thought to be approximately 0.2º F using the CEQUAL model. Therefore, there would be no statistical difference between river temperature with and without the change in flow.

5.2 Effects to Terrestrial Habitat

5.2.1 Uplands

Construction impacts to shrub-steppe communities would occur during excavation for pipe laying and expansion of the East Low Canal. Direct short-term losses during pipeline construction are estimated at 87 acres of shrub-steppe, 17 acres of steppe grassland, and 6.3 acres of scabland shrublands. Long-term impacts to upland plant communities north and south of I-90 would include 112 acres of shrub-steppe and 18 acres of steppe grassland required for expansion of the East Low Canal. The affected areas are primarily associated with lateral piping and canal expansion in areas south of I-90. There would be less impact to upland areas north of I-90 because fewer lateral pipelines and pump station installations would occur in this area. Impacts during construction on lands that are not required for permanent facilities are considered to be short-term impacts because restoration can occur at those locations. However, restoration of native shrub-steppe habitats to preconstruction conditions would be difficult and would likely require at least 15 years or more for site establishment.

Lands with native and nonnative vegetation impacts during construction would be reseeded with local native species following construction with a goal of restoring the impacted community. If in-kind replacement cannot be done on private lands, another suitable site would be found. No short-term direct or indirect impacts to populations of rare plants are expected under the Proposed Action because none were found in areas that would be impacted by construction activities.

The consolidation of irrigated lands adjacent to new pipeline distribution systems and the East Low Canal through the process of “infilling” will result in some previously irrigated and/or disturbed areas being irrigated with Proposed Action surface water. This “infilling,” however, will result in the transfer of water rights from one parcel to another on a one-for-one basis and will not result in the expansion of the total amount of irrigated agriculture in the affected area. Land parcels that were previously irrigated with groundwater will transfer their water right from well-water-irrigated parcels to surface water parcels closer to the East Low Canal where CBP water can be delivered through the proposed pipeline lateral distribution systems. This transfer of water right and land parcels from groundwater wells to surface water delivery through "infilling" would represent about 15 percent of the total irrigated acres affected by the action. The Proposed Action will have minimal impact on agricultural lands because all affected areas have previously been disturbed through land development in the past.

5.2.2 Wetlands

The Proposed Action would have short-term adverse impacts on wetland resources, including approximately 38 acres of the fringe PEM wetland adjacent to the ELC due to temporary construction impacts that would occur during excavation for pipe laying and canal expansion south of I-90. These impacts are considered short-term because the PEM wetland would likely reestablish in the same place following construction activities. Approximately 1.0 acre of PEM wetlands are anticipated to be significantly and permanently impacted adjacent to the ELC because of canal expansion. Adjacent to the ELC, wetlands affected by temporary construction impacts would be seeded with local native wetland species following construction with a goal of restoring the impacted community.

No long-term wetland impacts are anticipated in the areas adjacent to Banks Lake. No long-term impacts to wetland resources are anticipated adjacent to the ELC because all identified wetland areas are located in down-slope positions adjacent to the canal. Proposed canal improvements associated with the Proposed Action would be limited to the upslope side of the canal. No impacts to the wetlands located on the down-slope side of the canal are anticipated in conjunction with the implementation of the Proposed Action.

5.3 Effects on Listed ESUs and DPSs in the Columbia River

This section describes the effects of Reclamation's Proposed Action on ESA-listed salmon ESUs and steelhead DPSs and their designated critical habitats in the action area downstream from Grand Coulee Dam. The area of analysis for each ESU and DPS includes those river reaches and reservoirs where the ESUs or DPSs occupied geographic area overlaps the action area. The effects discussion considers the combined hydrologic effects of the Proposed Action against the current environmental baseline and cumulative effects in the Columbia River Basin.

The ability to determine effects of the Proposed Action on ESUs and DPSs is complicated by numerous factors, especially effects on water quality and streamflow in the Columbia River associated with the operation of multiple hydroelectric facilities between Reclamation's Proposed Action and ESUs and DPSs. Facilities and operations related to the Proposed Action are located above areas where listed salmon and steelhead have access (i.e., Grand Coulee Dam). As a result, water diversion operations (e.g., operation of pump facilities) related to the Proposed Action will not directly affect any of the species covered in this BA. In addition, the Proposed Action does not affect predation, harvest, or hatchery activities for any ESU or DPS analyzed.

The Proposed Action would alter the timing and quality of Columbia River flows downstream of Grand Coulee Dam. Because the thirteen ESUs and DPSs enter or use the action area at various locations downstream from Grand Coulee Dam for one or more life-history stages, additional water diversion from the Columbia River under the Proposed Action could affect these species. These potential effects would be most pronounced in the upper Columbia River downstream from Grand Coulee Dam. Here, reductions in Columbia River flow would have the greatest proportional change to riverflows and would diminish with distance downstream where tributary inflow and an array of other environmental and anthropogenic factors have greater influence.

The listed ESUs and DPSs discussed in this section, together with their designated critical habitat, occur in the action area beginning at the farthest upstream point of anadromy on the Columbia River, Chief Joseph Dam (RM 545.0), and ending at the mouth of the Columbia River at the Pacific Ocean. Most spawn and rear in numerous tributaries to the Columbia River and use the Columbia River primarily for upstream and downstream migration. Some ESUs and DPSs, however, use the lower Columbia River for spawning and rearing, as well as migration.

The ESUs and DPSs closest to Reclamation facilities include the interior Columbia Basin species; predominantly UCR spring Chinook salmon and UCR steelhead; and to a lesser extent, MCR steelhead and populations of Snake River spring/summer Chinook salmon, SR fall-run Chinook salmon, SR sockeye, and SR basin steelhead. These ESUs/DPSs have a greater likelihood of being adversely affected by the Proposed Action because of their location in the Columbia River Basin relative to the action and exposure to greater proportional flow reductions in the mainstem Columbia River. Snake River basin salmon ESU's and the SR steelhead DPS would be affected to the extent that these species use the mainstem Columbia River as a migration corridor. Downstream from the mouth of the Snake River, effects of flow and water quality are attenuated by the combined flow of the Columbia and Snake Rivers and other tributaries, which seasonally contribute substantial inflows that dampen the effect on the migration corridor. Likewise, Columbia River Basin species that occupy areas in the Columbia and Willamette Rivers below Bonneville Dam would not be as likely to be adversely affected by the Proposed Action because of their location in areas with substantial tributary inputs that ameliorate flow effects.

The Proposed Action's effects on listed fish or their designated critical habitat in the Columbia River below Bonneville Dam are expected to be extremely small, too small to measure because of the small magnitude of diversions relative to overall Columbia River flows and because of the dampening effect of significant tributary inflows below the points of diversion above Grand Coulee Dam. Anticipated Hydrologic changes under the Proposed Action are ameliorated by tributary inputs below Grand Coulee, McNary, and Bonneville dams. The average annual difference in water volume with and without the Proposed Action operations is 164,000 acre-feet (or an average flow reduction below

Grand Coulee Dam of 2,700 cfs in October, and 350 cfs between November and March). As described in Section 5.1.2 above, these average flow reductions amount to a 3.7-percent reduction of the average annual flow in the Columbia River below Grand Coulee and a 2.53- and 2.4-percent reduction in Columbia River flows at McNary Dam and Bonneville Dam, respectively, during the month of October. For the months of November through March, Columbia River average flow reductions ranging between 0.39 percent and 0.29 percent below Grand Coulee Dam are anticipated based on the average diversion of 350 cfs during these months. The percentage of Columbia River flow reductions decrease to between 0.29 percent to 0.21 percent at McNary Dam, and between 0.26 percent to 0.19 percent at Bonneville Dam, when 350-cfs diversions occur during the November-through-March time period.

The greatest amount of hydrologic change to Columbia River flows occurs during the month of October when approximately 3.7-percent to 2.4-percent reductions in average annual flow is anticipated to occur below Grand Coulee and Bonneville dams, respectively. These hydrologic changes are considered to be measureable hydrologic impacts at these locations that occur on an annual basis during October. Conversely, Proposed Action flow reductions that range between 0.39 percent and 0.19 percent of annual average Columbia River flows that are anticipated to occur between the months of November through March at these locations are considered to be immeasurable impacts, because their extremely small magnitude relative to overall Columbia River flow could not be detected in any discernable way.

These proportional flow reductions are anticipated to decrease and become even smaller in the Columbia River estuary and plume because of additional tributary inputs that will occur downstream of Bonneville Dam as well as the influence of tidal fluctuations in the lower river and estuary. The river below Bonneville Dam is heavily influenced by these tidal effects, and the further downstream, the greater the influence. At their peak, tidal influences are substantial and tend to increase Columbia River water surface elevations by several feet. By comparison, the effects of the Proposed Action on Columbia River water surface elevations are anticipated to be immeasurable under the proposed November-through-March diversions and will be much less than an inch during the peak diversion period in October in the lower river and estuary.

To analyze how mainstem Columbia River hydrologic changes affect the mainstem anadromous salmon and steelhead ESUs and DPSs, Reclamation compared the timing overlap between Proposed Action flow impacts described above and in Section 5.1.2 to the overall adult migration and juvenile/smolt outmigration timing for each of the affected Columbia River Basin ESUs/DPSs. Reclamation then analyzed the magnitude of the hydrologic change that was likely to occur to each affected life-history stage to determine the overall potential effect to that ESU/DPS.

To aid in the comparison of timing overlap between the Proposed Action hydrologic changes and salmon and steelhead life-stage timing, Reclamation provides summary graphs of adult and smolt outmigration timing in the Columbia River for several salmon and steelhead species (Figure 36, Figure 37, and Figure 38. Summary graphs are not provided for each ESU and DPS. Rather, one graph is provided for adult fall Chinook, steelhead, sockeye, and coho salmon to illustrate overall long-term average adult migration timing for these species (Figure 36) while 2 separate graphs (Figure 37and Figure 38) are provided to illustrate the generalized timing for Columbia River salmon smolt index areas. Several dam passage counting sites are provided for each species to indicate the relative difference in passage timing that could occur in different locations throughout the entire Columbia mainstem reach that will be impacted by hydrologic changes due to the Proposed Action.

For adult upstream migration timing, Figure 36 illustrates the 2012 and 10-year average passage timing at Bonneville, McNary, Ice Harbor and Lower Granite (Snake River), Priest Rapids, and Wells Dams for each of the four representative salmon and steelhead species. These graphs illustrate that the primary upstream adult migration timing occurs between April and June for Spring Chinook, August through October for Fall Chinook, June through mid-November for steelhead, mid-June through July for sockeye salmon, and mid-August through mid-November for coho salmon. No adult timing information is presented for lower Columbia River ESUs/DPSs because these species use habitat areas downstream of Bonneville Dam and no mainstem dam passage information is available. It is assumed, however, that adult migration timing for lower Columbia River ESUs and DPSs will be similar to the passage timing illustrated in Figure 36 for upper Columbia and Snake River basin salmon ESUs and steelhead DPSs. For more information about life-history requirements for all 13 listed Columbia River Basin salmon and steelhead populations, see Section 4.2 of this BA and the 2007 *Comprehensive Analysis* (Action Agencies 2007b) which is incorporated here by reference.

Figure 37 and Figure 38 provide the 2012 and 10-year average smolt index passage timing at seven mainstem Columbia and Snake River Dams, including: Bonneville, John Day, McNary, Rock Island, Lower Monumental, Little Goose, and Lower Granite Dams. Figure 37 represents smolt outmigration timing for both the "stream-" and "ocean-" type life histories of Chinook salmon that are exhibited in the Columbia and Snake River basins. Figure 37 illustrates that for the stream-type yearling spring Chinook (1-Chinook) that smolt outmigration typically occurs between April through mid-June, whereas for the ocean-type subyearling fall Chinook (0-Chinook) smolt outmigration tends to occur later, typically June through mid-August. Figure 38 illustrates the outmigration index timing for three additional Columbia River salmon and steelhead species, steelhead, sockeye, and coho. The outmigration timing for these species is similar and typically occurs April through June.

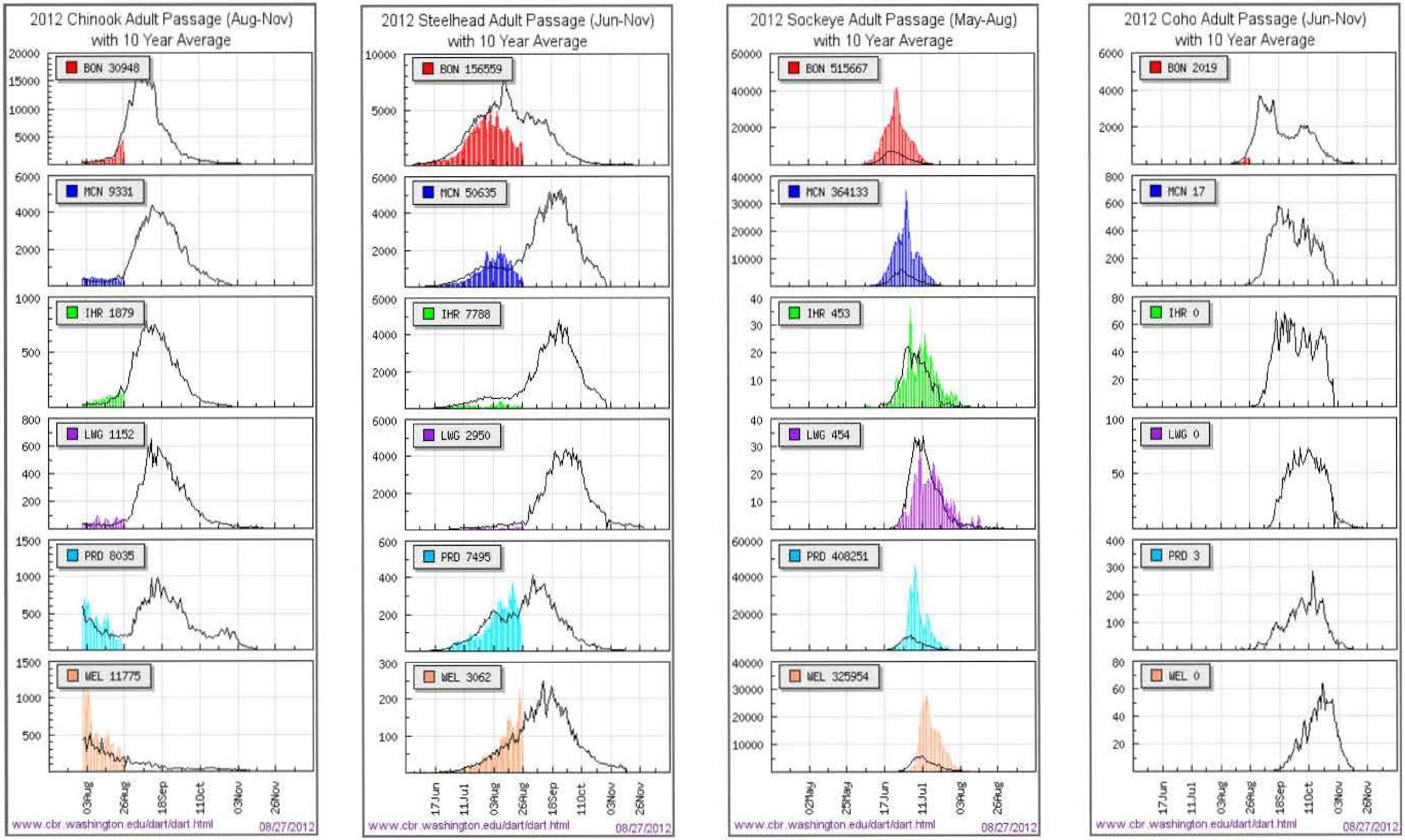

Figure 36. 2012 cumulative abundance and passage timing and 10-year average passage timing for adult fall Chinook, steelhead, sockeye, and coho salmon at 6 dams in the Columbia River Basin. Data from Columbia River DART website 2012 (BON = Bonneville, MCN = McNary, IHR = Ice Harbor, LWG = Lower Granite, PRD = Priest Rapids, and WEL = Wells)

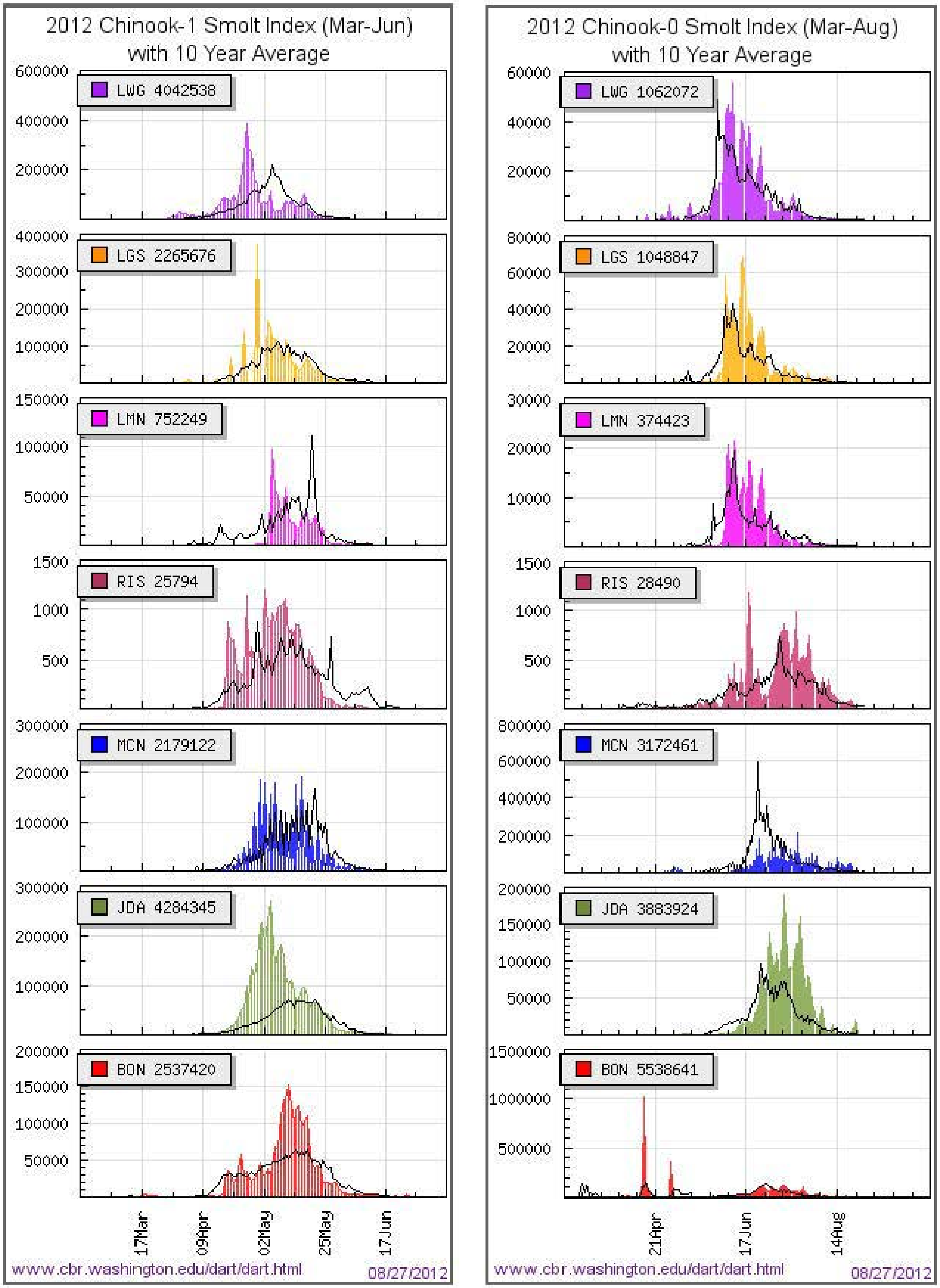

Figure 37. 2012 cumulative abundance and passage timing and 10-year average passage timing index for yearling Chinook smolts (1-Chinook) and subyearling Chinook smolts (0-Chinook) at seven dams in the Columbia River Basin (data from Columbia River DART website 2012).

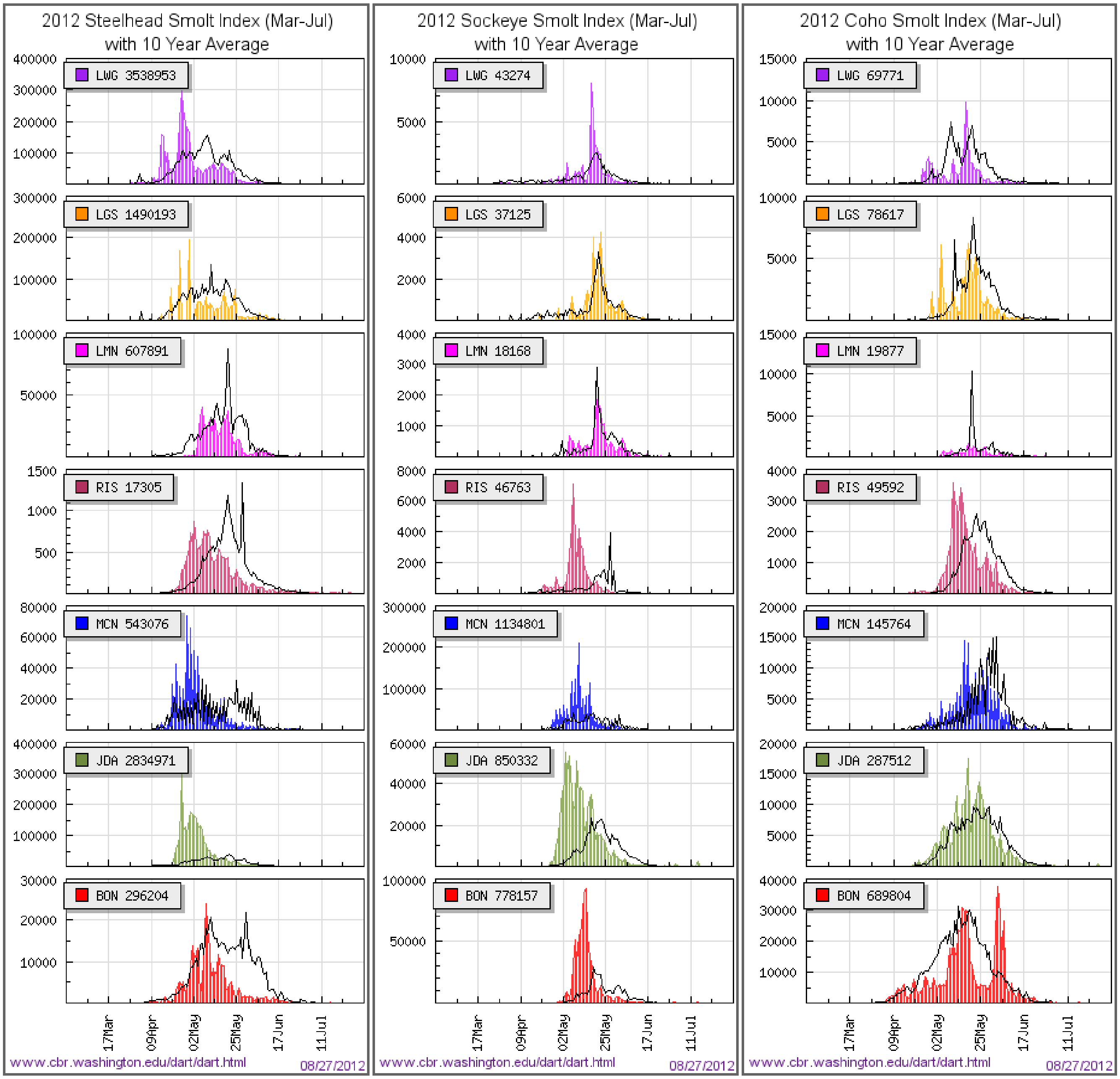

Figure 38. 2012 cumulative abundance and passage timing and 10-year average passage timing index for Columbia River Basin steelhead smolts, sockeye smolts, and coho salmon smolts at seven dams in the Columbia River Basin (data from Columbia River DART website 2012).

Summary of Effect Determinations for Species and Designated Critical Habitat

With the exception of chum salmon that spawn and initially rear in the mainstem Columbia River downstream of Bonneville Dam, other ESUs and DPSs use the affected reaches of the lower and upper Columbia River primarily as a migratory route. The following summary describes the effects of the Proposed Action on the listed ESUs/DPSs and their designated critical habitat.

The effects of the Proposed Action on anadromous fish are associated directly or indirectly with hydrologic changes in the upper and lower Columbia River attributable to the Proposed Action. It is important to put into context these hydrologic changes from the Proposed Action compared to flows downstream in the Columbia River migratory corridors where flows and FCRPS dam operations have the most influence on fish. The Proposed Action directly affects flows downstream of Grand Coulee Dam and downstream to Bonneville Dam and then to the Pacific Ocean. The Proposed Action will require an average annual diversion of 164,000 acre-feet of water, or 3.7 percent and 2.4 percent of Columbia River flows at Grand Coulee and Bonneville Dam outflows in October, respectively. By comparison, the annual average runoff is 128 million acre-feet at McNary Dam, and 198 million acre-feet at the Columbia River mouth. These comparisons indicate that impacts from Reclamation's Proposed Action diminish further downstream in the Columbia River.

Based on the information presented in Section 5.1, "*Hydrologic Effects*," on timing and magnitude of effects from implementing the Proposed Action, and an analysis of Columbia River Basin salmon and steelhead species timing in affected Columbia River reaches, Table 34 summarizes the effect determinations for species and designated critical habitat for this consultation. The following sections of this BA provide information and rationale for these effect determinations for each ESU and DPS.

Table 34. Summary of effects determinations for species and designated critical habitat for 13 salmon and steelhead ESUs/DPSs and 3 anadromous/nearshore marine species in the Columbia River.

ESU/DPS name	Species Effects Determination[1]			
	Spawning	**Adult Migration**	**Juvenile Rearing/ Migration**	**Critical Habitat Effects Determination**
Upper Columbia River (UCR) Spring Chinook salmon ESU (*Oncorhynchus tshawytscha*)	NE	NLAA	NLAA	Immeasurable
Upper Columbia River (UCR) steelhead DPS (*O. mykiss*)	NE	NLAA	NLAA	Immeasurable
Snake River (SR) Spring/Summer Chinook salmon ESU (*O. tshawytscha*)	NE	NLAA	NLAA	Immeasurable
Snake River (SR) Fall Chinook salmon ESU (*O. tshawytscha*)	NE	NLAA	NLAA	Immeasurable
Snake River (SR) sockeye ESU (*O. nerka*)	NE	NLAA	NLAA	Immeasurable
Snake River (SR) steelhead DPS (*O. mykiss*)	NE	NLAA	NLAA	Immeasurable
Middle Columbia River (MCR) steelhead DPS (*O. mykiss*)	NE	NLAA	NLAA	Immeasurable
Lower Columbia River (LCR) Chinook Salmon ESU (*O. tshawytscha*)	NE	NLAA	NLAA	Immeasurable
Columbia River (CR) Chum Salmon ESU (*O. keta*)	LAA	NLAA	NLAA	Adverse Affect
Lower Columbia River (LCR) Coho Salmon ESU (*O. kisutch*)	NE	NLAA	NLAA	Not applicable
Lower Columbia River (LCR) Steelhead DPS (*O. mykiss*)	NE	NLAA	NLAA	Immeasurable
Upper Willamette River (UWR) Chinook salmon ESU (*O. tshawytscha*)	NE	NLAA	NLAA	Immeasurable
Upper Willamette River (UWR) steelhead DPS (*O. mykiss*)	NE	NLAA	NLAA	Immeasurable
Southern DPS of Pacific Eulachon (*Thaleichthys pacificus*)	NLAA	NLAA	NLAA	Immeasurable
Southern DPS of Green Sturgeon (*Acipenser medirostris*)	Not applicable	NLAA	Not applicable	Immeasurable
Southern Resident DPS of Killer Whales (*Orcinus orca*)	Not applicable	Not applicable	Not applicable	Not applicable

[1] NE = no effect; NLAA = may affect, not likely to adversely affect; LAA = may affect, likely to adversely affect.

5.4 Columbia and Snake River ESUs/DPSs

Table 35 shows types of sites, essential physical and biological features designated as PCEs, and the species life stage of ESA-listed salmon ESUs and steelhead DPSs each PCE supports for designated critical habitat in the Columbia River downstream of Chief Joseph Dam to the mouth, including PCEs for Snake River basin ESUs and the SR steelhead DPS. Chapter 19 of the *Comprehensive Analysis* (Action Agencies 2007b) describes the geographic extent, conservation role, and current condition of designated critical habitat for each of the species listed in Table 35. The ESA defines critical habitat as specific areas that possess those physical or biological features essential to the species' conservation.

5.4.1 Upper Columbia River Spring Chinook Salmon

The UCR Spring Chinook salmon ESU spawns and rears in the Columbia River outside the action area, and smolts enter the action area in the Columbia River between Chief Joseph Dam and the Snake River confluence. This ESU also utilizes the mainstem Columbia River from the Snake River confluence to the Pacific Ocean for juvenile and adult migration. This ESU has a stream-type life history with adults migrating through the Columbia River mainstem during the months of April through June, and Chinook smolts outmigrating as yearlings primarily during the months of May and June. These time periods generally correspond with the period when the Proposed Action will not be diverting water from the Columbia River in areas downstream of Grand Coulee Dam. See Section 4.2.1 of this BA as well as Chapter 8 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Because UCR spring Chinook salmon use the action area for both adult and smolt migrations, the potential effects of the Proposed Action on this ESU and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all mainstem river reaches below Chief Joseph Dam.

Reclamation's modeled analysis indicates that past and present O&M actions related to the FCRPS and CBP have altered Columbia River streamflows below Grand Coulee Dam under the environmental baseline. These flow alterations, combined with private water development activities in the upper Columbia River Basin, have contributed in some degree to present environmental conditions within the action area and are expected to continue into the future. Continued flow alterations attributable to the Proposed Action may continue to affect migrating and rearing UCR Spring Chinook salmon in the Columbia River and this ESU's designated critical habitat when flows are reduced to varying degrees between October and March. The Proposed Action will have no effect on this ESU during the spring and summer months between April and September because no additional diversions are proposed during this time period.

Table 35. Site types, essential physical and biological features designated as PCEs, and species life stage each PCE supports for the Columbia River downstream of the Snake River confluence.

Site and PCE	Essential Physical and Biological Features	Species Life Stage
Upper Columbia River Spring Chinook		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Upper Columbia River steelhead		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Middle Columbia River steelhead		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Snake River Spring/Summer Chinook		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Snake River Fall Chinook		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Snake River Sockeye		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Freshwater rearing	Water quality and quantity, floodplain connectivity, forage, natural cover	
Snake River steelhead		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Lower Columbia River Chinook Salmon		
Freshwater rearing	Water quality and quantity, floodplain connectivity, forage, natural cover	Juvenile
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Columbia River Chum		
Freshwater spawning	Water quality and quantity, spawning substrate	Adult
Freshwater rearing	Water quality and quantity, floodplain connectivity, forage, natural cover	Juvenile
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Lower Columbia River steelhead		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Upper Willamette River Chinook Salmon		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult
Upper Willamette River steelhead		
Freshwater migration	Water quality and quantity, natural cover	Juvenile and Adult

Given the magnitude of hydrologic changes in the Columbia River relative to the overall flows in the Columbia River that are affected by the Proposed Action, the effects of such flow alterations are too small to measure and are not likely to have an adverse affect on either UCR spring Chinook adults, outmigrating smolts, or rearing juveniles. The Proposed Action will have no effect on UCR spring Chinook salmon spawning or smolt outmigrations since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. For example, when flow effects on smolt survival or juvenile rearing could occur between November and March, the Proposed Action will deplete flows by a monthly average of 350 cfs. This flow depletion represents less than 0.39 percent of the annual flow in the Columbia River below Grand Coulee Dam and between 0.29 percent and 0.19 percent of flow reductions further downstream at McNary and Bonneville Dams under these conditions (computed data in Table 32). Effects to the UCR spring Chinook ESU from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect, Critical Habitat for this ESU.

Table 35 lists PCEs for Upper Columbia River spring Chinook salmon. Essential features of this ESU's spawning and rearing areas will not be affected by the Proposed Action because spawning and rearing occurs in Columbia River tributaries and not in the mainstem Columbia River where the effects of the action are realized. This ESU has approximately 448 miles of occupied riverine and estuarine designated critical habitat in the Columbia River corridor between Rock Island Dam and the Columbia River mouth (NMFS CHART 2005). The migratory corridor critical habitat is not likely to be adversely affected because the effect of flow depletions for the Proposed Action in the Columbia River is small, estimated to be only about 3.7 percent of the annual average flow below Grand Coulee Dam in October and between 0.39 percent and 0.29 percent during November through March when UCR spring Chinook could be rearing and migrating through the mainstem Columbia River. Effects to critical habitat PCEs related to migration become even less as measured downstream of McNary and Bonneville Dams where Proposed Action flow reductions are expected to range between 0.26 percent and 0.19 percent of average Columbia River flows. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the UCR spring Chinook salmon ESU or the safe passage PCE of designated critical habitat. Any effects are likely to be immeasurable for this ESU.

5.4.2 Upper Columbia River Steelhead

This DPS spawns and rears outside of the action area in tributaries entering the Columbia River between Chief Joseph Dam and the Snake River confluence. This DPS has a stream-type life history with adults migrating from the Pacific Ocean through the action area up to spawning tributaries during the months of April through October (peak of August and September). Smolts enter the action area from their natal tributaries and outmigrate as yearlings primarily during the months of April and June. Migration timing for UCR steelhead adults overlaps with the Proposed Action flow reduction of 2,700-cfs in October. For steelhead smolts, these time periods correspond with Proposed Action flow reductions of 350 cfs in Columbia River average flows below Grand Coulee Dam when water is diverted between November and March. See Section 4.2.2 of this BA as well as Chapter 9 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Because UCR steelhead use the action area for both adult and smolt migration, the potential effects of the Proposed Action on this DPS and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all river reaches below Chief Joseph Dam.

Continued flow alterations attributable to the Proposed Action may continue to affect migrating UCR steelhead in the Columbia River and this DPS' designated critical habitat when flows are reduced to varying degrees between October and March. The Proposed Action will have no effect on this DPS during the months of April through September because no additional diversions are proposed during this time period.

Given the magnitude and timing of Proposed Action hydrologic changes in the Columbia River relative to the overall flows in the Columbia River, the effects of such flow alterations are generally too small to measure. Where they are measureable (i.e., October), timing does not significantly overlap with life-history timing of UCR steelhead and are not likely to have an adverse affect on either migrating steelhead adults or outmigrating smolts. For example, when Proposed Action flow reductions are measureable (i.e., October reductions of 3.7 percent below Grand Coulee Dam), the timing of the hydrologic change does not significantly overlap with UCR steelhead adult migration to a sufficient degree to adversely affect the DPS. The anticipated 3.7-percent flow reduction in October corresponds with the very end of the adult steelhead migration and will occur after most steelhead have finished their upstream migration in this DPS. In addition, small flow reductions that occur during the adult upstream migration period are not thought to adversely affect adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. Furthermore, the reduction in Columbia River flows during the upstream adult migration period in October could help reduce the incidence of fallback at mainstem Columbia River dams which would increase the potential for upstream migration success to occur for this species.

When flow effects on smolt survival or juvenile rearing could occur during the months of November through March, this flow depletion represents less than 0.39 percent of the annual flow in the lower Columbia River below Grand Coulee Dam and between 0.29 percent and 0.19 percent of flow reductions further downstream at McNary and Bonneville Dams under these conditions (computed data in Table 32). Effects to the UCR steelhead DPS from such small flow reductions are either not measureable, or when measureable in October, are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect, this DPS.

Critical Habitat

Table 35 lists PCEs for UCR steelhead. Essential features of this DPS' spawning and rearing areas will not be affected by the Proposed Action because spawning and rearing occurs in Columbia River tributaries and not in the mainstem Columbia River where the effects of the action are realized. The Columbia River rearing and migration corridor for this DPS consists of that segment from the confluence of the Yakima and Columbia rivers downstream to the Pacific Ocean. This DPS has approximately 331 miles of occupied riverine and estuarine designated critical habitat in the Columbia River corridor (NMFS CHART 2005). The migratory corridor critical habitat is not likely to be adversely affected because the effect of flow depletions for the Proposed Action in the Columbia River is small, estimated to be only about 3.7 percent of the annual average flow below Grand Coulee Dam in October and between 0.39 percent and 0.29 percent during November through March when UCR steelhead could be rearing and migrating through the mainstem Columbia River. Proposed action flow reductions become even smaller when measured at McNary and Bonneville dams, with approximate flow reductions between of 2.5 percent to 2.4 percent in October and between 0.29 percent and 0.19 percent, respectively, between November and March. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor for this DPS.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Upper Columbia River steelhead DPS or the safe passage PCE of designated critical habitat in the Columbia River corridor. Any effects are likely to be immeasurable or insignificant during the period when flow reductions are measureable for this DPS.

5.4.3 Middle Columbia River Steelhead

This DPS spawns and rears in the Columbia River outside the action area, and enters the defined action area in the Columbia River between Priest Rapids Dam and the Bonneville Dam. Juveniles and adults from populations in this DPS enter the action area as far downstream as the Deschutes River. This DPS also utilizes the mainstem Columbia River from The Dalles Dam to the Pacific Ocean for juvenile and adult migration. This DPS has a stream-type life history with adults migrating through the Columbia River mainstem during the months of May through October (peak of August and September), and smolts outmigrating as yearlings primarily during the months of April and June, although some smolt outmigration has been known to occur during the late winter period prior to March. Migration timing for MCR steelhead adults overlaps with the Proposed Action flow reduction of 2,700-cfs in the month of October. For steelhead smolts, these time periods correspond with Proposed Action flow reductions of up to 350 cfs in Columbia River average flows below McNary Dam in those rare instances when water is diverted between the winter months of November and March. See Section 4.2.3 of this BA as well as Chapter 10 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Because MCR steelhead use the action area for both adult and smolt migration, as well as some juvenile rearing, the potential effects of the Proposed Action on this DPS and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all river reaches below Priest Rapids Dam. Any effects from the Proposed Action on listed DPSs and their designated critical habitat will diminish progressively downstream.

Reclamation's modeled analysis indicates that past and present O&M actions related to the FCRPS and CBP have altered Columbia River streamflows below Grand Coulee Dam under the environmental baseline. These flow alterations, combined with private water development activities in the upper Columbia River Basin, have contributed in some degree to present environmental conditions within the action area and are expected to continue into the future. Continued flow alterations attributable to the Proposed Action may continue to affect migrating and rearing MCR steelhead in the Columbia River and this DPS' designated critical habitat when flows are reduced to varying degrees between October and March. The Proposed Action will have no effect to this DPS during the spring and summer months between April through September because no additional diversions are proposed during this time period.

Given the magnitude and timing of Proposed Action hydrologic changes in the Columbia River relative to the overall flows in the Columbia River, the effects of such flow alterations are generally too small to measure or, where measureable (i.e., October), do not significantly overlap with life-history timing of MCR steelhead and are not likely to have an adverse affect on either migrating steelhead adults or outmigrating smolts. The Proposed Action will have no effect on MCR steelhead spawning or smolt outmigrations since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. For example, when Proposed Action flow reductions are measureable (i.e., October reductions of 2.53 percent at McNary Dam) the timing of the hydrologic change does not significantly overlap with MCR steelhead adult migration to a sufficient degree to adversely affect the DPS. The anticipated 2.53-percent flow reduction in October corresponds with the very end of the adult steelhead migration after most steelhead have finished their upstream migration in this DPS. In addition, small flow reductions that occur during the adult upstream migration period are not thought to adversely affect adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. Furthermore, the reduction in Columbia River flows during the upstream adult migration period in October could help reduce the incidence of fallback at mainstem Columbia River dams which would increase the potential for upstream migration success to occur for this species.

When flow effects on smolt survival or juvenile rearing could occur during the months of November through March, this flow depletion represents less than 0.29 percent of the annual flow in the lower Columbia River at McNary Dam and between 0.26 percent and 0.19 percent of flow reductions further downstream at Bonneville Dam under these conditions (computed data in Table 32). Effects to the MCR steelhead DPS from such small flow reductions are either not measureable, or when measureable in October, are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect, this DPS.

Critical Habitat

Table 35 lists PCEs for the MCR steelhead DPS. Essential features of this DPS' spawning areas will not be affected by Reclamation's Proposed Action because spawning occurs in Columbia River tributaries and not in the mainstem Columbia River where the effects of the action are realized. As discussed previously, any effects from Reclamation's Proposed Action will diminish progressively downstream and will likely have less effect on listed designated critical habitat farther downstream. The potential effect of Reclamation's Proposed Action on designated critical habitat for MCR steelhead would be similar to effects described for UCR steelhead (Section 4.2.2., "*Upper Columbia River Steelhead*"). However, those MCR steelhead populations entering the action area farther downstream would be less affected. The Columbia River rearing and migration corridor consists of that segment from the confluence of the Wind and Columbia rivers downstream to the Pacific Ocean. This confluence is located at the downstream boundary of the Middle Columbia/Grays Creek HUC5 which was the furthest downstream HUC5 with spawning or tributary PCEs identified in the range of this DPS. Fish distribution and habitat use data identify approximately 151 miles of occupied riverine and estuarine designated critical habitat in the Columbia River corridor (NMFS CHART 2005). The migratory corridor critical habitat is not likely to be adversely affected because the effect of flow depletions for the Proposed Action in the Columbia River is small, estimated to be only about 2.53 percent of the annual average flow below McNary Dam in October and between 0.29 percent and 0.23 percent during November through March when MCR steelhead are no longer actively migrating through the mainstem Columbia River. Proposed action flow reductions become even smaller when measured at Bonneville Dam with approximate flow reductions of 2.4 percent in October and between 0.26 percent and 0.19 percent, respectively, between November and March. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor for this DPS.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Middle Columbia River steelhead DPS or the safe passage PCE of designated critical habitat in the Columbia River corridor. Any effects are likely to be immeasurable, or insignificant during the period when flow reductions are measureable for this DPS.

5.4.4 Snake River Spring/Summer Chinook Salmon

The listed Snake River spring/summer Chinook salmon ESU consists of individual populations from the Imnaha, Salmon, Grande Ronde, and Clearwater Rivers that enter the Snake River between Hells Canyon Dam and Lower Granite Pool. Juvenile and adult spring/summer Chinook salmon from these populations use the Snake River primarily as a migration corridor from spawning and rearing areas to and from the ocean. This ESU is also dependent on the Columbia River migration corridor from the Snake and Columbia River confluence downstream to the Pacific Ocean. SR spring/summer Chinook adults utilize the Columbia River migration corridor between the months of February and April, while smolts outmigrate as yearlings between April and early June with the peak at Lower Granite Dam typically in early May. These time periods correspond with Proposed Action flow reductions of between 350 and 0 cfs in Columbia River average flows below Grand Coulee Dam. See Section 4.2.4 of this BA as well as Chapter 5 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

There are no Proposed Action spawning-, rearing-, or migration-related effects to SR spring/summer Chinook populations or to designated critical habitats within the Snake River basin because there will be no hydrologic changes within the Snake River as a result of the Proposed Action. However, SR spring/summer Chinook salmon use the action area in the mainstem Columbia River for both adult and smolt migration, so effects to the Columbia River migration corridor must be considered for all SR basin species. The potential effects of Reclamation's Proposed Action on this ESU and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all river reaches below the Columbia and Snake River confluence.

Continued flow alterations attributable to the Proposed Action may continue to affect migrating SR spring/summer Chinook salmon in the Columbia River and this ESU's designated critical habitat when flows are reduced to varying degrees between October and March. The Proposed Action will have no effect to this ESU during the months of April through September because no additional diversions are proposed during this time period.

Given the magnitude of hydrologic changes in the Columbia River relative to the overall flows in the Columbia River that are affected by the Proposed Action, the effects of such flow alterations are too small to measure and are not likely to have an adverse affect on either SR spring/summer Chinook adults, rearing juveniles or outmigrating smolts. The Proposed Action will have no effect on SR spring/summer Chinook salmon spawning or smolt outmigrations since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. For example, flow effects resulting from the Proposed Action would deplete flows by a monthly average of 350 cfs during the early smolt migration period that could overlap with the period when water is being diverted from the Columbia River in Novemebr through March. This flow depletion, however, represents less than 0.29 percent of the annual flow in the Columbia River at McNary Dam, and between 0.26 percent and 0.19 percent of flow reductions further downstream at Bonneville Dam under these conditions (computed data in Table 32). Potential effects to adult SR spring/ summer Chinook would be even smaller because these small flow reductions would not impede upstream migrations for those periods when adult migration timing overlaps with anticipated flow reductions in the mainstem Columbia River. Effects to the SR spring/summer Chinook ESU from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect, this ESU.

Critical Habitat

Table 29 lists PCEs for SR spring/summer Chinook salmon. Essential features of this ESU's spawning areas will not be affected by the Proposed Action because spawning occurs in Columbia River tributaries and not in the mainstem Columbia River where the effects of the action are realized. The lower Snake/Columbia River rearing and migration corridor begins in southeast Washington immediately downstream of the confluence of the Snake River with the Palouse River. The corridor includes approximately 58 miles of the Lower Snake River and 320 miles of the Columbia River. The migratory corridor critical habitat is not likely to be adversely affected because the effect of flow depletions for the Proposed Action in the Columbia River is small, estimated to be only about 2.53 percent of the annual average flow at McNary Dam in October and between 0.32 percent and 0.21 percent during November through March when SR spring/summer Chinook are actively migrating through the mainstem Columbia River. Proposed action flow reductions become even smaller when measured at Bonneville Dam with approximate flow reductions of 2.4 percent in October and between 0.26 percent and 0.19 percent, respectively, between November and March. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Snake River spring/summer Chinook salmon ESU or the safe passage PCE of designated critical habitat. Any effects are likely to be immeasurable for this ESU.

5.4.5 Snake River Fall Chinook Salmon

This ESU spawns and rears in the Snake River outside the action area, and enters the defined action area in the Columbia River below the Snake and Columbia River confluence. This ESU also utilizes the mainstem Columbia River from the Snake and Columbia River confluence to the Pacific Ocean for juvenile and adult migration. Fall Chinook salmon throughout their range, especially interior populations, primarily adhere to an ocean-type life-history strategy whereby the young fry emerge from the gravel in late winter or early spring, rear for 2 to 3 months until they reach a migratory size, and then emigrate seaward before water temperatures become too warm (Healey 1991). Because of this narrow timing window between fry emergence and emigration, fall Chinook salmon usually spawn in stream reaches having relatively warm water that promotes early fry emergence and rapid juvenile growth.

Adults from this ESU migrate through the Columbia River mainstem during the months of September through November, while smolts typically outmigrate as subyearlings during the months of June through early August. Migration timing for SR fall-run Chinook adults overlaps with Proposed Action flow reduction of 2,700 cfs in the month of October. The Proposed Action will have no effect on SR fall-run Chinook spawning or juvenile rearing since these activities occur in the Snake River mainstem and tributaries that are outside of the action area. See Section 4.2.5 of this BA as well as Chapter 4 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

There are no Proposed Action spawning-, rearing-, or migration-related effects to SR fall-run Chinook populations or to designated critical habitats within the Snake River basin because there will be no hydrologic changes within the Snake River as a result of the Proposed Action. However, SR fall-run Chinook salmon use the action area in the mainstem Columbia River for both adult and smolt migrations, as well as for juvenile rearing, so effects to the Columbia River migration corridor must be considered for all SR basin species. The potential effects of Reclamation's Proposed Action on this ESU and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all river reaches below the Columbia and Snake River confluence.

Continued flow alterations attributable to the Proposed Action may continue to affect migrating SR fall-run Chinook salmon in the Columbia River and this ESU's designated critical habitat when flows are reduced to varying degrees between October and March. The Proposed Action will have no effect to this ESU during the months of April through September because no additional diversions are proposed during this time period.

Given the magnitude and timing of Proposed Action hydrologic changes in the Columbia River relative to the overall flows in the Columbia River, the effects of such flow alterations are generally too small to measure, or where measureable (i.e. October) do not significantly overlap with life-history timing of SR fall-run Chinook and are not likely to have an adverse affect on either migrating Chinook adults or outmigrating smolts. For example, when Proposed Action flow reductions are measureable (i.e. October reductions of 2.53 percent at McNary Dam) the resulting small flow reductions that occur during the adult upstream migration period are not thought to adversely affect adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. Furthermore, the reduction in Columbia River flows during the upstream adult migration period in October could help reduce the incidence of fallback at mainstem Columbia River dams which would increase the potential for upstream migration success to occur for this species.

When flow effects on smolt survival would be most probable between June through August, the Proposed Action will not deplete flows in the Columbia River during the smolt migration period. Flow depletions between the months of November and March that could potentially occur under the Proposed Action could affect juvenile rearing in the mainstem Columbia River. However, reductions that occur during the winter period represent less than 0.29 percent of the annual flow in the lower Columbia River at McNary Dam and a 0.26 to 0.21-percent flow reduction further downstream at Bonneville Dams under these conditions (computed data in Table 32). Effects to the SR fall-run Chinook ESU from such small flow reductions are either not measureable, or when measureable in October, are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect, this ESU.

Critical Habitat

Table 29 and Table 35 list the PCEs for SR fall-run Chinook salmon for spawning and juvenile rearing and migration. Essential features of SR fall-run Chinook salmon spawning and early rearing areas that occur in the free-flowing section of river below Hells Canyon Dam would not be affected because no Snake River flow alteration will occur under the Proposed Action. The lower Snake/Columbia River rearing and migration corridor begins in southeast Washington immediately downstream of the confluence of the Snake River with the Palouse River. The corridor includes approximately 58 miles of the Lower Snake River and 320 miles of the Columbia River. The migratory corridor critical habitat is not likely to be adversely affected because the effect of flow depletions for the Proposed Action in the Columbia River is small, estimated to be only about 2.53 percent of the annual average flow at McNary Dam in October and between 0.29 percent and 0.21 percent during November through March when SR fall-run Chinook are unlikely to be migrating through the mainstem Columbia River and will be rearing in mainstem areas downstream of the Snake River confluence. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Snake River fall Chinook salmon ESU or the safe passage PCE of designated critical habitat. Any effects are likely to be immeasurable for this ESU.

5.4.6 Snake River Sockeye Salmon

Juvenile sockeye salmon enter the Snake River from the Salmon River, and they actively migrate through the lower Snake and Columbia Rivers later in the summer than Snake River spring/summer Chinook salmon. Because they are relatively few in number, sockeye salmon smolts have not been studied as much as Chinook salmon and steelhead in the Snake and Columbia Rivers. This ESU is also dependent on the Columbia River migration corridor from the Snake and Columbia River confluence downstream to the Pacific Ocean. SR sockeye adults utilize the Columbia River migration corridor between the months of June and July, while smolts outmigrate as yearlings between May and July with the peak at Lower Granite Dam typically in late June. These time periods of adult and smolt SR sockeye use do not correspond with flow reductions that are anticipated to occur under the Proposed Action. See Section 4.2.6 of this BA and Chapter 6 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

There are no Proposed Action spawning-, rearing-, or migration-related effects to Snake River sockeye populations or to designated critical habitats within the Snake River basin because there will be no hydrologic changes within the Snake River as a result of the Proposed Action. However, Snake River sockeye use the action area in the mainstem Columbia River for both adult and smolt migration, as well as juvenile rearing, so effects to the Columbia River migration corridor must be considered for all SR basin species. The potential effects of Reclamation's Proposed Action on this ESU and its designated critical habitat pertain only to flows in the Columbia River migration corridor and estuary in all river reaches below the Columbia and Snake River confluence.

Continued flow alterations attributable to the Proposed Action may continue to affect migrating SR sockeye salmon in the Columbia River and this ESU's designated critical habitat when flows are reduced to varying degrees between October and March. The Proposed Action will have no effect to this ESU during the spring and summer months between April through September because no additional diversions are proposed during this time period.

Given the magnitude of hydrologic changes in the Columbia River relative to the overall flows in the Columbia River that are affected by the Proposed Action, the effects of such flow alterations are too small to measure and are not likely to have an adverse affect on either SR sockeye adults or outmigrating smolts. As a result, there will likely be no effect to these life stages of SR sockeye if the Proposed Action is implemented. The Proposed Action will have no effect on SR sockeye spawning since this activity occurs primarily in the Salmon River in the Snake River basin that is well outside of the action area. Proposed Action flow reductions during the winter months (November through March) of up to 350 cfs in Columbia River average flows as measured at McNary Dam could potentially have an effect on rearing juveniles. However, this flow depletion represents less than 0.29 percent of the annual flow in the Columbia River at McNary Dam and between 0.26 percent and 0.19 percent of flow reductions further downstream at Bonneville Dam under these conditions (computed data in Table 32). Potential effects to adult sockeye would be even smaller because these small flow reductions would not impede upstream migrations for those periods when adult migration timing overlaps with anticipated flow reductions in the mainstem Columbia River. Effects to the SR sockeye ESU from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect, this ESU.

Critical Habitat

Table 29 and Table 35 list the PCEs for SR sockeye salmon for spawning as well as for juvenile rearing and migration. The lower Snake/Columbia River rearing and migration corridor for this ESU begins in southeast Washington immediately downstream of the confluence of the Snake River with the Palouse River. The corridor includes approximately 58 miles of the Lower Snake River and 320 miles of the Columbia River. Essential features of SR sockeye spawning and early rearing areas that occur in the free-flowing section of river below Hells Canyon Dam in the Snake River basin would not be affected because no Snake River flow alteration will occur under the Proposed Action. The migratory corridor critical habitat in the mainstem Columbia River is not likely to be adversely affected because the Proposed Action does not divert flows from the Columbia River during the adult or smolt migration periods for this ESU. The small hydrologic changes that are likely to occur during the October- and November-through-March time periods would not be expected to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Snake River sockeye salmon ESU or the safe passage PCE of designated critical habitat. Any effects are likely to be immeasurable for this ESU.

5.4.7 Snake River basin Steelhead

Snake River steelhead smolts actively outmigrate from Snake River tributaries in the spring at approximately the same time as juvenile SR spring/summer Chinook salmon. Adult SR steelhead migrate upstream in the Columbia and Snake River primarily in mid- to late summer. Some adults make it past Lower Granite Dam by the fall but some adults overwinter in the lower Snake River and continue their upstream migration in the following spring. The effects from the Proposed Action on juvenile steelhead should be similar to those for juvenile SR spring/summer Chinook salmon. See Section 4.2.7 of this BA and Chapter 7 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Migration timing for SR steelhead adults overlaps with Proposed Action flow reduction of 2,700 cfs in the month of October. For SR steelhead juveniles, these time periods correspond with Proposed Action flow reductions of up to 350 cfs in Columbia River average flows below McNary Dam.

There are no Proposed Action spawning-, rearing-, or migration-related effects to SR steelhead populations or to designated critical habitats within the Snake River basin because there will be no hydrologic changes within the Snake River as a result of the Proposed Action. However, SR steelhead use the action area in the mainstem Columbia River for both adult and smolt migration so effects to the Columbia River migration corridor must be considered for all SR basin species. The potential effects of the Proposed Action on this DPS and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all river reaches below the Columbia and Snake River confluence.

Continued flow alterations attributable to the Proposed Action may continue to affect migrating Snake River steelhead in the Columbia River and this DPS' designated critical habitat when flows are reduced to varying degrees between October and March. The Proposed Action will have no effect to this DPS during the months of April through September because no additional diversions are proposed during this time period.

Given the magnitude and timing of Proposed Action hydrologic changes in the Columbia River relative to the overall flows in the Columbia River, the effects of such flow alterations are generally too small to measure or, where measureable (i.e., October), do not significantly overlap with life-history timing of SR steelhead and are not likely to have an adverse affect on either migrating steelhead adults or outmigrating smolts. The Proposed Action will have no effect on SR steelhead spawning or smolt outmigrations since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. For example, when Proposed Action flow reductions are measureable (i.e., October reductions of 2.53 percent at McNary Dam), the resulting small flow reductions that occur during the adult upstream migration period are not thought to adversely affect adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. Furthermore, the reduction in Columbia River flows during the upstream adult migration period in October could help reduce the incidence of fallback at mainstem Columbia River dams which would increase the potential for upstream migration success to occur for this species.

Flow effects resulting from the Proposed Action would deplete flows by a monthly average of 350 cfs during the early smolt migration period that could overlap with the period when water is being diverted from the Columbia River in November through March. This flow depletion, however, represents less than 0.29 percent of the annual flow in the Columbia River at McNary Dam, and between 0.26 percent and 0.19 percent of flow reductions further downstream at Bonneville Dam under these conditions (computed data in Table 32). Effects to the SR steelhead DPS from such small flow reductions are either not measureable or, when measureable in October, are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect, this DPS.

Critical Habitat

Chapter 19 of the *Comprehensive Analysis* (Action Agencies 2007b) describes the geographic extent, conservation role, and current condition of designated critical habitat for the Snake River basin steelhead DPS. The lower Snake/Columbia River rearing and migration corridor begins in southeast Washington immediately downstream of the confluence of the Snake River with the Palouse River. The corridor includes approximately 58 miles of the Lower Snake River and 320 miles of the Columbia River. Watersheds downstream of the Palouse River are outside of the spawning range of this ESU and likely used in a limited way as juvenile rearing habitat for this DPS. Table 35 lists these PCEs for Snake River basin steelhead for freshwater migration. Essential features of Snake River steelhead spawning, rearing, and migration areas would not be affected by the Proposed Action, because spawning and rearing occurs in Snake River tributaries that are outside of the action area. Essential features of safe passage in the Columbia River migration corridor from the Snake and Columbia rivers' confluence to the Pacific Ocean will also not be adversely affected because this DPS migrates in the early spring period that is commensurate with very small flow reductions resulting from the Proposed Action. The migratory corridor critical habitat is not likely to be adversely affected because the effect of flow depletions for the Proposed Action in the Columbia River is small, estimated to be only about 2.53 percent of the annual average flow below McNary Dam in October and between 0.29 percent and 0.21 percent during November through March, when only a few SR steelhead would be actively migrating through the mainstem Columbia River. Proposed action flow reductions become even smaller when measured at Bonneville Dam with approximate flow reductions of 2.4 percent in October and between 0.26 percent and 0.19 percent, respectively, between November and March. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor for this DPS.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Snake River steelhead DPS or the safe passage PCE of designated critical habitat. Any effects are likely to be immeasurable for this DPS.

5.4.8 Columbia River Chum Salmon

Adults of this ESU use the action area in the Columbia River downstream from Bonneville Dam for migration, spawning, and rearing. This ESU uses the portion of the action area that begins approximately 178 miles downstream from the Columbia/Snake River confluence and even farther (450 total miles downstream) from Reclamation's Grand Coulee Dam where the Proposed Action diversions will occur. Fish from this ESU spawn and rear in Columbia River tributaries outside the action area; they also spawn and rear in the mainstem Columbia River and mainstem side channels downstream from Bonneville Dam. Some adults occasionally pass above the dam, but until recently it was unknown if they successfully spawn there. Recent observations of juvenile chum salmon migrating passed Bonneville Dam confirms that chum can successfully spawn upstream of the dam. Generally, chum salmon adults migrate during the months of October through November. Although spawning typically occurs in November through December, some spawning could occur in the month of October. Juveniles from this ESU typically outmigrate as subyearlings soon after emergence in February and March. The rapid outmigration timing for chum salmon means that they utilize the mainstem Columbia River for rearing and migration for a relatively short amount of time, and usually complete their outmigration during the months of March through May. Migration and early spawn timing for chum salmon adults overlaps with Proposed Action flow reduction of 2,700 cfs in the month of October. For chum salmon juveniles and smolts, mainstem rearing and outmigration timing correspond with Proposed Action flow reductions of 350 cfs in the Columbia River average flows below Bonneville Dam during the November-to-March time period. The Proposed Action will have no effect on chum salmon spawning or juvenile rearing in Columbia River tributaries since these activities occur in areas that are outside of the action area. However, the Proposed Action will have an effect on chum salmon spawning because these fish use the mainstem and, potentially, side channels of the mainstem Columbia River during the month of October when measureable flow effects will occur. See Section 4.2.8 of this BA as well as Chapter 11 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Chum salmon spawn in shallower, slower-running streams and side channels more frequently than do other salmonids. In some locations, subgravel flow (upwelled groundwater from seeps and springs) may be important in the choice of redd sites by chum salmon. Many Columbia River chum have been found to select spawning sites in areas of upwelling groundwater. A chum salmon flow objective of approximately 125,000 cfs from the start of chum salmon spawning in November until the end of fry emergence in March is identified as an FCRPS action, although river stage downstream from Bonneville Dam rather than actual flow has been used to provide adequate habitat for spawning and incubating chum salmon. Streamflows from coordinated FCRPS operations are to be adjusted to compensate for tidal influence and any effect from the flows out of the Willamette River to maintain these flow and elevation objectives for chum salmon protection.

Reclamation has determined that the Proposed Action has the potential to affect chum salmon spawning, rearing, and migration for this ESU because all of these life-history stages occur in the Columbia River within the action area for this species. Because adult chum salmon from this ESU spawn in the mainstem Columbia River when Proposed Action flow reductions are measureable (i.e., October reductions of 2.4 percent below Bonneville Dam) the timing of the hydrologic change will significantly overlap with chum salmon adult migration and spawn timing to a sufficient degree to adversely affect the species. The anticipated 2.4-percent flow reduction in October corresponds with the early spawning period and the very end of the adult migration period for this ESU. Although the small flow reductions that occur during the adult upstream migration period are not anticipated to adversely affect adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish, the flow reductions during the October spawning period are measureable and could potentially influence habitat conditions in mainstem and side channel spawning areas that are used by adults from this ESU. Reclamation therefore concludes that the Proposed Action is significant and is likely to adversely affect spawning habitat for this chum salmon ESU.

Conversely, when effects on juvenile and smolt survival would be most likely to occur (between March and May), the Proposed Action will deplete flows by a monthly average of 350 cfs during the juvenile rearing and early smolt outmigration period in March. This flow depletion represents between 0.26 percent and 0.19 percent of the annual flow in the lower Columbia River below Bonneville Dam under these conditions (computed data in Table 32). Because of the distance downstream from Grand Coulee Dam where the flow effects of the Proposed Action would be most significant, the much larger volume of water in the Columbia River downstream of the Snake River confluence, and the influence of tidal effects to lower Columbia River water surface elevations is greatest, the effects of the Proposed Action on migration and rearing downstream from Bonneville Dam will be unquantifiable and will likely be negligible for juvenile rearing and smolt migration.

Reclamation concludes that its Proposed Action will have a measureable effect on adult spawning in the lower Columbia River mainstem, but will not have a quantifiable effect on juvenile rearing or both adult and smolt migrations.

Critical Habitat

Table 35 lists PCEs for Columbia River chum salmon for freshwater migration, spawning areas, and rearing areas. The lower Columbia River chum critical habitat rearing and migration corridor consists of that segment from the mouth of the Columbia River at the Pacific Ocean upstream to an imaginary line connecting the confluences of the Sandy River (Oregon) and Washougal River (Washington). This corridor overlaps with the following counties: Clatsop, Columbia, and Multnomah counties in Oregon; and Clark, Cowlitz, Pacific, and Wahkiakum counties in Washington. Fish distribution and habitat use data identify approximately 118 miles of occupied riverine and estuarine habitat in this corridor. As discussed for this ESU, Reclamation's Proposed Action in the upper Columbia River reduce flows in the lower Columbia River below Bonneville Dam by about 2.4 percent in October and between 0.26 percent to 0.19 percent for the months of November through March when Proposed Action flow reductions will occur. The magnitude of any effects from flow alterations on this ESU's migration and rearing PCEs of designated critical habitat would be too small to measure outside of the October flow alteration period. However, the measureable effect of the Proposed Action on chum salmon spawning habitat in October is likely to have adverse affects on critical habitat, although these would be difficult to measure. Despite the implementation of flow objectives and elevation targets below Bonneville Dam through the operation of the FCRPS, Reclamation concludes that chum salmon spawning habitat will be negatively affected by the Proposed Action.

Effects Conclusion

Reclamation concludes that its Proposed Action will have a measureable effect on adult chum salmon spawning in the Columbia River mainstem, but will not have a quantifiable effect on juvenile rearing or adult and smolt migrations. In addition, the Proposed Action will not have an adverse affect on the Columbia River chum salmon freshwater rearing and migration PCEs of designated critical habitat, but will have an adverse affect on freshwater spawning PCEs. As a result, the Proposed Action ***may affect, and is likely to adversely affect,*** the Columbia River chum salmon ESU.

5.4.9 Lower Columbia River Chinook Salmon

The LCR Chinook salmon ESU spawns, incubates, and rears outside of the action area. Its designated critical habitat occurs in the action area where juveniles and adults utilize tributary subbasins between the Sandy and Washougal River downstream to the Pacific Ocean. Adults and juveniles use approximately the lower 101 miles of the Columbia River for migration and rearing. The Proposed Action will have no effect on LCR Chinook spawning since this activity occurs in the Columbia River tributaries outside of the action area. Chinook salmon from this ESU exhibit a mix of ocean-type and stream-type life-history patterns, although the ocean-type fall Chinook dominate the populations. Upstream migrating adults enter the action area when they enter the Columbia River between the months of March through April, and August through September for spring Chinook and fall Chinook populations, respectively. Chinook smolts outmigrate at similar times as both yearling and subyearlings between the months of May and June despite the mixture of ocean-type and stream-type populations in this ESU. See Section 4.2.9 of this BA as well as Chapter 12 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Because LCR Chinook salmon use the action area for both adult and smolt migration, as well as some juvenile rearing in the mainstem Columbia River, the potential effects of Reclamation's Proposed Action on this ESU and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all river reaches below Bonneville Dam.

Reclamation's Proposed Action is likely to have minimal, if any discernible, effect on this ESU as flow depletions from the Proposed Action are very small and immeasurable this far downstream in the lower Columbia River. In addition, tidal influences in the lower Columbia River can be substantial and have a much greater influence on Columbia River flow and water surface elevations than would the Proposed Action. The Proposed Action will have no effect on LCR Chinook spawning or smolt outmigrations since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. For example, when flow effects on juvenile rearing survival would be most probable between November through March, the Proposed Action flow reductions in the area downstream of Bonneville Dam comprises about 0.26 to 0.19 percent of Columbia River flows in this reach on an annual average basis. When tidal influences and other tributary inputs are added to the flows below Bonneville Dam, the cumulative impact of the Proposed Action becomes even smaller in the lower sections of the Columbia River. Finally, the Proposed Action will have no effect to this ESU during the months of April through September because no additional diversions are proposed during this time period. As a result, Reclamation has determined that the Proposed Action may affect, and is not likely to adversely affect, the LCR Chinook salmon ESU.

Critical Habitat

Table 35 lists PCEs for LCR Chinook salmon for freshwater migration and rearing. Essential features of this ESU's spawning habitat will not be affected by Reclamation's Proposed Actions, because spawning occurs in tributaries to the Columbia River which are outside of the action area. Some rearing of subyearling fall Chinook could occur in the mainstem lower Columbia River. The lower Columbia River rearing and migration corridor consists of that segment of the Columbia River from the confluences of the Sandy River (Oregon) and Washougal River (Washington) to the Pacific Ocean (NMFS CHART 2005). Watersheds downstream of the Sandy and Washougal River subbasins are outside the spawning range of this ESU and likely used in a limited way as juvenile rearing habitat for this ESU. As discussed for this ESU, Reclamation's Proposed Action is likely to have minimal if any discernible effect on designated critical habitat as flow depletions from the Proposed Actions are very small and immeasurable this far downstream in the lower Columbia River. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Lower Columbia River Chinook salmon ESU or the safe passage PCE of designated critical habitat. Any effects are immeasurable.

5.4.10 Lower Columbia River Coho Salmon

Lower Columbia River coho salmon enter the action area in the spring and fall when smolts exit various lower Columbia River tributaries downstream of the Hood River, or when adults migrate through the Columbia River mainstem to access spawning tributaries. Fish from this ESU spawn and rear in Columbia River tributaries that are outside the action area. This area is approximately 400 miles downstream from the Proposed Action in the Upper Columbia River Basin. Generally, coho salmon adults migrate during the months of September through October, although an early run exists within this ESU with adults migrating between July and August. Smolts from this ESU typically outmigrate as yearlings during the months of April and June. Juvenile coho salmon are known to overwinter in tributaries to the Columbia River and may use the mainstem Columbia River for rearing during the winter period when Proposed Action diversions could occur. Migration timing for LCR coho adults overlaps with Proposed Action flow reduction of 2,700 cfs in the month of October. For LCR coho smolt and juvenile fish that use the lower Columbia mainstem for rearing, these time periods correspond with Proposed Action flow reductions of 350 cfs in Columbia River average flows below Bonneville Dam. See Section 4.2.10 of this BA and Chapter 13 of the

Comprehensive Analysis (Action Agencies 2007b) for background and base status information on this species.

Because LCR coho use the action area for both adult and smolt migration, the potential effects of Reclamation's Proposed Action on this ESU pertain only to flows in the Columbia River migration corridor in all river reaches below Hood River (Oregon) and the Big White Salmon River (Washington).

Continued flow alterations attributable to the Proposed Action may continue to affect migrating LCR coho in the Columbia River when flows are reduced to varying degrees between October and June. However, Reclamation's Proposed Action would be expected to have minimal effects on this listed species since it occurs a significant distance downstream from the Proposed Action area. The Proposed Action will have no effect to this ESU during the months of July, August, and September because no additional diversions are proposed during this time period.

Given the magnitude and timing of Proposed Action hydrologic changes in the Columbia River relative to the overall flows in the Columbia River and considering the extreme distance downstream of where the Proposed Action will occur, the effects of such flow alterations are generally too small to measure, or where measureable (i.e. October) do not significantly overlap with life-history timing of LCR coho and are not likely to have an adverse affect on either migrating steelhead adults or outmigrating smolts. The Proposed Action will have no effect on LCR coho spawning or smolt outmigrations since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. For example, when Proposed Action flow reductions are measureable (i.e. October reductions of 2.4 percent below Bonneville Dam) the small flow reductions that occur during the adult upstream migration period are not thought to adversely affect migrating adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. When flow effects on rearing juveniles and early smolt survival would be most probable between November and March, the Proposed Action will deplete flows by a monthly average of 350 cfs. This flow depletion represents less than 0.26 percent of the annual flow in the lower Columbia River below Bonneville Dam (computed data in Table 32). Effects to the LCR coho salmon ESU from such small flow reductions are either not measureable, or when measureable in October, are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect this ESU.

Critical Habitat

NMFS has not designated critical habitat for this ESU.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Lower Columbia River coho salmon ESU. Any effects of the Proposed Actions are either immeasurable to outmigrating smolts, or where measureable (i.e. October) are not likely to impede upstream adult fish migration for this species.

5.4.11 Lower Columbia River Steelhead

Fish from this DPS spawn and rear in Columbia River tributaries outside the action area, and enter the defined action area when migrating via the mainstem Columbia River from the mouth upstream to the Sandy and Washougal River confluences. This DPS has a mixture of stream-type and ocean-type life history with adults migrating through the Columbia River mainstem on a year-around basis. Generally, summer steelhead adults migrate during the months of May through October (peak of August and September), while winter steelhead migrate much later, between November through April. Despite the different adult migration times exhibited by LCR steelhead, smolts from this DPS typically outmigrate as yearlings during the months of April and June. Juvenile steelhead can be found in the lower river mainstem for rearing during any month of the year, although they are more typically found in tributary systems to the Columbia River. Migration timing for LCR steelhead adults overlaps with Proposed Action flow reductions of 2,700 cfs in the month of October. For steelhead juveniles, these time periods correspond with Proposed Action flow reductions of 350 cfs in Columbia River average flows below Grand Coulee Dam between November and March. See Section 4.2.11 of this BA as well as Chapter 14 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Because LCR steelhead use the action area for both adult and smolt migration, as well as juvenile rearing, the potential effects of Reclamation's Proposed Action on this DPS and its designated critical habitat pertain only to flows in the Columbia River migration corridor from Bonneville Dam downstream to the Pacific Ocean.

Continued flow alterations attributable to the Proposed Action may continue to affect migrating LCR steelhead in the Columbia River and this DPS's designated critical habitat when flows are reduced to varying degrees between October and March. However, Reclamation's Proposed Action would be expected to have minimal effects on this listed species since it occurs a significant distance downstream from the proposed withdrawal point above Grand Coulee Dam and any influence of the Proposed Action flow reductions would be indistinguishable in the lower Columbia River. In addition, the significant tidal influence in this reach tends to have a greater impact on habitat conditions and water surface elevations in both the estuary and the mainstem river than flow conditions alone. As a result, the effects of the Proposed Action are minimized in the lower river through these other factors. The Proposed Action will have no effect to this DPS during the months of April through September because no additional diversions are proposed during this time period.

Given the magnitude and timing of Proposed Action hydrologic changes in the Columbia River relative to the overall flows in the Columbia River, the effects of such flow alterations are generally too small to measure, or where measureable (i.e. October) do not significantly overlap with life-history timing of LCR steelhead and are not likely to have an adverse affect on either migrating steelhead adults, outmigrating smolts, or rearing juveniles. The Proposed Action will have no effect on LCR steelhead spawning or smolt outmigrations since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. For example, when Proposed Action flow reductions are measureable (i.e. October reductions of 2.4 percent below Bonneville Dam), the timing of the hydrologic change does not significantly overlap with LCR steelhead adult migration to a sufficient degree to adversely affect the DPS. The anticipated 2.4-percent flow reduction in October corresponds with the very end of the adult steelhead migration after most steelhead have finished their upstream migration in this DPS. In addition, small flow reductions that occur during the adult upstream migration period are not thought to adversely affect migrating adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. When flow effects are anticipated to occur during the November-through-March period when juveniles are rearing in the lower Columbia River, the Proposed Action will deplete flows by a monthly average of 350 cfs. This flow depletion represents less than 0.26 percent of the annual flow in the lower Columbia River below Bonneville Dam (computed data in Table 32). Effects to the LCR steelhead DPS from such small flow reductions are either not measureable, or when measureable in October, are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect this DPS.

Critical Habitat

Table 35 lists PCEs for LCR steelhead. Essential features of this DPS's spawning habitat will not be affected by Reclamation's Proposed Action because spawning occurs in Columbia River tributaries and not in the mainstem Columbia River where the effects of the action are realized. The lower Columbia River rearing and migration corridor consists of that segment from the mouth of the Columbia River at the Pacific Ocean upstream to an imaginary line connecting the confluences of the Sandy River (Oregon) and Washougal River (Washington) (NMFS CHART 2005). The migratory corridor critical habitat is not likely to be adversely affected because the effect of flow depletions for the Proposed Action in the Columbia River is small, estimated to be only about 2.4 percent of the annual average flow below Bonneville Dam in October and between 0.26 percent and 0.19 percent during November through March when LCR steelhead are actively rearing and perhaps migrating through the mainstem Columbia River in small numbers. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. At this location in the Columbia River, the relatively minor flow alterations of Reclamation's Proposed Action are likely to have a negligible effect on designated critical habitat in this DPS. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor for this DPS.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the LCR steelhead DPS or the safe passage PCE of designated critical habitat in the Columbia River corridor. Any effects are likely to be immeasurable, or insignificant during the period when flow reductions are measureable for this DPS.

5.4.12 Upper Willamette River Chinook Salmon

The UWR Chinook salmon ESU spawns, incubates, and rears outside of the action area. Its designated critical habitat occurs in the action area where juveniles exit the Willamette River and enter the Columbia River, approximately 223 miles downstream from the confluence of the Columbia and Snake Rivers, and even farther downstream (494 miles) from Reclamation's proposed water diversions at Grand Coulee Dam. The Proposed Action will have no effect on UWR Chinook spawning since this activity occurs in the Willamette River outside of the action area. Adults and juveniles use the lower 101 miles of the Columbia River for migration. Upstream migrating adults leave the action area when they enter the Willamette River between the months of April through June for spawning, and Chinook smolts outmigrating as yearlings primarily during the months of May and June. These time periods correspond with a period when the Proposed Action does not divert water and, as a result, the Proposed Action is not likely to have an adverse affect on these life stages in the upper Willamette River system. See Section 4.2.12 of this BA as well as Chapter 15 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Because UWR Chinook salmon use the action area for both adult and smolt migration, the potential effects of Reclamation's Proposed Action on this ESU and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all mainstem reaches below the Willamette River confluence at Columbia RM 101.5.

Reclamation's Proposed Action is likely to have minimal if any discernible effect on this ESU as flow depletions from the Proposed Actions are very small and immeasurable this far downstream in the lower Columbia River. For example, when flow effects could influence survival of rearing juveniles and smolts between the November-through-March period, the Proposed Action flow reductions in the area downstream of Bonneville Dam comprise about 0.26 percent to 0.21 percent of Columbia River flows in this reach on an annual average basis. The Proposed Action will have no effect to this ESU during the months of April through September because no additional diversions are proposed during this time period. As a result, Reclamation determined that the Proposed Action may affect, and is not likely to adversely affect the UWR Chinook salmon ESU.

Critical Habitat

Table 35 lists PCEs for Upper Willamette River Chinook salmon for freshwater migration. Essential features of this ESU's spawning and rearing areas will not be affected by Reclamation's Proposed Action, because spawning and rearing occurs in the Willamette River system. The lower Willamette/Columbia River rearing and migration corridor consists of that segment from the confluence of the Willamette and Clackamas rivers to the Pacific Ocean. This corridor also includes the Multnomah Channel portion of the Lower Willamette River. Watersheds downstream of the Clackamas River subbasin are outside the spawning range of this ESU and are likely used in a limited way as juvenile rearing habitat for this ESU. Fish distribution and habitat use data identify approximately 137 miles of occupied riverine and estuarine designated critical habitat in this corridor (NMFS CHART 2005). As discussed for this ESU, Reclamation's Proposed Action is likely to have minimal if any discernible effect on designated critical habitat as flow depletions from the Proposed Actions are very small and immeasurable this far downstream in the lower Columbia River. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Upper Willamette River Chinook salmon ESU or the safe passage PCE of designated critical habitat. Any effects are likely to be immeasurable and insignificant.

5.4.13 Upper Willamette River Steelhead

The UWR steelhead DPS spawns, incubates, and rears outside of the action area. Adults and juveniles use the lower 101 miles of the Columbia River for migration. Designated critical habitat occurs in the action area where juveniles exit the Willamette River and enter the Columbia River, approximately 223 miles downstream from the confluence of the Columbia and Snake Rivers, and even farther downstream (494 miles) from Reclamation's proposed water diversions at Grand Coulee Dam. The Proposed Action will have no effect on UWR steelhead spawning or juvenile rearing since these activities occur in the Willamette River outside of the action area. Upstream migrating adults leave the action area when they enter the Willamette River between the months of April through June for spawning, and steelhead smolts outmigrating primarily during the months of May and June. These time periods and life history stages do not overlap with proposed flow reductions in the Columbia River for the Proposed Action. See Section 4.2.13 of this BA as well as Chapter 16 of the *Comprehensive Analysis* (Action Agencies 2007b) for background and base status information on this species.

Because UWR steelhead use the action area for both adult and smolt migration, the potential effects of Reclamation's Proposed Action on this DPS and its designated critical habitat pertain only to flows in the Columbia River migration corridor in all mainstem reaches below the Willamette River confluence at Columbia RM 101.5.

Reclamation's Proposed Action is likely to have minimal, if any discernible, effect on this DPS as flow depletions from the Proposed Actions are very small and immeasurable this far downstream in the lower Columbia River. For example, when flow effects on rearing juvenile survival would be most probable between November and March, the Proposed Action flow reductions in the area downstream of Bonneville Dam comprises about 0.26 percent to 0.21 percent of Columbia River flows in this reach on an annual average basis. The Proposed Action will have no effect to this ESU during the spring and summer months of April through September because no additional diversions are proposed during this time period. As a result, Reclamation determined that the Proposed Action may affect, and is not likely to adversely affect, the UWR steelhead DPS.

Critical Habitat

Table 35 lists PCEs for Upper Willamette River steelhead for freshwater migration. Essential features of this DPS's spawning and rearing areas will not be affected by Reclamation's Proposed Actions, because spawning and rearing occurs in the Willamette River system. The lower Willamette/Columbia River rearing and migration corridor consists of that segment from the confluence of the Willamette and Clackamas rivers to the Pacific Ocean. This corridor also includes the Multnomah Channel portion of the Lower Willamette River. Watersheds downstream of the Clackamas River subbasin are outside the spawning range of this ESU and likely used in a limited way as juvenile rearing habitat for this ESU. Fish distribution and habitat use data identify approximately 138 miles of occupied riverine and estuarine designated critical habitat in this corridor (NMFS CHART 2005). As discussed for this ESU, Reclamation's Proposed Action is likely to have minimal, if any discernible, effects on designated critical habitat as flow depletions from the Proposed Actions are very small and immeasurable this far downstream in the lower Columbia River. These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. As a result, the Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat in the mainstem Columbia River corridor.

Effects Conclusion

In summary, based on the above analysis, Reclamation's Proposed Action ***may affect, but is not likely to adversely affect,*** the Upper Willamette River steelhead DPS or the safe passage PCE of designated critical habitat. Any effects of the Proposed Actions are immeasurable.

5.5 Effects to Pacific Eulachon

NMFS identified destruction, modification, or curtailment of habitat and an inadequacy of regulatory mechanisms as the principal factors responsible for the decline of the southern DPS of eulachon (75 FR 13012). Changes in ocean conditions due to climate change remain as the most significant threats to eulachon and their habitats, with climate-induced changes to freshwater habitats identified as a moderate threat (75 FR 13012).

Reclamation's Proposed Action may influence freshwater habitat important to eulachon through modification of the Columbia River flows and slight changes in water quality parameters, such as river temperature and total dissolved gas (TDG) concentrations during migratory and spawning periods. The influence of the Upper Snake Project varies throughout the year as well as annually.

5.5.1 Altered Hydrograph

Throughout their range, eulachon typically enter spawning rivers during the winter months, when Columbia River flow is typically lowest and the mean monthly influence of the Odessa Proposed Action ranges from a 0.26-percent to a 0.19-percent flow depletion below Bonneville Dam. This influence is even smaller where most eulachon are found in the lower 100 miles of the Columbia River due to contributions of inflow from the Willamette River and other lower Columbia River tributaries as well as the significant tidal effects that the estuary and lower river experience from frequent tides that extend all the way up to Bonneville Dam. It appears that eulachon evolved to time their spawning such that larvae would be flushed to the ocean during the high flows associated with the spring freshet.

Prior to the construction of Columbia River Basin dams, annual spring freshet flows through the Columbia River estuary were approximately 50 percent greater than the post-development levels. These freshet flows flushed the estuary and carried the larval eulachon to the sea. Post-dam development flows in the Columbia River are characterized by lower spring freshet flows and higher winter flows. In addition to development of federal water projects, flow regulation by other dam operators, water withdrawal from all sources, and climate change have also contributed to reduce the Columbia River's average flow, altered its seasonality, and reduced sediment discharge and turbidity (NMFS 2008b).

Decreasing winter flows (attributable to multiple causes) could affect the timing of adult eulachon entering the Columbia River to spawn; however, the Proposed Action generally would have a very minor depleting influence on winter flows. Given a general lack of data and scientific understanding, the effects associated with changes in flow on eulachon are unclear and the flow-related biological effects of the Proposed Action would be immeasurable during the migration timing for this species.

Because flow reductions above Grand Coulee Dam related to the Proposed Action are small compared to mainstem Columbia River flows, it is not likely that the Proposed Action will influence mainstem Columbia River flows (or even be measureable) at a time when and where eulachon spawn in the mainstem Columbia River. Flow reductions of between 0.26 percent and 0.21 percent during the mainstem spawning period are not distinguishable from normal river fluctuations and are not likely to alter physical conditions such as depth or water velocity to a measureable degree. These small hydrologic impacts of the Proposed Action are also likely to be masked by the much larger influence that tidal effects have on the lower Columbia River. Therefore, it is unlikely that there is an effect on the timing of eulachon migration or in the ability of eulachon to spawn in the Columbia River.

5.5.2 Water Quality

Temperature. Water temperature appears to influence the timing of migration and spawning of eulachon (ODFW and WDFW 2009). Spawning typically occurs when river temperatures are between 4.0°C (39°F) and 10.0°C (50°F) (ODFW and WDFW 2009). Water temperature in the lower Columbia River is influenced by both mainstem flow and tributary flows. Tributaries contribute 20 to 40 percent of the average monthly flows in the lower Columbia River during the winter and spring periods. Therefore, tributary flows likely moderate water temperatures during the period of time when eulachon are present. ODFW and WDFW (2009) reported that due to cold Columbia River water temperatures in 1993, eulachon strayed into many Washington coastal streams and bays, potentially because river temperatures were warmer. However, it is not clear whether temperature anomalies in any given year in production streams have any effect on survival and recruitment.

Because flow reductions above Grand Coulee Dam related to the Proposed Action are small compared to mainstem Columbia River flows, is not likely that the Proposed Action will influence mainstem Columbia River temperatures (or even be measureable) where eulachon spawn. Water temperature modeling done to determine the effect of Proposed Action water withdrawals indicated that water temperatures would decrease by approximately 0.03 degrees F, on average, during the month of October. However, this is prior to the migration and spawn timing of eulachon in the Columbia River and would therefore not have an impact on eulachon migration or spawning success. The small flow reductions during all other times of the year were not sufficient to have a measureable influence of water temperatures in the Columbia River when eulachon life histories are active in the Columbia River. Therefore, it is unlikely that there is an effect on the timing of eulachon migration in the Columbia River.

Total Dissolved Gas. Most eulachon spawning occurs in tributary rivers that are not affected by increased TDG concentrations resulting from spill at Bonneville Dam; however, eulachon that spawn in the mainstem Columbia River after April 10 may on occasion be subjected to increased TDG levels. Given that the fertilized eggs adhere to the coarse substrates at the bottom of the river and that larval densities have been observed in higher abundance in mid- and bottom water samples in the Columbia River (Howell et al. 2001), the deleterious effects of concentrated TDG are likely reduced due to depth compensation. Once spawning has occurred, the larvae are flushed rapidly to the ocean, further minimizing exposure time to increased TDG. Finally, even though eulachon have been observed migrating up the Columbia River as far as Bonneville Dam, eggs have been collected and spawning presumed from RM 35 up to RM 73 in the mainstem Columbia River (NMFS 2010a) and individuals are thought to migrate this far upstream only when the run size is extremely large. Therefore, in most years, the percentage of the run potentially exposed to elevated TDG levels is expected to be very small.

5.5.3 Impacts to Prey

Adult eulachon that enter the Columbia River to spawn do not feed; larvae outmigrating to the ocean may feed in the Columbia River estuary. Once larval eulachon exhaust their yolk sac, copepod nauplii, phytoplankton, and other micro-organisms have been identified in stomach content analysis (NMFS 2010b). The miniscule hydrologic effect of the Proposed Action likely has no effect on the micro-organism prey base that larval eulachon utilize in the estuary.

5.5.4 Conclusions

It is very unlikely that the Proposed Action has any measurable effect on the distribution or abundance of the southern DPS of Pacific eulachon or interferes with eulachon spawning and estuary rearing in the Columbia River. In summary, considering the small hydrologic influence of the Proposed Action on lower mainstem Columbia River flows, Reclamation concludes the effects of the Proposed Action on the southern DPS of Pacific eulachon to be discountable or insignificant. Therefore, the Proposed Action as described, ***may affect, but is not likely to adversely affect*** the southern DPS of Pacific eulachon.

5.5.5 Effects to Pacific Eulachon Critical Habitat

The Federal Register listing notice for Pacific eulachon critical habitat (76 FR 65234) summarizes the activities that may affect the essential features and necessitate the need for special management considerations or protection for each area. For the lower Columbia River, these are: dams and water diversions; dredging and deposition of dredged material; inwater construction or alterations; pollution and runoff from point and nonpoint sources; tidal energy or wave energy projects; operation of port and shipping terminals; and habitat restoration projects.

Of these activities, only the effects associated with dams and water diversions on the components of essential features for Pacific eulachon are connected in any way to the Proposed Action and are analyzed below. The remaining activities will not be considered further.

Water Flow

For spawning sites and migratory corridors, a flow regime that supports all life stages and supports adult migrations and juvenile outmigrations could be affected by dams and diversions through physical structures impeding migrations or by the operation of dams affecting flow (NMFS 2010c). The Proposed Action does not have any physical features in the proposed critical habitat area so the only mechanism to affect this component is water diversion operations.

For spawning habitats, a flow regime that supports spawning and survival includes a spring freshet although, in general, eulachon spawn at low water levels prior to spring freshets. Sufficient flow may also be needed to flush silt and debris from spawning substrate surfaces to prevent suffocation of developing eggs (NMFS 2010c). The possible effects to flow due to the altered hydrograph were discussed previously in the species effects section. In summary, any flow reduction effects from the Proposed Action are very small in this reach of the Columbia River (2.4 percent reduction in October flows and between 0.26 percent and 0.19 percent reductions between November and March) and are not likely to adversely affect eulachon. Likewise, the effects of the

Proposed Action would be very unlikely to negatively affect the component of flow for either spawning or migration.

Water Quality and Temperature

Water temperature suitable for spawning and survival of adults and outmigrating larvae is identified as a component of essential features for Pacific eulachon spawning and migration corridor features (NMFS 2010c). Water temperatures between 4°C (39°F) and 10°C (50°F) are preferred for spawning in the Columbia River. Water temperature could also influence run timing. Eulachon are susceptible to contaminants and have been shown to avoid polluted waters (NMFS 2010c).

The operation of dams and diversions can affect water quality and temperature. However, it is not thought that the effects of the Proposed Action on mainstem Columbia River flows below Bonneville Dam are likely to influence mainstem Columbia River temperatures when and where eulachon spawn and would be unlikely to affect run timing of eulachon migration in the Columbia River. The water diversion operations related to the Proposed Action are far upstream of the eulachon habitat (515 miles downstream of Grand Coulee Dam) and would not affect contaminants within proposed critical habitat.

Substrate

Substrate suitable for egg deposition and development is a component of essential features for spawning habitat. Spawning substrates typically consist of silt, sand, gravel, cobble, or detritus; sometimes pea-sized gravel and coarse sand are used (NMFS 2010c).

Dams generally impede or alter bedload movement and change the sediment deposition, thereby affecting the substrate composition. The Proposed Action is far upstream of the eulachon habitat and is not likely to be of sufficient magnitude to directly affect sediment transport. However, because of the small particle size of material in the Columbia River esturary, the hydrological influence on the Columbia River flows due to the Proposed Action could minutely affect sediment transport for sands and silts in the area of proposed critical habitat. These effects however, are anticipated to be small and immeasurable.

Food

Prey to support larval eulachon once they have depleted their yolk sac is a component of the essential features for the migration corridor. Once larval eulachon begin exogenous feeding, copepod larvae and other micro-organisms are important prey resources (NMFS 2010c). Young eulachon larvae are rapidly flushed to the ocean, often within days of hatching, and subsist on their yolk sac during this downstream dispersal (ODFW and WDFW 2009). The natal estuary is an important component of the migration corridor because larval eulachon may be retained there for several weeks or longer (NMFS 2010c). The Proposed Action may have a minor influence on the hydrology in the lower Columbia River (0.26 percent or less flow reduction in all months except October, when flow reductions of 2.4 percent will occur), but any effect on copepod larvae or other prey organisms is likely to be immeasurable. The very small hydrologic effect of the

Proposed Action on mainstem Columbia River flows in the estuary likely has no effect on reducing the micro-organism prey base that larval eulachon utilize in the estuary.

Conclusions

Water flow, water quality, temperature, substrate, and food have all been identified as components of essential physical or biological features for Pacific eulachon in the lower Columbia River critical habitat as designated. Dams and diversions have been identified as activities that may affect the physical and biological features essential to the southern DPS of Pacific eulachon. Reclamation has analyzed the Proposed Action's effects on these critical habitat feature components and found the effects to be insignificant and discountable. Therefore, the Proposed Action ***may affect, but is not likely to adversely affect,*** designated critical habitat for the Southern DPS of Pacific eulachon.

5.6 Effects to Green Sturgeon

Green sturgeon only encounter the effects of the Proposed Action between Bonneville Dam and the Columbia River plume, including the Columbia River estuary. Adults are known to be found in this portion of the action area only during late summer and fall. The Proposed Action will have a small effect on streamflow (e.g. flows are decreased about 2.4 percent at Bonneville Dam in October, and between 0.26 percent to 0.19 percent in November through March). These small hydrologic changes are not likely to affect water depth or velocity characteristics in any measureable way. For much of the time that green sturgeon are in the lower Columbia River, no effects will occur to the species due to no Proposed Action flow reductions between April through September. Such minor flow effects, when they overlap with green sturgeon presence in the Columbia River estuary, would have immeasurable effects on benthic fish species such as green sturgeon.

Larger effects of the Proposed Action in the occupied portion of the action area, such as minor hydrologic changes that could result in indistinguishable habitat characteristic effects to the Columbia River estuary, are unlikely to have substantial effects on green sturgeon because adult green sturgeon tend to use deepwater habitats. Any additional effects from implementation of the Proposed Action are likely to decrease these estuary habitat conditions. No green sturgeon spawning or juvenile rearing is known to occur in the Columbia River Basin so no effects to these life-history components of the green strurgeon life cycle are anticipated.

5.6.1 Effects to Green Sturgeon Critical Habitat

As discussed in the *Federal Register* listing notice for green sturgeon, the principal factor in the decline of the southern DPS is the reduction of the spawning area to a limited section of the Sacramento River (71 FR 17757). Because there is no evidence that green sturgeon have ever spawned in the Columbia River, estuary, or plume, effects on green sturgeon spawning habitat are not considered (Rien et al. 2002). Many of the other threats listed in the notice are also limited to the spawning, juvenile rearing, and migration habitat in California, and similarly are not factors in this consultation.

Table 1 of the *Federal Register* listing notice for green sturgeon critical habitat also summarizes the activities that may affect the PCEs and necessitate the need for special management considerations or protection for each area (74 FR 52300).

For the lower Columbia River estuary, these are: In-water construction or alterations; dams and water diversions; dredging and deposition of dredged material; Liquid Natural Gas (LNG) projects; point and nonpoint pollution, and commercial shipping.

For the coastal marine waters from the southernmost point at the mouth of the Columbia River estuary to Willapa Bay, Washington, they are: Bottom-trawl fishing; dredging and deposition of dredged materials; alternative energy hydrokinetic projects; and LNG projects.

Of these activities, only the effects associated with dams and water diversions on the PCE's are connected in any way to the Proposed Action and are analyzed below. The remaining activities will not be considered further.

NMFS has identified four PCEs for green sturgeon in estuarine and coastal marine areas designated as critical habitat within in the action area for this consultation—passage, food resources, water quality, and sediment quality. NMFS identified flow as a PCE in the context of adult migrations to upstream spawning areas in the Sacramento River and the Sacramento-San Joaquin Delta, California, but did not specify this parameter as a PCE in nonnatal estuaries such as the lower Columbia River (see Table 1 in 74 FR 52300). Effects of the Proposed Action on these PCEs in the action area are described in the following paragraphs.

Passage

The Proposed Action water diversions occur far upstream of the designated critical habitat and do not affect passage for green sturgeon.

Food Resources (Estuarine and Coastal Marine Areas)

Little is known about the feeding habitats of green sturgeon except that they are bottom (benthic) feeders. They are not known to rely on salmonids as a prey base; the guts of eight individuals taken in 2000 and nine taken in 2003 in Willapa Bay contained ghost shrimp (*Neotrypaea californiensis*), fish (including lingcod, *Ophiodon elongates*), Dungeness crab (*Cancer magister*), crangonid shrimp, and small amounts of polychaetes, clams, and amphipods (Dumbauld et al. 2008). The same authors present the only information available on feeding habitats in the Columbia River based on two green sturgeon landed in 2004 and 2005 that had identifiable items in their stomachs—mostly crangonid shrimp.

It is was considered that Federal storage and release operations throughout the Columbia Basin, as influenced by operations of the FCRPS, could indirectly affect the PCE of food in the estuary and plume. However, given the paucity of information on preferred prey, or even relative use of the deep channel versus shallow areas, there is no evidence that the slight changes in the lower Columbia River hydrograph, as a result of the Proposed Action will negatively affect the PCE of food.

Water Quality (Estuarine and Coastal Marine Areas)

Flow alterations resulting from dam operations may affect the water quality PCE in designated critical habitat. Dam operations primarily affect two physical water quality parameters – TDG and water temperature. Flow reductions associated with the Proposed Action may decrease the magnitude and duration of TDG levels below Grand Coulee Dam and the upper Columbia River. However, these TDG reductions are likely to be immeasurable and insignificant. Furthermore, any TDG levels reduction in the upper Columbia River Basin is unlikely to contribute to TDG reductions as far down as Bonneville Dam. Finally, TDG levels are not likely to impact green sturgeon because any elevated TDG levels at Bonneville Dam are likely to decline over the 72-km reach between Bonneville Dam and RM 46, the upstream extent of critical habitat, because gas pressures trend toward equilibrium with the atmosphere and as flows from unaffected tributaries mix with the Columbia River.

Water temperature in the lower Columbia River is influenced by both mainstem flow and tributary flows. Tributaries contribute 20 to 40 percent of the average monthly flows in the lower Columbia River; therefore, tributary flows likely moderate water temperatures during the period of time when green sturgeon are present. Water temperature is also affected by the FCRPS hydroelectric dams and storage reservoirs. Given these larger influencing factors on water temperature in the Columbia River, the influence of the Proposed Action on water temperatures in green sturgeon critical habitat is likely immeasurable. Water temperature modeling done to determine the effect of Proposed Action water withdrawals indicated that water temperatures would decrease by approximately 0.03 degrees F, on average, during the month of October. The small flow reductions during all other times of the year were not sufficient to have a measureable influence of water temperatures in the Columbia River when green sturgeon life histories are active in the Columbia River. In addition, effects on temperatures in the reach below RM 46 are moderated by tidal exchange with the ocean and the numerous tributaries entering the Columbia River. Water temperature monitoring in marine, estuarine, and tidal freshwater sites in the lower Columbia River for 2003 to 2006 (Bottom et al 2008) did not show temperatures exceeding 24°C (75°F) (the maximum suitable water temperature for juvenile green sturgeon specified in the critical habitat listing document [74 FR 52300]) during the peak green sturgeon occurrence period. .

Because flow reductions above Grand Coulee Dam related to the Proposed Action are small compared to mainstem Columbia River flows, it is not likely that the Proposed Action will influence mainstem Columbia River temperatures or TDG levels (or even be measureable) in areas where green sturgeon occupy the lower Columbia River and estuary. Therefore, it is unlikely that there is an effect on the timing of green sturgeon usage of the Columbia River.

Sediment Quality (Estuarine Areas)

Dams can impede or alter bedload movement and change sediment deposition patterns. While Columbia River mainstem reservoirs may affect sediment and nutrient supply to the lower Columbia River, the Proposed Action is far upstream of green sturgeon habitat and would not directly affect sediment transport or deposition processes. The hydrological influence on the Columbia River flows due to the Proposed Action flow reductions could minutely affect sediment transport in the area, but most likely the effect would be undetectable in the lower Columbia River and estuary. Little is known of the foraging habits and preferred prey of subadult and adult green sturgeon at this time (see previous Food Resources Section), it is difficult to know the degree to which, or even whether, changes in sediment supply to the estuary affect this species' food supply. As a result, the effects of the Proposed Action on sediment transport of the Columbia River mainstem reservoirs are likely to be insignificant.

Conclusions

The analysis of the FCRPS operations on the green sturgeon PCE's concluded those operations were not likely to adversely affect designated critical habitat and that the FCRPS was not likely to adversely affect the listed southern DPS of green sturgeon. The analysis in this BA considers the proportional effect of the Proposed Action on flow dependent operations of the FCRPS on the PCEs for designated critical habitat in the action area for green sturgeon. All effects were found to be insignificant, discountable, or both. Based on these findings, Reclamation has determined that the Proposed Action ***may affect, but is not likely to adversely affect,*** designated critical habitat for the southern DPS of green sturgeon.

5.7 Effects of the Prospective Actions on Southern Resident Killer Whales

The potential effects of the Proposed Action on Southern Resident killer whales relate to prey availability. Contamination (prey quality) is not an issue because the effects of the Proposed Action do not include the introduction of contaminants into freshwater.

Most of the direct effects of the Proposed Action occur within the freshwater system and plume of the Columbia River; effects experienced by Southern Residents in the coastal area are therefore indirect. The Proposed Action is not likely to have any effect on the abundance of killer whale prey in the ocean. The best available information indicates that salmon are the preferred prey of killer whales year round, including in coastal waters (see Status of the Species, Section 4.6.1), and that Chinook are the preferred salmon species. Any changes in prey abundance could affect the entire population of Southern Resident killer whales. Prey abundance is a concern for killer whales both in the near and long term. To survive in the near term, killer whales require regular supplies of adult Chinook prey in the ocean, and to recover over the longer term, killer whales require abundant Chinook stocks coast-wide, likely including stocks from the Columbia River.

This analysis considers the effects of the Proposed Action on Columbia River flow reductions which then have the potential to directly reduce the amount of salmon and steelhead production in the Columbia River. Any adverse affects to these populations, particularly Chinook salmon ESUs from the Proposed Action would be of concern to the Southern Resident killer whale DPS. This analysis concluded that the Proposed Action may affect, but was not likely to adversely affect 12 of the 13 salmon and steelhead ESUs or DPSs in the Columbia River Basin, including all 5 of the Chinook salmon ESUs.

However, this analysis also determined that the Proposed Action was likely to adversely affect Columbia River chum salmon. Because chum salmon are known to constitue a small fraction of the diet of killer whales from the Southern Resident DPS, it is reasonable to conclude that any effects to this prey species could have adverse affects to killer whales. As a result, there could be a short- or long-term reduction in the prey base for killer whales due to the adverse affect to chum salmon. However, because chum salmon are considered to be a minor component of the diet of killer whales and the reduction in chum salmon abundance is not anticipated to be measureable, Reclamation therefore concludes that the Odessa Proposed Action ***may affect, but is not likely to adversely affect,*** the Southern Resident DPS of killer whale.

5.8 Effects Conclusion Summary

The sections below provide a final summary of the effect determinations for the species and designated critical habitats for the 13 salmon and steelhead ESUs/DPS, and for the 3 anadromous marine species addressed in this biological assessment.

5.8.1 Listed Columbia and Snake River Salmon ESUs and Steelhead DPSs

The Proposed Action may affect, and is likely to adversely affect, one listed species—the Columbia River chum salmon ESU. Adverse effects from the Proposed Action to this ESU will occur primarily from flow reductions in the mainstem Columbia River below Bonneville Dam during the fall migration and spawning period for adult chum salmon.

The Proposed Action may affect, but is not likely to adversely affect, 12 ESA-listed salmon and steelhead species—Upper Columbia River spring Chinook ESU; Upper Columbia River steelhead DPS, Snake River spring/summer Chinook salmon ESU, Snake River fall Chinook salmon ESU; Snake River sockeye salmon ESU; Snake River steelhead DPS; Middle Columbia River steelhead DPS; Lower Columbia River Chinook salmon ESU; Lower Columbia River coho salmon ESU; Lower Columbia River steelhead DPS; Upper Willamette River Chinook salmon ESU; and the Upper Willamette River steelhead DPS.

Designated Salmon and Steelhead Critical Habitat

The Proposed Action would affect the conservation value to a small, unquantifiable degree for PCEs and essential features of designated critical habitat for the following:

- Columbia River Chum salmon ESU

The Proposed Action is not likely to appreciably diminish the conservation value of PCEs and essential features of designated critical habitat for the following salmon ESUs and steelhead DPSs:

- Upper Columbia River spring Chinook salmon ESU

- Upper Columbia River steelhead DPS
- Snake River spring/summer Chinook salmon ESU
- Snake River fall Chinook salmon ESU
- Snake River sockeye salmon ESU
- Snake River basin steelhead DPS
- Middle Columbia River steelhead DPS
- Lower Columbia River Chinook salmon ESU
- Lower Columbia River steelhead DPS
- Upper Willamette River Chinook salmon ESU
- Upper Willamette River steelhead DPS

Critical habitat has not been designated for the Lower Columbia River coho salmon ESU.

Finally, The Proposed Action may affect, but is not likely to adversely affect, the species or adversely affect designated critical habitat for the 3 anadromous marine DPSs listed in Table 36.

Table 36. Summary of nonsalmonid species effects conclusions.

Species	Status	Species Effects Conclusion	Critical Habitat Effects Conclusion
Southern DPS of Pacific Eulachon	Threatened	Not Likely to Adversely Affect	No Adverse Affect
Southern DPS of Green Sturgeon	Threatened	Not Likely to Adversely Affect	No Adverse Affect
Southern Resident DPS of Killer Whale	Endangered	Not Likely to Adversely Affect	No Effect

6.0 CUMULATIVE EFFECTS

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 this biological opinion. 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 ESA. A large number of non-Federal actions associated with agriculture, aquaculture, transportation construction and rural and urban development occur in the action area. These actions may include changes in land and water uses, including ownership and intensity, any of which could impact listed species or their habitat. Government actions are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area make analysis of these cumulative effects difficult.

6.1 Climate Change

The current status of salmon and steelhead species and their critical habitat in the Pacific Northwest has been influenced by climate change over the past 50-100 years and this change is expected to continue into the future (IASB 2007). Average annual Northwest air temperatures have increased by approximately 1°C since 1900, which is nearly twice that for the last 100 years, indicating an increasing rate of change. The latest climate models project a warming of 0.1 to 0.6°C per decade over the next century. This change in surface temperature has already modified, and is likely to continue to modify, freshwater, estuarine, and marine habitats of salmon and steelhead, including designated critical habitat. Consequently, abundance, productivity, spatial distribution, and diversity of salmonid life stages occupying each type of affected habitat is likely to be further modified, generally in a detrimental manner. There is still a great deal of uncertainty associated with predicting specific changes in timing, location and magnitude of future climate change. It is also likely that the intensity of climate change effects on salmon, steelhead, eulachon, and green sturgeon will vary by geographic area.

6.1.1 Habitat Effects

Climate change effects on tributary habitat include: reduction of cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and competition among species (IASB 2007). While small tributary habitats are not utilized by eulachon or green sturgeon, changes in upstream tributary habitat would have an those species' habitat in the mainstem Columbia River. For example, changes in water temperature of tributary habitat could increase temperatures in downstream habitats. Water temperature is important for migration, spawning, and embryo development in eulachon. Water temperature could also influence the migration and feeding habits of green sturgeon.

Esturine habitat are also likely to be impacted by climate change through higher winter freshwater flows and higher sea level elevation that may lead to increased sediment deposition and wave damage; lower freshwater flows in late spring and summer may lead to upstream extension of the salt wedge, possibly influencing the distribution of salmonid prey and predators; and increased temperature of freshwater inflows may extend the range of warm-adapted nonindigenous species that are normally found only in freshwater. In all of these cases, the specific effects on salmon and steelhead abundance, productivity, spatial distribution and diversity are poorly understood. (ISAB 2007)

As described in ISAB (2007), effects of climate change that have influenced marine habitat include: increased ocean temperature, increased stratification of the water column, and changes in intensity and timing of coastal upwelling. These continuing changes will alter primary and secondary productivity, the structure of marine communities, and in turn, the growth, productivity, survival, and migrations of salmonids. A mismatch between earlier smolt migrations (due to earlier peak spring freshwater flows and decreased incubation period) and altered upwelling may reduce marine survival rates. Increased concentration of CO2 reduces the availability of carbonate for shell-forming invertebrates, including some that are prey items for juvenile salmonids. Similarly, we do not know what the specific effects would be on eulachon or green sturgeon.

6.1.2 Surface Water Quantity

Climate change is likely to impact patterns of water discharge and temperature throughout the Columbia River Basin. Warmer temperatures across the basin are contributing to declines in total snow accumulations (Mote 2003). For the Columbia River, modeling performed by the Washington Department of Ecology suggests a small increase in average annual supplies and a larger shift in the timing of flow away from summer/fall months towards the winter/spring (Ecology 2011).

In addition, the FEIS identified two possible non-Federal actions which could impact Columbia River flows. The Umatilla Basin Aquifer Recovery Project will reduce flows in the Columbia River in combination with the Proposed Action by diverting water from the Columbia and Umatilla Rivers. After full implementation, the aquifer recovery project could divert from 80,000 to 120,000 acre-feet of Columbia River water annually during winter months. This project will meet the Columbia River flow objectives as a requirement of its implementation and is not likely to add to the impact on the Columbia River species of concern. Full implementation of the Yakima Integrated Plan may include very slight reductions in flows as flows in the Yakima River (<1 percent) are reduced in the winter and spring with estimated April to September flow reductions of 50-70,000 acre-feet.

With respect to how these hydrologic changes are likely to affect salmon and steelhead in the Columbia River, the Umatilla Basin Aquifer Recovery Project will meet the Columbia River flow objectives as a requirement of its implementation and will not add to cumulative impacts on the Columbia River species of concern. The Yakima River Basin Integrated Plan will contribute positively to fishery resources and populations in the Yakima River basin, including species of concern by improving flows for fish passage and rearing, opening up currently closed areas and improving physical habitat.

6.1.3 Conservation Actions

Coordinated Salmon recovery and conservation efforts are likely to continue into the future. These efforts are detailed Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2004), the ESA Recovery Planning for Salmon and Steelhead in the Willamette and Lower Columbia River Basins (NMFS 2005a), the Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW 2010a), the Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (WDFW 2010a), and the Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead (Good et al. 2005). Several entities are currently implementing recovery and conservation efforts. The Washington Department of Fish and Wildlife's 21st Century Salmon and Steelhead initiative provides support for habitat restoration projects, manages WDFW lands for the benefit of salmon, recommends a series of hatchery reforms, and implements a number of research and monitoring efforts. (WDFW 2010)

7.0 ESSENTIAL FISH HABITAT

Essential fish habitat (EFH) has been designated for federally managed groundfish, coastal pelagics, Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and Puget Sound pink salmon (*O. gorbuscha*) fisheries within the waters of Washington, Oregon, Idaho, and California (PFMC 1999). Congress defined EFH in the Magnuson-Stevens Act (MSA), as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The EFH guidelines from NMFS further interpret the EFH definition as:

- Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate;
- Substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities;
- Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and
- "Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Definitions for the geographic extent and physical descriptions of EFH for groundfish species, coastal pelagics, and Pacific salmon can be found in management plans amendments for these respective species. Excerpts from these Management Plans are provided below:

> [d]esignated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon and California, seaward to the boundary of the U.S. exclusive economic zone (230.2 miles) (PFMC 1998a, 1998b). Detailed descriptions and identification of EFH for the groundfish species are found in the Final Environmental Assessment/ Regulatory Impact Review for Amendment 11 to The Pacific Coast Groundfish Management Plan (PFMC 1998a) and NMFS Essential Fish Habitat for West Coast Groundfish Appendix (Casillas et al. 1998). Detailed descriptions and identifications of EFH for the coastal pelagic species are found in Amendment 8 to the Coastal Pelagic Species Fishery Management Plan (PFMC 1998b).
>
> Freshwater EFH for Federally managed Pacific salmon includes all those rivers, streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except above the impassable barriers identified by PFMC (1999).

> Chief Joseph Dam, Dworshak Dam, and the Hells Canyon Complex (Hells Canyon, Oxbow, and Brownlee dams) are among the listed man-made barriers that represent the upstream extent of the Pacific salmon fishery EFH. Freshwater salmon EFH excludes areas upstream of longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for several hundred years). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (230.2 miles) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border. Detailed descriptions and identification of EFH for Pacific salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999).

Appendix A to Amendment 14 of the Pacific Coast Salmon Plan (PFMC 1999) listed EFH for Chinook salmon and coho salmon in the Snake and Columbia Rivers downstream from Chief Joseph Dam on the Columbia River and Hells Canyon Dam on the Snake River. EFH was delineated by 4th field hydrologic unit codes (HUCs). A HUC is a geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as delineated by the USGS on State Hydrologic Unit Maps. The fourth level of classification is the cataloging unit, the smallest element in the hierarchy of hydrologic units, representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. The final rule of "Fisheries Off West Coast States; West Coast Salmon Fisheries; Amendment 14; Essential Fish Habitat Descriptions for Pacific Salmon" was published in the *Federal Register* Wednesday, October 15, 2008 (73 FR 60987). It codifies the EFH identifications and descriptions for freshwater and marine habitats of Pacific salmon managed under the Salmon Fishery Management Plan (FMP), including Chinook, coho, and pink salmon.

EFH for salmon species was listed without regard for whether the several ESUs of Chinook and coho salmon were federally listed under the ESA or not. The particular Chinook or coho salmon ESUs that occupied the area were not considered when designating EFH. For this consultation, Reclamation considers both ESA-listed and nonlisted Chinook and coho salmon ESUs that spawn, rear, and/or migrate in the action area.

7.1 Action Area

The action area with regard to EFH consultation includes the farthest upstream point at which federally managed salmon smolts enter (or adults exit) the Columbia River downstream of Chief Joseph Dam. In the Columbia River, the action area includes wherever a tributary stream meets the Columbia River, downstream to the farthest point at the Columbia River estuary and nearshore ocean environment for which designated EFH for groundfish, coastal pelagics, and Chinook and coho salmon might be influenced by the Proposed Action.

This area encompasses eight 4th field HUCs beginning just downstream from Chief Joseph Dam and progressing downstream in the Columbia River to its mouth. Table 37 shows the geographic extent and Columbia River miles (RM) of these 4th field HUCs. Delineations of some of these 4th field HUCs are estimated from maps and may be approximate.

Table 37. Approximate HUC starting and ending points in the EFH action area.

HUC	Hydrologic Unit Name	From	To
17020005	Columbia River – Chief Joseph Dam	Chief Joseph Dam at RM 545.0 (Impassible Barrier)	Entiat River confluence at RM 483.7
17020010	Upper Columbia – Entiat River	Entiat River confluence at RM 483.7	Wanapum Dam at RM 415.0
17020016	Upper Columbia – Priest Rapids	Wanapum Dam at RM 415.0	Mouth of Snake River at RM 324.4
17070101	Mid Columbia – Lake Wallula	Mouth of Snake River at RM 324.4	John Day Dam at RM 215.6
17070105	Mid Columbia – Hood	John Day Dam at RM 215.6	Bonneville Dam at RM 146.1
17080001	Lower Columbia – Sandy River	Bonneville Dam at RM 146.1	Mouth of Willamette River at RM 101.5
17080003	Lower Columbia – Clatskanie River	Mouth of Willamette River at RM 101.5	Jones Beach at RM 47
17080006	Lower Columbia River	Jones Beach at RM 47	Mouth of Columbia River at RM 0

EFH is designated for Chinook and/or coho salmon in the eight HUCs in Appendix A of Amendment 14 (PFMC 1999, and 73 FR 60987). Table 38 shows these eight HUCs with the EFH-designated species, affected ESU, and life-history use.

In the case of the Mid-Columbia–Lake Wallula HUC (17070101), Table A-1 of Appendix A of Amendment 14 (PFMC 1999) lists only Chinook salmon, while Table A-6 indicates that this HUC is current habitat for coho salmon. Reclamation will focus analysis and discussion on the species listed in Appendix A, Table A-1 (PFMC 1999). EFH listing did not differentiate specific Chinook or coho salmon ESUs, nor consider any ESA listing status. For purposes of this EFH consultation, Reclamation includes all Snake and Columbia River Chinook and coho salmon ESUs, whether ESA-listed or not, that use the Snake and Columbia River action area for either spawning, rearing, or migrating. Many of the ESUs use the action area only for migration. In the case of the Snake River ESUs, Reclamation has included them in the EFH analysis because they utilize the Columbia River downstream from the Columbia and Snake River confluence for migration. As a result, spawning and rearing will not be considered for Snake River Chinook ESUs because the Proposed Action will have no effect to these essential fish habitat areas in the Snake River basin.

Table 38. Snake River and Columbia River Basin HUCs with designated Chinook and coho salmon EFH, ESU, and life-history use (from Tables A-1 and A-6 in PFMC 1999).

HUC	Hydrologic Unit Name	Species	Current or Historic Distribution	ESU	Life-history Use[1]
17020005	Columbia River – Chief Joseph Dam	Chinook salmon (Coho salmon)	Current habitat (Currently accessible but unutilized historical habitat)	Upper Columbia River spring Chinook salmon Upper Columbia River summer/fall Chinook salmon	M M
17020010	Upper Columbia – Entiat River	Chinook salmon (Coho salmon)	Current habitat (Currently accessible but unutilized historical habitat)	Upper Columbia River spring Chinook salmon Upper Columbia River summer/fall Chinook salmon	M S, R, M
17020016	Upper Columbia – Priest Rapids	Chinook salmon (Coho salmon)	Current habitat (Current habitat)	Upper Columbia River spring Chinook salmon Upper Columbia River summer/fall Chinook salmon Middle Columbia River spring Chinook salmon	M S, R, M M
17070101	Mid Columbia – Lake Wallula[2]	Chinook salmon (Coho salmon)	Current habitat (Current habitat)	Snake River fall Chinook salmon Snake River spring/summer Chinook salmon Upper Columbia River spring Chinook salmon Upper Columbia River summer/fall Chinook salmon Middle Columbia River spring Chinook salmon	R, M M M M M
17070105	Mid Columbia – Hood	Chinook salmon	Current habitat	Snake River fall Chinook salmon Snake River spring/summer Chinook salmon Upper Columbia River spring Chinook salmon Middle Columbia River spring Chinook salmon Upper Columbia River summer/fall Chinook Deschutes River summer/fall Chinook salmon	R, M M M M M M
		Coho salmon	Current habitat	Lower Columbia River coho salmon	S, R, M
17080001	Lower Columbia – Sandy River	Chinook salmon	Current habitat	Snake River fall Chinook salmon Snake River spring/summer Chinook salmon Upper Columbia River spring Chinook salmon Middle Columbia River spring Chinook salmon Upper Columbia River summer/fall Chinook Deschutes River summer/fall Chinook salmon	M M M M M M

HUC	Hydrologic Unit Name	Species	Current or Historic Distribution	ESU	Life-history Use[1]
				Lower Columbia River Chinook salmon	S, R, M
		Coho salmon	Current habitat	Lower Columbia River coho salmon	S, R, M
17080003	Lower Columbia – Clatskanie River	Chinook salmon	Current habitat	Snake River fall Chinook salmon Snake River spring/summer Chinook salmon Upper Columbia River spring Chinook salmon Middle Columbia River spring Chinook salmon Upper Columbia River summer/fall Chinook salmon Deschutes River summer/fall Chinook salmon Lower Columbia River Chinook salmon Upper Willamette River Chinook salmon	M M M M M M S, R, M M
		Coho salmon	Current habitat	Lower Columbia River coho salmon	S, R, M
17080006	Lower Columbia River	Chinook salmon	Current habitat	Snake River fall Chinook salmon (T)[3] Snake River spring/summer Chinook salmon (T) Upper Columbia River spring Chinook salmon (E) Middle Columbia River spring Chinook salmon (N) Upper Columbia River summer/fall Chinook (N) Deschutes River summer/fall Chinook salmon (N) Lower Columbia River Chinook salmon (T) Upper Willamette River Chinook salmon (T)	M M M M M M S, R, M M
		Coho salmon	Current habitat	Lower Columbia River coho salmon (T)	S, R, M

[1] S = spawning, R = rearing, M = migration

[2] EFH is listed for Chinook salmon in HUC 17070101 on Table A-1 (PFMC 1999), while Table A-6 lists current habitat for both Chinook and coho salmon in the same HUC (PFMC 1999).Since Table A-1 lists EFH for species within HUCs, Reclamation shall not consider EFH for coho salmon in this HUC.

[3] ESA listing status as of May 2007 - NMFS ESA Salmon Listings Website: E = Endangered, T = Threatened, N = Not Warranted, U = Undetermined.

Reclamation considers the following nine Chinook and coho salmon ESUs in this EFH consultation, listed from upstream (closest to the Odessa Proposed Action) to downstream:

- Upper Columbia River spring Chinook salmon
- Upper Columbia River summer/fall Chinook salmon
- Middle Columbia River spring Chinook salmon
- Snake River spring/summer Chinook salmon
- Snake River fall Chinook salmon
- Deschutes River summer/fall Chinook salmon
- Lower Columbia River Chinook salmon
- Lower Columbia River coho salmon
- Upper Willamette River Chinook salmon

Some of these ESUs are ESA-listed (see Table 38 at bottom), while others that are not warranted or have undetermined status for ESA listing have relatively robust populations, although not at historical levels of abundance.

7.2 Status, Life History, Habitat Requirements, and Effects Analysis

The Chinook and coho salmon ESUs are listed and discussed as they are encountered in geographic order proceeding downstream from Chief Joseph Dam to mouth of the Columbia River.

7.2.1 Upper Columbia River Spring Chinook Salmon

Section 4.2.1 of this BA provides a description of the Upper Columbia River spring Chinook salmon ESU along with its current ESA listing status. Chapter 8 of the *Comprehensive Analysis* (Action Agencies 2007b) also contains additional information about the life history and population status of this ESU and is incorporated here by reference. This ESU is currently listed as endangered under the ESA (70 FR 37160).

Because effects to the species and designated critical habitat were previously analyzed for this ESU under Section 5.4.1, *Effects Analysis*, of this BA, the life-history characteristics and timing overlaps with Proposed Action elements will not be repeated here. Though some differences may exist, the effects of the Proposed Action on Chinook EFH are expected to be similar in nature and magnitude to those already considered for the species and critical habitat analyses. Thus, the effects to EFH are expected to be similar to those previously described in the ESA portion of this document. A summary of EFH effects are provided below for this ESU.

Effects

Reclamation has determined that effects to EFH for spawning and migration will not occur, since these activities occur in Columbia River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. Conversely, effects to EFH freshwater rearing habitat in the mainstem Columbia River for this ESU may occur, because juvenile Chinook could use the area for rearing during times of the year when diversions do occur. UCR spring Chinook are expected to utilize EFH for migration in all 8 mainstem Columbia River HUCs identified in Table 37.

Given the magnitude of hydrologic changes in the Columbia River relative to the overall flows in the Columbia River that are affected by the Proposed Action, the effects of such flow alterations are either too small to measure or do not overlap with Proposed Action timing. As a result, the Proposed Action is not likely to have an adverse affect on EFH for freshwater migration for Chinook adults or outmigrating smolts. Flow alterations that could occur during the winter rearing period are anticipated to be infrequent in occurrence and extremely minor in magnitude due to water withdrawals of up to 350 cfs (0.39- to 0.29-percent flow reductions below Grand Coulee Dam) between the months of November and March. As a result, Reclamation determined that potential effects to Chinook salmon rearing habitat would be insignificant as a result of the Proposed Action.

Effects to EFH from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action ***is not likely to adversely affect EFH*** for this ESU.

7.2.2 Upper Columbia River Summer/Fall Chinook Salmon

NMFS concluded that this ESU was not warranted for listing under the ESA on March 9, 1998 (63 FR 11482). This ESU was formerly referred to as Middle Columbia River summer/fall Chinook salmon ESU (Myers et al. 1998) and includes all ocean-type Chinook salmon spawning in areas between McNary and Chief Joseph Dams. A large portion of this ESU consists of the “upriver brights” from the Hanford Reach of the Columbia River that use the action area for spawning, rearing, and migration in areas upstream of the Mid Columbia – Lake Wallula HUC (17070101). This is about 272 miles downstream from Grand Coulee Dam where the Proposed Action will occur.

The Hanford Reach fall run is the predominant population; the 1990-to-1994 geometric mean was about 58,000 fish (Myers et al. 1998). Long-term trends for the three largest populations are positive, but they are mixed for smaller populations. From 2001 to 2005, implementation of fish protection measures in the Hanford Reach, along with improvements in ocean productivity and harvest restrictions, lead to the rebound of the ESU to escapement levels around 90,000 adults. In 2007, numbers of Hanford reach Chinook spawners fell to less than 14,000 adults, but spawning escapement reached management goals of 25,000 adults for 2008 and 2009. Escapement levels for Hanford Reach fish rebounded to more than 65,000 adults in both 2010 and 2011 (Langshaw and Hoffarth 2012). In recent years, roughly 50 percent (range of 35 percent to 70 percent) of the Columbia River’s URB fall Chinook salmon counted at McNary Dam have spawned in the Hanford Reach. The URB population spawning in the Hanford Reach is considered a "core population" of fall Chinook salmon that may be used to re-colonize nearby tributaries and mainstem areas (ISG 1996, Langshaw and Hoffarth 2012). The summer run is heavily influenced by hatchery releases in the Upper Columbia River Basins (e.g. Wells Dam stock). Freshwater spawning and rearing habitat has experienced degradation, with hydropower project-related inundation of mainstem spawning grounds and degradation of the migration corridor. However, these conditions exist for the most part on the Columbia River in the action area and a number of improvements have been made to correct degraded conditions for fish passage and spawning. Due to their importance, the Hanford Reach fall and summer Chinook populations are protected through a variety of agreements and Memoranda of Understanding (MOUs) between Federal agencies and the Columbia River Public Utility Districts (PUDs). Among these protection agreements and MOUs are the Vernita Bar Settlement Agreement of 1988 between the Federal Energy Regulatory Commission (FERC) and the PUDs, and more recently, the Hanford Reach Fall Chinook Protection Program Agreement (HRFCPPA) between the Columbia River PUDs,WDFW, NMFS, the Service, BPA, and several regional Tribal Governments. The HRFCPPA contains provisions for measures that meet or exceed all protection measures covered under the original Vernita Bar Settlement Agreement and additional provisions to improve the survival of juvenile fall Chinook salmon after emergence for this ESU (Grant County PUD 2012). The action area downstream from the mouth of the Snake River in the Mid Columbia – Lake Wallula HUC (17070101) and other Columbia River 4th field HUCs is used primarily for rearing and migration.

Adults from this ESU migrate through the Columbia River mainstem during the months of August through November, while smolts typically outmigrate as subyearlings during the months of June through early August. Typically, summer/fall Chinook salmon in the mid-Columbia region begin spawning in late October, peak in mid-November, and complete spawning in late November (Langshaw and Hoffarth 2012, Chapman et al. 1994, cited in Myers et al. 1998). Developing eggs incubate in the gravel for an extended period (5 to 7 months) until they emerge as fry from the gravel in late winter or spring (mid-February to April). Migration timing and mainstem spawning for UCR summer/fall Chinook adults overlaps with Proposed Action flow reduction of 2,700 cfs in the month of October. For fall Chinook smolts, the Proposed Action does not allow for additional diversions during the outmigration period. As a result, the Proposed Action is not likely to affect juvenile migration habitat in the mainstem Columbia River below Grand Coulee and McNary Dams.

Effects

Reclamation has determined that the Proposed Action has the potential to effect EFH for spawning, rearing, and migration for this ESU because all of these life-history stages occur in the Columbia River within the action area for this species. UCR summer/fall Chinook are expected to utilize EFH in all 8 mainstem Columbia River HUCs identified in Table 37. EFH for spawning, rearing, and migration primarily occur in the Upper and Mid Columbia HUCs (17020005 to 17070101; Upper Columbia to Lake Wallula HUCs), whereas EFH for migration and some rearing occurs downstream of the Snake and

Columbia River confluence as fish enter the Lake Wallula HUC (17070101) to the Pacific Ocean.

Because adult Chinook from this ESU spawn in the mainstem Columbia River when Proposed Action flow reductions are measureable (i.e. October reductions of 3.7 percent below Grand Coulee Dam) the timing of the hydrologic change will significantly overlap with UCR summer/fall Chinook adult migration and spawn timing to a sufficient degree to affect EFH. The anticipated 3.7-percent flow reduction in October corresponds with the very beginning of the spawning period and the very end of the adult migration period for this ESU. The small flow reductions that occur during the end of the adult upstream migration period are not anticipated to adversely affect adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. Furthermore, the reduction in Columbia River flows during the upstream adult migration period in October could help reduce the incidence of fallback at mainstem Columbia River dams which would increase the potential for upstream migration success to occur for this species.

Although the flow reductions during the October spawning period are considered to be measureable and could potentially influence habitat conditions in mainstem spawning areas that are used by adults from this ESU, the effect of reducing flow in the mainstem Columbia River through the Hanford Reach in October will not significantly overlap with the fall Chinook spawning period that primarily occurs in November. Flow reductions in November are predicted to be only 0.29 percent of total Columbia River flows upstream of McNary Dam. This small flow reduction during the time when fall Chinook are actively spawning is unlikely to have significant adverse affects to EFH for Chinook spawning. In addition, the Proposed Action will not have any impact on the ability of the PUDs and signatories to the Vernita Bar Settlement Agreement or the HRFCPPA from meeting their flow objectives that have been set for the protection of fall Chinook spawning and early freshwater rearing. Reclamation therefore concludes that the Proposed Action is not likely to adversely affect EFH for spawning for this Chinook salmon ESU.

For fall Chinook smolts, the Proposed Action does not allow for additional diversions during the outmigration period. As a result, the Proposed Action is not likely to affect juvenile migration habitat in the mainstem Columbia River below Grand Coulee and McNary Dams. Columbia River flow depletions that could occur during the Novemebr through March time period which could overlap with juvenile rearing habitat within and downstream of the Hanford Reach, represents less than 0.39 percent of the annual flow in the lower Columbia River below Grand Coulee Dam and between 0.29 percent and 0.21 percent of flow reductions further downstream at McNary and Bonneville Dams under these conditions (computed data in Table 32). Because of the distance downstream from Grand Coulee Dam where the flow effects of the Proposed Action would be most significant, and the much larger volume of water in the Columbia River downstream of the Snake River confluence, the effects of the Proposed Action on EFH for migration and rearing downstream of the Mid Columbia – Lake Wallula HUC (17070101) will be unquantifiable and will likely be negligible for migration and juvenile rearing.

Reclamation concludes that its Proposed Action will have a measureable effect on Columbia River flows during the fall Chinook spawning period in October. However, very few fall Chinook spawn during this time and effects to EFH for spawning are considered minor as a result. EFH for adult migration and juvenile rearing exists in the upper Columbia River mainstem and could potentially be affected by the Proposed Action; however, these potential affects are small in nature and will not have a quantifiable effect on juvenile rearing or adult migration. As a result, the Proposed Action ***is not likely to adversely affect*** EFH in the Columbia River for Upper Columbia River summer/fall Chinook salmon.

7.2.3 Middle Columbia River Spring Chinook Salmon

NMFS concluded that this ESU was not warranted for listing under the ESA on March 9, 1998 (63 FR 11482). This ESU includes stream-type Chinook salmon spawning in the Klickitat, Deschutes, John Day, and Yakima Rivers, excluding the Snake River basin (Myers et al. 1998). Adults from this ESU migrate through the Columbia River mainstem during the months of April through September, while smolts typically outmigrate as yearlings during the months of June through early August. Some artificial propagation programs have been implemented for this ESU. An early attempt at artificial propagation in 1899 was eventually unsuccessful, while programs established in the late 1940s and 1950s were more successful. Substantial artificial propagation occurs in the Deschutes River basin.

A rough estimate of the total inriver returns of this ESU can be made by subtracting hatchery returns and Zone 6 fishery landings from the difference between Bonneville Dam counts and the sum of Priest Rapids and Ice Harbor Dams counts. A 1997 estimate of abundance calculated as described above resulted in a 5-year geometric mean (1992 to 1996) of about 25,000 adults, but this is probably an upper bound of escapement (Myers et al. 1998). From 1998 through 2006, numbers of adult spring Chinook salmon annually counted passing Bonneville, Priest Rapids, and Ice Harbor Dams were approximately one to five times, two to seven times, and one to three times, respectively, greater than in 1997 (FPC 2007). Downstream migrants from the Yakima River population of this ESU enter the action area in the Mid Columbia – Lake Wallula HUC (17070101) when they pass the mouth of the Snake River. This is about 272 miles downstream from the start of the Proposed Action area downstream of Grand Coulee Dam. Other populations enter the action area farther downstream (381 miles from Grand Coulee) where flow effects from the Proposed Action are even less. The ESU primarily uses the action area for juvenile and adult migration. Spawning and rearing occur in the major tributaries listed above that are outside of the action area. As described above for the Upper Columbia summer/fall Chinook salmon ESU, some fish originating from the upper portions of the MCR spring Chinook ESU may also be positively affected by the protective agreements (Vernita Bar Settlement Agreement and the HRFCPPA) that are currently in place for the protection of Hanford Reach fall Chinook.

Effects

Reclamation has determined that effects to EFH for spawning and for both adult and smolt migration will not occur since these life-history stages occur outside of the action area or do not temporally overlap with periods when the Proposed Action will be diverting water. Conversely, effects to EFH freshwater rearing habitat in the mainstem Columbia River for this ESU may occur because some juvenile Chinook could use the area as rearing habitat for a portion of their life history outside of their natal tributary streams. Middle Columbia River spring Chinook are expected to utilize EFH in 6 of the 8 mainstem Columbia River HUCs identified in Table 37. These HUCs are located from the Upper Columbia – Priest Rapids HUC (17020016) downstream to the mouth of the Columbia River.

Given the magnitude of hydrologic changes in the Columbia River relative to the overall flows in the Columbia River that are affected by the Proposed Action, the effects of such flow alterations are too small to measure and are not likely to have an adverse affect on EFH for freshwater migration for Chinook adults or outmigrating smolts. For juvenile MCR spring Chinook that could be using the mainstem Columbia River for rearing during the November-through-March period when Proposed Action water diversions could occur, some potential adverse affects could be expected. However, these effects would be immeasurable and insignificant due to the small extent of the effect. For example, when flow effects on juvenile rearing survival would be most probable between November and March, the Proposed Action will deplete flows by a monthly average of up to 350 cfs. This flow depletion represents less than 0.39 percent of the annual flow in the Columbia River below Grand Coulee Dam and between 0.29 percent and 0.19 percent of flow reductions further downstream at McNary and Bonneville Dams under these conditions (computed data in Table 32). As highlighted by these decreasing flow reduction percentages, the effects of Reclamation's Proposed Action diminishes substantially with distance downstream from Grand Coulee Dam.

Effects to EFH from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action ***is not likely to adversely affect*** EFH for this ESU.

7.2.4 Snake River Spring/Summer Chinook Salmon

Section 4.2.4 of this BA provides a description of the Snake River spring/summer Chinook salmon ESU along with its current ESA listing status. Chapter 5 of the *Comprehensive Analysis* (Action Agencies 2007b) also contains additional information about the life history and population status of this ESU and is incorporated here by reference. This ESU is currently listed as threatened under the ESA (70 FR 37160).

Because effects to the species and designated critical habitat were previously analyzed for this ESU under Section 5.4.4, *Effects Analysis,* of this BA, the life-history characteristics and timing overlaps with Proposed Action elements will not be repeated here. Though some differences may exist, the effects of the Proposed Action on Chinook EFH are expected to be similar in nature and magnitude to those already considered for the species and critical habitat analyses. Thus, the effects to EFH are expected to be similar to those previously described in the ESA portion of this document. A summary of EFH effects are provided below for this ESU.

Effects

Reclamation has determined that effects to EFH for spawning and migration will not occur since these activities occur in Snake River tributaries that are either outside of the action area or occur during periods when no diversions are being proposed. Conversely, effects to EFH freshwater rearing habitat in the mainstem Columbia River for this ESU may occur because juvenile Chinook could use the area for rearing during times of the year when diversions do occur. Snake River spring/summer Chinook are expected to utilize EFH for migration in 5 of the 8 mainstem Columbia River HUCs identified in Table 37. These HUCs are located from the Mid Columbia– Lake Wallula HUC (17070101) downstream to the mouth of the Columbia River.

Reclamation's Proposed Action flow reductions will be attenuated considerably by the time fish from this ESU enters the Columbia River in the Mid Columbia–Lake Wallula HUC (17070101) because of substantial tributary inflows from the Snake River basin. Therefore, the effect of the relatively minor flow changes in the Columbia River on upper Snake River spring/summer Chinook at this point and downstream is most likely negligible. These flow alterations would amount to approximately 2.53 percent flow reduction in October as measured at McNary Dam. However, since no adult or juvenile migrations are expected in October, this flow alteration will not adversely affect EFH for freshwater migration. For all other months when the Proposed Action is occurring (November through March), the effect of flow reductions to average Columbia River flows would range between 0.29 percent and 0.19 percent downstream of McNary and Bonneville Dams (Table 32). The small magnitude of these anticipated flow reductions are not likely to have any measureable effects to EFH conditions in the mainstem Columbia River.

Reclamation therefore concludes that its Proposed Action ***is not likely to adversely affect*** EFH in the Columbia River for the Snake River spring/summer Chinook salmon ESU.

7.2.5 Snake River Fall Chinook Salmon

Section 4.2.5 of this BA provides a description of the Snake River fall Chinook salmon ESU along with its current ESA listing status. Chapter 4 of the *Comprehensive Analysis* (Action Agencies 2007b) also contains additional information about the life history and population status of this ESU and is incorporated here by reference. This ESU is currently listed as threatened under the ESA (70 FR 37160).

Because effects to the species and designated critical habitat were previously analyzed for this ESU under Section 5.4.5, *Effects Analysis,* of this BA, the life-history characteristics and timing overlaps with Proposed Action elements will not be repeated here. Though some differences may exist, the effects of the Proposed Action on Chinook EFH are expected to be similar in nature and magnitude to those already considered for the species and critical habitat analyses. Thus, the effects to EFH are expected to be similar to those previously described in the ESA portion of this document. A summary of EFH effects are provided below for this ESU.

Downstream migration proceeds mostly from late May through June, with a small proportion moving past Lower Granite Dam in July and August (see Figure 32). Two Columbia River HUCs—Mid-Columbia–Lake Wallula (17070101) and Mid-Columbia–Hood River (17070105) support fall Chinook salmon rearing and migration for all the juveniles produced outside of the action area in the Snake River basin. Once juvenile fall Chinook salmon leave the Snake River and enter the Columbia River, they continue to rear and migrate to the ocean through these two additional 4th field HUCs. Lower Columbia River HUCs with EFH that are downstream of these only contain EFH areas for adult and juvenile freshwater migration.

Effects

Reclamation has determined that effects to EFH for spawning will not occur since this life-history stage occurs outside of the action area in the Snake River basin. Conversely, effects to EFH freshwater rearing and migration habitat in the mainstem Columbia River for this ESU may occur because juveniles use the Columbia River for rearing and both adult and juvenile Chinook use the area for migration once they leave the Snake River. SR fall-run Chinook are expected to utilize EFH for rearing in 2 of the 5 mainstem HUCs as described above, and will use freshwater migration EFH in 5 of the 8 mainstem Columbia River HUCs identified in Table 37. These HUCs are located from the Mid Columbia–Lake Wallula HUC (17070101) downstream to the mouth of the Columbia River.

Reclamation's Proposed Action flow reductions will be attenuated considerably by the time fish from this ESU enters the Columbia River in the Mid Columbia – Lake Wallula HUC (17070101) because of substantial combined flows of the Columbia and Snake Rivers. Therefore, the effect of the relatively minor flow changes in the Columbia River on upper Snake River fall Chinook at this point and downstream is most likely negligible. These flow alterations would amount to approximately 2.53 percent flow reduction in October as measured at McNary Dam. Although the flow reductions during the October adult migration period are considered to be measureable and could potentially influence habitat conditions in the mainstem that are used by adults from this ESU, the effect of reducing flow in October will not significantly overlap with the SR fall Chinook migration period. Flow reductions in November are predicted to be only 0.29 percent of total Columbia River flows upstream of McNary Dam. This small flow reduction during the time when fall Chinook are actively migrating is unlikely to have significant adverse affects to EFH for Chinook adult migration. For all other months when the Proposed Action is occurring (November through March) the effect of flow reductions to average Columbia River flows would range between 0.29 percent and 0.21 percent at McNary Dam and would be approximately 0.26 percent to 0.19 percent as measured farther downstream at Bonneville Dam (Table 32). The small magnitude of these anticipated flow reductions are not likely to have any measureable effects to EFH conditions in the mainstem Columbia River for juvenile rearing or migration for juveniles or adults.

Effects to EFH from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action ***is not likely to adversely affect*** EFH for the Snake River fall Chinook ESU.

7.2.6 Deschutes River Summer/Fall Chinook Salmon

The Deschutes River summer/fall Chinook ESU includes all naturally spawned populations of Chinook salmon from the Deschutes River. NMFS determined it did not warrant listing under the ESA on September 16, 1999 (64 FR 50394). Spawning and rearing habitat for this ESU comprise approximately 2,687 square miles in the Deschutes River basin of Oregon. Outmigrating juvenile Deschutes River summer/fall Chinook salmon enter the action area when they exit the Deschutes River and enter the Mid Columbia–Hood HUC (17070105) at RM 215. This is about 380 miles downstream from the Upper Columbia River below Grand Coulee Dam. Fish in this ESU use this HUC and three additional HUCs downstream primarily as a migration corridor.

Adults from this ESU migrate through the Columbia River mainstem during the months of August through November, while smolts typically outmigrate as subyearlings during the months of June through early August. Typically, summer/fall Chinook salmon in the mid-Columbia region begin spawning in late September, peak in mid-October, and complete spawning in late November (Chapman et al. 1994, cited in Myers et al. 1998). Developing eggs incubate in the gravel for an extended period (5 to 7 months) until they emerge as fry from the gravel in late winter or spring (mid-February to April). Subyearlings outmigrate and rear throughout the mid- to late summer where they migrate down the Deschutes River and enter the action area when they enter the Columbia River in the Mid Columbia – Hood River HUC (17070105). Migration timing and mainstem spawning for Deschutes River summer/fall Chinook adults overlaps with Proposed Action flow reduction of 2,700 cfs in the month of October. For fall Chinook smolts and rearing juveniles, these time periods correspond with Proposed Action flow reductions of up to 350 cfs in Columbia River average flows below Grand Coulee and McNary Dams.

Effects

Reclamation has determined that effects to EFH for spawning and smolt migration will not occur since these life-history stages occur outside of the action area or do not temporally overlap with periods when the Proposed Action is diverting water. Conversely, effects to EFH freshwater rearing and migration habitat in the mainstem Columbia River for this ESU may occur because both adult and juvenile Chinook use the area for migration and/or rearing. Middle Columbia River spring Chinook are expected to utilize EFH for migration in 4 of the 8 mainstem Columbia River HUCs identified in Table 37. These HUCs are located from the Mid Columbia – Hood River HUC (17070105) downstream to the mouth of the Columbia River.

Reclamation's Proposed Action flow reductions will be attenuated considerably by the time fish from this ESU enters the Columbia River in the Mid Columbia–Hood River HUC (17070105) because of substantial tributary inflows from the Snake River basin. Therefore, the effect of the relatively minor flow changes in the Columbia River on Deschutes River summer/fall Chinook at this point and downstream is most likely negligible. These flow alterations would amount to approximately 2.53-percent flow reduction in October as measured at McNary Dam. The anticipated 2.53-percent flow reduction in October corresponds with the end of the fall Chinook migration in this ESU although adults will likely be migrating throughout the month of October. However, the flow reductions that occur during the adult upstream migration period are not thought to adversely affect adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. Furthermore, the reduction in Columbia River flows during the upstream adult migration period in October could help reduce the incidence of fallback at mainstem Columbia River dams which would increase the potential for upstream migration success to occur for this species. For all other months when the Proposed Action is occurring (November through March), the effect of flow reductions to average Columbia River flows would range between 0.29 and 0.21 percent as measured at McNary Dam and between 0.26 and 0.19percent of flow reductions further downstream at Bonneville Dam under these conditions (Table 32). Given the magnitude of hydrologic changes in the Columbia River relative to the overall flows in the Columbia River that are affected by the Proposed Action, the effects of such flow alterations are too small to measure and are not likely to have an adverse affect on EFH for freshwater migration for Chinook adults or outmigrating smolts.

Effects to EFH from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action ***is not likely to adversely affect*** EFH for the Deschutes River summer/fall Chinook ESU.

7.2.7 Lower Columbia River Chinook Salmon

Section 4.2.9 of this BA provides a description of the Upper Columbia River spring Chinook salmon ESU along with its current ESA listing status. Chapter 12 of the *Comprehensive Analysis* (Action Agencies 2007b) also contains additional information about the life history and population status of this ESU and is incorporated here by reference. This ESU is currently listed as threatened under the ESA (70 FR 37160).

Because effects to the species and designated critical habitat were previously analyzed for this ESU under Section 5.4.9, *Effects Analysis,* of this BA, the life-history characteristics and timing overlaps with Proposed Action elements will not be repeated here. Though some differences may exist, the effects of the Proposed Action on Chinook EFH are expected to be similar in nature and magnitude to those already considered for the species and critical habitat analyses. Thus, the effects to EFH are expected to be similar to those previously described in the ESA portion of this document. A summary of EFH effects are provided below for this ESU.

Downstream migration proceeds mostly from late May through June, with a small proportion moving out of the Columbia River through August. The lower three HUCs on the Columbia River (Lower Columbia – Sandy River (17080001); Lower Columbia – Clatskanie River (17080003) and Lower Columbia River (17080006)) support fall Chinook salmon rearing and migration for all the juveniles produced outside of the action area in lower Columbia River tributaries. Once juvenile fall Chinook salmon leave the tributaries and enter the Columbia River, they continue to rear and migrate to the ocean through these three 4th field HUCs.

Effects

Reclamation has determined that effects to EFH for spawning will not occur since this life-history stage occurs outside of the action area in the Columbia River Basin. Conversely, effects to EFH freshwater rearing and migration habitat in the mainstem Columbia River for this ESU may occur because juveniles use the Columbia River for rearing and both adult and juvenile Chinook use the area for migration once they enter the mainstem Columbia River in the action area. Lower Columbia River Chinook are expected to utilize EFH for rearing and migration in all three lower Columbia River HUCs described above.

Reclamation's Proposed Action flow reductions will be attenuated considerably by the time fish from this ESU enters the Columbia River in the EFH HUCs downstream of Lower Columbia – Clatskanie River HUC (17080001) because of substantial tributary inflows from upstream tributaries. Therefore, the effect of the relatively minor flow changes in the Columbia River on EFH for this ESU at this point and downstream is most likely negligible. These flow alterations would amount to approximately 2.4-percent flow reduction in October as measured at Bonneville Dam. However, since no adult or juvenile migrations are expected in October this flow alteration will not adversely affect EFH for freshwater migration. For all other months when the Proposed Action is occurring (November through March) the effect of flow reductions to average Columbia River flows would range between 0.26 percent and 0.19 percent at Bonneville Dam and would be expected to be even less when measured farther downstream between Bonneville Dam and the Columbia River mouth. The effects of tidal influences which tend to increase water surface elevations in the lower Columbia River below Bonneville Dam will also attenuate any hydrologic effects that would occur from the Proposed Action. Taken together, the small magnitude of these anticipated flow reductions and masking affects from additional fluctuations of water from tidal influences are not likely to result in any measureable effects to EFH conditions in the mainstem Columbia River for juvenile rearing or migration for juveniles or adults.

Effects to EFH from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action ***is not likely to adversely affect*** EFH for the Lower Columbia River Chinook ESU.

7.2.8 Lower Columbia River Coho Salmon

Section 4.2.10 of this BA provides a description of the Lower Columbia River Coho salmon ESU along with its current ESA listing status. Chapter 13 of the *Comprehensive Analysis* (Action Agencies 2007b) also contains additional information about the life history and population status of this ESU and is incorporated here by reference. This ESU is currently listed as threatened under the ESA (70 FR 37160).

Because effects to the species and designated critical habitat were previously analyzed for this ESU under Section 5.4.10, *Effects Analysis,* of this BA, the life-history characteristics and timing overlaps with Proposed Action elements will not be repeated here. Though some differences may exist, the effects of the Proposed Action on coho salmon EFH are expected to be similar in nature and magnitude to those already considered for the species analysis. Thus, the effects to EFH are expected to be similar to those previously described in the ESA portion of this document. A summary of EFH effects are provided below for this ESU.

Adults from this ESU migrate through the Columbia River mainstem during the months of September through December, while smolts typically outmigrate as yearlings during the months of May through early August. Typically, coho salmon in the mid-Columbia region begin spawning in late September, peak in mid-October, and complete spawning in late November (Chapman et al. 1994, cited in Myers et al. 1998). Developing eggs incubate in the gravel for an extended period (5 to 7 months) until they emerge as fry from the gravel in late winter or spring (mid-February to April). Migration timing and mainstem spawning for lower Columbia River coho salmon overlaps with Proposed Action flow reduction of 2,700 cfs in the month of October. For coho smolts and rearing juveniles, these time periods correspond with Proposed Action flow reductions of up to 350 cfs in Columbia River average flows below Bonneville Dam.

Downstream migration proceeds mostly from late May through June, with a small proportion moving out of the Columbia River through August. The lower four HUCs on the Columbia River downstream of Mid Columbia–Hood River HUC (17070105) support coho salmon rearing and migration for all the juveniles produced outside of the action area in lower Columbia River tributaries. Once juvenile coho salmon leave the tributaries and enter the Columbia River, they continue to rear and migrate to the ocean through these 4 4th field HUCs.

Effects

Reclamation has determined that effects to EFH for spawning will not occur since this life-history stage occurs outside of the action area in the Snake River basin. Conversely, effects to EFH freshwater rearing and migration habitat in the mainstem Columbia River for this ESU may occur because juveniles use the Columbia River for rearing and both adult and juvenile coho use the area for migration once they enter the mainstem Columbia River in the action area. LCR coho salmon are expected to utilize EFH for migration and rearing in 4 of the 8 mainstem Columbia River HUCs identified in Table 37. These HUCs are located from the Lower Columbia–Hood River HUC (17070105) downstream to the mouth of the Columbia River.

Given the magnitude and timing of Proposed Action hydrologic changes in the Columbia River relative to the overall flows in the Columbia River and considering the extreme distance downstream of where the Proposed Action will occur, the effects of such flow alterations are generally too small to measure, or where measureable (i.e. October) do not significantly overlap with life-history timing of LCR coho and are not likely to have an adverse affect on either migrating steelhead adults or outmigrating smolts. For example, when Proposed Action flow reductions are measureable (i.e. October reductions of 2.4 percent below Bonneville Dam), the small flow reductions that occur during the adult upstream migration period are not thought to adversely affect migrating adults because reduced flows do not impede fish migration or adversely affect migration behavior in upstream migrating fish. When flow effects on overwintering juvenile coho salmon survival would be most probable between November and March, the Proposed Action will deplete flows by a monthly average of 350 cfs during the overwinter rearing period. This flow depletion represents between a 0.26-percent to 0.19-percent flow reduction in the lower Columbia River below Bonneville Dam (computed data in Table 32). Effects to the LCR coho salmon ESU from such small flow reductions are either not measureable, or when measureable in October, are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action may affect, but is not likely to adversely affect this ESU.

Effects to EFH from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action ***is not likely to adversely affect*** EFH for the Lower Columbia River coho salmon ESU.

7.2.9 Upper Willamette River Chinook Salmon

Section 4.2.12 of this BA provides a description of the Upper Willamette River spring Chinook salmon ESU along with its current ESA listing status. Chapter 15 of the *Comprehensive Analysis* (Action Agencies 2007b) also contains additional information about the life history and population status of this ESU and is incorporated here by reference. This ESU is currently listed as threatened under the ESA (64 FR 14308).

Because effects to the species and designated critical habitat were previously analyzed for this ESU under Section 5.4.12, *Effects Analysis,* of this BA, the life-history characteristics and timing overlaps with Proposed Action elements will not be repeated here. Though some differences may exist, the effects of the Proposed Action on Chinook EFH are expected to be similar in nature and magnitude to those already considered for the species and critical habitat analyses. Thus, the effects to EFH are expected to be similar to those previously described in the ESA portion of this document. A summary of EFH effects are provided below for this ESU.

Effects

Reclamation has determined that effects to EFH for spawning and rearing will not occur since these life-history stages occur outside of the action area. Conversely, effects to EFH freshwater migration habitat in the mainstem Columbia River for this ESU may occur because both adult and juvenile Chinook use the area for migration. Upper Willamette River Chinook are expected to utilize EFH for freshwater migration in two of the eight mainstem Columbia River HUCs identified in Table 37. These EFH areas include the Lower Columbia – Clatskanie River HUC (17080003) as well as the Lower Columbia River HUC (17080006) downstream to the mouth of the Columbia River.

Reclamation's Proposed Action flow reductions will be attenuated considerably by the time fish from this ESU enters the Columbia River in the Lower Columbia – Clatskanie River HUC (17080003) because of substantial tributary inflows from upstream tributaries. Therefore, the effect of the relatively minor flow changes in the Columbia River on Upper Willamette River Chinook EFH at this point and downstream is most likely negligible. These flow alterations would amount to approximately 2.4-percent flow reduction in October as measured at Bonneville Dam. However, since no adult or juvenile migrations are expected in October, this flow alteration will not adversely affect EFH for freshwater migration. For all other months when the Proposed Action is occurring (November through March), the effect of flow reductions to average Columbia River flows would range between 0.26 percent and 0.19 percent as measured at Bonneville Dam under these conditions (Table 32). Given the magnitude of hydrologic changes in the Columbia River relative to the overall flows in the Columbia River that are affected by the Proposed Action, the effects of such flow alterations are too small to measure and are not likely to have an adverse affect on EFH for freshwater migration for Chinook adults or outmigrating smolts or to rearing EFH for juvenile Chinook salmon from this ESU. The effects of tidal influences which tend to increase water surface elevations in the lower Columbia River below Bonneville Dam will also attenuate any hydrologic effects that would occur from the Proposed Action. Taken together, the small magnitude of these anticipated flow reductions and masking affects from additional fluctuations of water from tidal influences are not likely to result in any measureable effects to EFH conditions in the mainstem Columbia River for juvenile rearing or migration for juveniles or adults.

Effects to EFH from such small flow reductions are not measureable and are considered to be insignificant during periods that overlap with adult and juvenile usage of the mainstem Columbia River. As a result, Reclamation determined that the Proposed Action ***is not likely to adversely affect*** EFH for the Upper Willamette River Chinook ESU.

7.3 Summary of EFH Effects Analysis

Reclamation concludes that its Proposed Action involving the additional diversion of 164,000 acre-feet of water upstream of Grand Coulee Dam will not adversely affect EFH for spawning, migration, or rearing for all of the following Chinook and coho salmon ESUs that are covered under the Magnuson-Stevens Act: Upper Columbia River spring

Chinook salmon; Upper Columbia River summer/fall Chinook salmon; Middle Columbia River spring Chinook salmon; Snake River spring/summer Chinook; Snake River fall Chinook; Deschutes River summer/fall Chinook salmon; Lower Columbia River Chinook salmon; Lower Columbia River coho salmon; and Upper Willamette River Chinook salmon.

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